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Underground quarries their possible use for mining tourism purposes – Slovak perspectives on the example of the underground stone quarry of Veľká Stráň

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ABSTRACT

In the first part of the study, we have pointed out that mining tourism is a new, undervalued and less used a form of tourism, geotourism. We present its definition and present its specifics that make it unique on such a scale – by which it can be defined as a separate form of tourism. Mining tourism can be thought to contain virtually all objects, phenomena and processes, which, from prehistory till today, were related to one of the oldest human activities - mining and their subsequent access to and inclusion in tourism. In the world, underground quarries are currently used for various purposes, such as environmental, cultural centers, concert halls, wineries, churches, warehouses, and tourist destinations.In the second part of the study, we deal with mining tourism on the example of the most extensive underground stone quarry in Slovakia. Quarry, Veľká Stráň currently serves as the goal of unorganized 'mining' natural tourism as part of a geological site protected as a nature reserve. However, underground stone has the potential to become the destination of organized mining tourism not only for school educational excursions but also for the general public.

Keywords: mining tourism, underground quarries, tourism localities, Slovakia

INTRODUCTION

There is no generally accepted definition of mining tourism yet. Perhaps this is one of the reasons why mining tourism has not yet been qualified as an individual form of tourism.

The Slovak school of geotourism, forming at the Technical University of Košice was farm by Professor Rybár (Faculty of Mining, Ecology, Process Control and Geotechnologies - F BERG). Rybár understands mining tourism as discovering technical monuments connected with the historic mining and related activities (metallurgy, coal trade, transport, building industry,etc.). The tangible or intangible monuments and mining relics, such as buildings, museums, technical facilities, mining and trade routes, mining culture, mining uniforms and clothing, mining tools, traditions, customs, also create part of mining tourism. (Rybár, 2016; Rybár et al., 2010; Rybár et al., 2012).

Today, we can find a mining tourism as a part of geotourism and industrial tourism, respectively. Schejbal defines montanistic tourism as a kind of industrial tourism, which is focused on exploring montanistic

disciplines and their developments in the history of human society (Schejbal, 2016). Examples of linking both historical and contemporary mining to tourism are known from many countries (Edwards & Coit, 1996; Cole, 2004; From, 2012; Conlin & Jolliffe, 2011; Vargas et al., 2009).

Geotourism is a form of sightseeing tourism, although, in some cases, it may also have some features in common with tourism specialist. So the phenomenon of having relationships with other types of tourism can be separated as an independent form. It involves getting to know the geological attractions and active participation in the "discovery" of interesting forms, rocks, minerals, terrain, and landscape (Rozycki & Dryglas, 2016). His findings have been made in line with other authors (Farsani et al., 2011; Hose, 2012; Garofano & Govoni, 2012; Dowling & Newsome, 2006; Dowling, 2011; Huang et al., 2011; Wu & Tsai, 2015).

Based on our research, we can add that the preserved and also interesting tangible and intangible cultural component of the mining landscape is essential for the development of mining tourism. The cultural component of the mining landscape is an integral part of the human mining heritage.

The first definition of mining tourism as individual tourism form was presented by Rybár and Štrba (2016) at the international conference Geotour 2016 in Florence. Its content is that mining tourism is a form of adventure tourism when just the presence of a tourist in underground mining areas is providing to him new feelings. Mining tourism is defined as a phenomenon describing unique mining machinery and facilities, enabling to get acquainted with the underground spaces with the specific abiotic and biotic component of nature present there, allows for admiring the cultural heritage linked to historical mining and is open to the general, professional and lay public.

Mining tourism is devoted both -to individual mining sites, and the entire mining regions and their development over time. Also, the architecture of historic mining towns and financial resources arising out of mining activities, form part of the mining tourism. Last but not least, the influence of mixed communities as mining was a freelancing occupation of free people who have moved across Europe (in recent times throughout the world as well) in various historical periods for work in new mining centers (Rybár, 2016).

According to our findings the term ‘mining tourism‘ includes objects and activities associated with naming this relatively new form of tourism. The term ‘mining‘ can be imagined to contain virtually everything that is related to one of the oldest human activities – mining, from the pre-history until today from its oldest and the simplest forms to unique modern technologies. From its in-situ presentation, in the form of old mining relics and following the footprints of applied technologies to preserved or restored parts of mines, from architectural sacral and secular treasures to mining colonies built for miners, from money acquired by mining, to presentations of featuring mining activities with modern multimedia techniques.

As for quarries utilized in the mining tourism, they must be thoroughly reviewed. Historically, geologically and geomorphologically significant quarries should become objects of mining tourism. The use of quarries in mining tourism is marginally dealt in works of, e.g., Baláček (2007), Weis (2009) and Hronček (2009; 2012).

In the research, the processing of individual quarry analyzes and the subsequent use of quarries in geotourism and mining tourism we have to proceed with the valid laws of the Slovak Republic (Regulations of Act No. 44/1988 Coll. on the Protection and Utilisation of Mineral Resources (the Mining Act) (Anonymus, 1988), Act No. 543/2002 Coll. on Nature and Landscape Protection (Anonymus, 2002), and Act No. 49/2002 Coll. on the

Protection of Monuments and Historical Sites, as amended (Anonymus, 2002a).

In the present article we are introducing the possibility of using quarries in mining tourism in Slovakia. The potential of quarries as targets of tourism in Slovakia has been underrated and underused so far. We must not forget about the fact, that the quarry immediately after opening of mineral resources extraction becomes more or less an interesting geological, morphological and landscape object, without any further research, promotion or anthropogenic modifications, conservation, reclamation, revitalization or construction.

UNDERGROUND QUARRIES IN THE WORLD AND THEIR USE IN MINING TOURISM

The use of the quarries for other purposes than mineral extraction was already known in the past.The underground quarries have been largely used, for example during the Cold War or the World War II. Especially in the territory of the German Empire, but also in England, Bohemia, Austria or Poland, factories, warehouses or shelters, built to protect people from Nazi, were placed in the quarries. During this period was enlarged the underground space of the limestone quarry at Litoměřice which became the largest underground factory in the Czech Republic (Hronček, 2015). Description on world known underground quarries are available on http://213.0.14.154/wordpress/wp-content/uploads/2014/07/Quarrylandscapes database.pdf

At the present, the former limestone quarry Val d'Enfer (Valley of Hell) in France is one of the most attractive tourist quarries, where cultural events, light and shadow projections, massive light installations and presentations of paintings from world artists (Gauguin, Van Gogh, Monet) are holding place (Clébert, 1972). 15 km from the Chisinau (Moldova) is built a wine cellar called Cricova Winery in the space of the former limestone quarry, where up to a million bottles of wine can be stored thanks to the large chambers. The limestone was extracted here from the 15th century. In the past, in Moldova, even the Orthodox churches were placed in the underground quarries. In the Lengefeld (Germany), wherein the past was extracted building material (Steche, 1885), is currently The Museum of lime and cement. The old china clay quarry in Great Britain, currently well-known as Eden Project, serves as a center for environmental education, Adnet quarry in Salzburg is used as a recreational area for locals, and in the limestone quarry in Rüdersdorf (Germany) the museum park is created. Fertőrákos Kőfejtő is a name for limestone quarry in Hungary, which is also called „the cave theater“ and thanks to the excellent acoustics it serves as a concert hall. The underground quarry in Utsunomiya (Japan), is a historical museum that allows to visitors to sail by a boat in the flooded parts of the quarry.In the other underground spaces, there are installed trampolines and slides.Unique is also the biggest European underground lake Seegrotte in town Hinterbrühl (Austria), which is former gypsum quarry and visitors can get to know these mining spaces and their history by a romantic cruise. It is open to the public from 1930, and since that time more than 10 million tourists have visited this quarry. The sandstone quarry of Carrière souterraine du Petit Banc in Belgium today serves as a museum of geological and archeological heritage.

The excursions to the underground chambers with guides and expert interpretations are organized in the dolomite quarry in Donosa (Spain), but also in the underground quarries in Solvajove doly in the district of Beroun (Czech Republic).

Another limestone quarry in Burgos (Spain) is partly active but it is not a tourist point yet. The same situation is with the underground slate quarry in Anjou (France). However, these underground spaces also provide many opportunities for

the future development of mining tourism and geotourism.

Quarries in other countries serve as target objects of mining tourism not only after the end of their operation and recultivation of their space to the state of "comfortable" environment for tourists but also during normal operation of the quarry, even during working hours. Common is the group tours of visitors transported directly into the center of the quarry by special services, regardless of comfort - noise, dust, often a health risk (Rybár, 2012).

UNDERGROUND STONE QUARRIES IN SLOVAKIA

Quarries were being opened in Slovakia only exceptionally in the period of modern history. We have managed to locate several underground quarries. Probably the most famous and oldest is an andesite quarry in Kysihýbel near Banská Štiavnica (Herčko, 1975). Others were opened, e.g., in Marianka near Bratislava for the slate mining (Kráľ, 2009), the Körmendy´s cave near Kremnica, where the pyroxenic-amphibolic andesite blocks were mined, and the tufa sandstone quarry in Vyšná Pokoradz. Interesting underground stone quarries were also found on medieval castles Devín and Lednica. We identified smaller underground chambers by the field research in the stone quarry of Devín, Vlachov and probably also in Hliník nad Hronom, where they are cluttered up.

The underground stone quarries that are found in Slovakia do not have excavated underground spaces to that extent that would correspond to a mine regarding an anthropogenic mining geomorphology. They are just simple incomplete underground spaces - galleries or mining chambers. Tunnels or mining corridors were excavated, e.g., during the slate mining in Marianka. The museum demonstration of the excavated tunnel of the chamber blasting in the quarry is located in the stone quarry at Ondrej's shaft in the Mining natural museum in Banská Štiavnica. Underground quarries in Kysihýbel, where a short tunnel with a chamber is formed and the stone quarry of Körmendy cave in Kremnica, which is formed by a chamber, are most shape-like to the underground stones quarries (mines). Both underground stone quarries have only

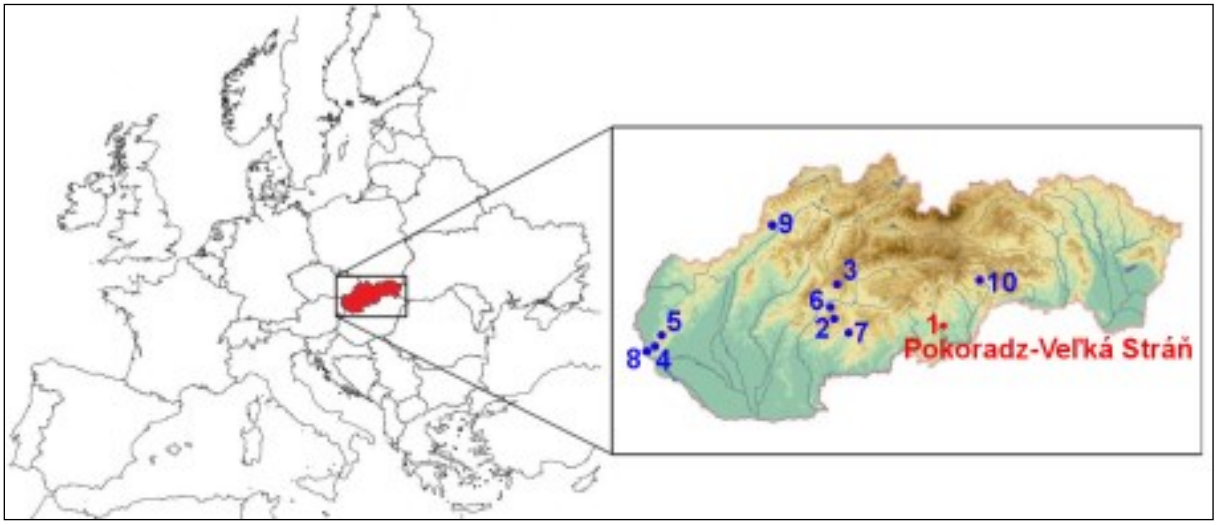

Fig. 1 The location of underground stone quarries in the area of Slovak Republic (quarrying until the end of the 19th century). 1. Pokoradz – Veľká Stráň, 2. Banská Štiavnica – Kysihýbel, 3. Kremnica – Körmendy´s cave, 4. Devín – Devínska Kobyla, 5. Marianka – slate quarry, 6. Hliník nad Hronom – Kečka, 7. Krupina – Turecké studne (Turkish wells), 8. castel Devín, 9. castel Lednica, 10. Vlachovo (ice-cellar) (compiled by authors)

Fig. 2 Underground stone quarry Kysihýbel near mining town Banská Štiavnica (photo by K. Weis)

Fig. 3 Underground slate quarry in Marianka near Bratislava (photo by P. Ondrus)

Fig. 4 Körmendy´s cave near Kremnica – underground stone quarry for the production of pyroxenic-amphibolic andesite (photo by P. Hronček)

Fig. 5 Extracted underground (cellars – formerly a Romanesque palace) at Devín Castle (photo by P. Hronček)

Fig. 6 Extracted underground (access tunnel) on Lednice Castle. This medieval tunnel is the oldest on the territory of Slovakia (photo by P. Hronček)

Fig. 7 Chamber in the medieval stone quarry in Devin (photo by P. Hronček)

small mining chambers, so we cannot talk about caverns. As the stone quarries are mined in the rock massifs, the entrance portals are formed by the surrounding rock cliff without any alteration (Hronček et al., 2011; Hronček, 2015).

The existence of **underground stone quarries or underground mining chambers** was confirmed in numerous quarries by field research. A few of them have preserved to the present, e.g., Kysihýbel, Štampľoch, Kermödy´s cave, Devín or Pokoradza. There are more relicts that point to their widespread occurrence, e.g., Devín, Chtelnica, and Hliník nad Hronom.

The essential feature of these shapes is that they originated in the rock walls of the surface stone quarries after the quarriers (breakers) were able to assess the quality of the extracted rock (stone) based on empirical experience. The highest quality material was usually found inside the massif, deeper below the earth's surface. This stone, suitable for disintegrating the building blocks of stone, was then followed by mining until they gradually reached the underground. The first step was the creation of a "cell" - a rectangular micro quarry, in which the underground chamber began to be gradually mined at the foot-wall. Such cells are well visible, for example in Chtelnica, Dechtice, Hliník nad Hronom or Kermöndy's cave. The width of the chamber depended on the assumed stability of the overlay, but it was usually about 5 - 10 m (Devín, Chtelnica). Only after the stability check, it could have expanded inwards (Kysihýbel, Kermödy's cave, Pokoradza). Stabilising pillars were left in more extensive chambers, e.g., in the underground of the upper Devín castle or the back of the chamber in Kysihýbel.

Overhangs have also been preserved as a transitional from in the stone quarries. In these cases, the lower part of the wall, where the better stone is located, is mined. Three overhangs are found, e.g., in Devín and one extensive in Pokoradza.

As mentioned above, chambers have been preserved only in four stone quarries, with up to six chambers in Pokoradza. Collapsing processes that created specific shapes on the walls of these historic stone quarries point to their higher occurrence. It is easy to identify the chamber if the entrance portal or its rectangular upper part, which has not fully collapsed. Two such relics have been preserved in Devín stone quarry.

Rock overhangs are a more familiar shape after ceilings of chambers collapse and become filled with talus. A new space, a rock overhang, opened at the top of the former wall of the stone quarry after the collapse of the overlay in the chamber. Three such overhangs can be identified, e.g., in Hliník nad Hronom and two in Chtelnica.

A particular type of relic after the collapse

Fig. 8 The first step of the excavation of the underground chamber - the wall is modified into a "cell" in which the underground chamber began to be gradually mined at the foot-wall. The stone quarry of Chtelnica (on the left) and the stone quarry Krupina (on the right) (photo by P. Hronček)

Fig. 9 Stabilising pillar in the chamber of the stone quarry in Kysihýbel (photo by Ľ. Lužina)

Fig. 10 Overhang, as the transition form of the mining chamber in the stone quarry Devín (photo by P. Hronček)

Fig. 11 Overhangs in stone quarry in Pokoradz (photo by P. Hronček)

Fig. 12 Defunct chamber in the stone quarry Devín (photo by P. Hronček)

Fig. 13 Cluttered up the chamber in a stone quarry in Hliník nad Hronom. Contemporary anthropogenic collapsing caveTmavá jaskyňa cave (photo by P. Hronček)

of the mining chamber is collapsing or crevice-like anthropogenic caves, which have been created by collapsing the overlay to the area of the former mining chamber. Three of them were created at the stone quarry in Hliník nad Hronom and one small in Chtelnica.

CASE STUDY: THE UNDERGROUND STONE QUARRY OF VEĽKÁ STRÁŇ

The most extensive underground quarry area in Slovakia is the Veľká Stráň stone quarry, located 1.3 km northeast of Vyšná Pokoradza (currently the local part of Rimavská Sobota) on the southwest slope of Veľká stráň (526 m above the sea level) at an altitude of 460 meters above the sea level.

The whole slope of Veľká stráň is built by the Pokoradza complex folding Miocene vulcanite with a significant layering. The highest part is formed by the breccia, which after the preparation of less resistant parts have created exciting rock formations (towers). The largest one of them is called Kamenný Janko. A thick set of diverse volcanic sedimentary material is found beneath the breccias. They are mostly pudding stones with rounded andesite oblongs with sandstone locations, which are cross-layered. This set is stored on a lahara layer, which is composed of chaotically arranged tiny breccias. They are agglutinated with tuff sands. The stream of lahara flowing southward absorbed all the vegetation that stood in the way. Therefore, we can now observe the prints of the leaves or the cavities of trunks, branches, and roots in its lower part, which is visible on the ceilings of the mining chambers. The bottommost part of the complex folding profile consists of well-sorted and layered

tufa sandstones that settled in the freshwater lakes of the vast lowlands in the middle Miocene 15 million years ago. Tufa sandstones in some places also include discontinuous locations of gravel, dust, clay and volcanic tuffs (Elečko,1985; Vass & Elečko, 1986; Vass & Elečko, 1989; Gaál, 1990).

The stone quarry Veľká Stráň was opened right on the base of the bottommost layer of grey, dark grey and in some places the brown-colored, mostly fine-grained tuff sandstones. We cannot accept the previously published stone quarry opening period in the second half of the 19th century (Jeleň& Galvánek,2009). Apparently, this is a much older stone quarry. We can say this not only because of the scale and shape of his relics but primarily by preserved relevant historical documents and stone artifacts in historic buildings in situ. Its importance and extensiveness are evidenced by the map of the second military mapping from 1839. The quarry is represented by an area symbol, which is why we assume that it had a length of at least about 250 or 300 m during this period. In addition to the area symbol, a point symbol is used as well. The maintained forest path led to the excavation shaft from the south, the relict of which exists even today. The German nomenclature also points to the importance of the stone quarry by naming it in the form of *Steinbruch*. Due to the extent of the stone quarry, it can be said that the surface mining was being performed there definitely at least in the 18th century. The existence of underground chambers cannot be documented but due to their current extent and excellent quality of the rock inside the massif, their existence in this period is possible. We do not know when the mining at the Veľká Stráň locality started by the current historical-mining knowledge. A specific indication is the occurrence of the same stone in medieval buildings in the surroundings of Rimavská Sobota. Tufa sandstones were already used for the construction of the Romanesque single-nave Church of St. John the Baptist, and probably also to the buildings of a preserved monastery in Rimavské Jánovce, built at the end of the 12th century and in the 1st quarter of the 13th century. However, the use of this material in the Middle Ages does not directly prove the existence of a stone quarry as the tufa sandstones north-east of the Rimavská Sobota emerge on the surface on several places (Elečko, 1985).

Until now, the vast relic of the stone quarry, which is overgrown by adult forests and has been extensively naturalized by geomorphologic processes, has been preserved. The length of the southern, more significant part of the stone quarry wall is 500 m, its height is about 8 m, it reaches a maximum of 13 m, but in several places, it has already been filled up with the

Fig. 14 Romanesque church in Rimavské Jánovce(photo by P. Hronček)

overlay. The vertical depth of the stone quarry reaches an average of 20 m but maximum up to 30 m. The relic of the access road leads along the entire wall. As mentioned above, a rocky overhang is placed above the mined stone, which was deposited on a great sloping heap behind the access path along the entire stone quarry. The former working courtyard is currently covered by some slopes of overlay slides, stones, and boulders. Most of the rock overhangs, formerly along the entire length of the wall of the stone quarry, have already fallen into the former working courtyard where there are some stone blocks up to 8 or 10 m in size. There are several large underground chambers in the stone quarry. The second, smaller stone quarry is located about 250 m north. It is about 160 m long, the wall height is about 12 m, and the vertical depth is up to 20 m. The stone quarries were not interconnected, and a separate road led to the northern stone quarry. As the mining in this stone quarry was less intense, there are no overhangs, nor underground chambers.

In the southern quarry wall, there is a set of the most extensive underground stone quarry in Slovakia, even individual chambers, depending on several parameters, are among the most extensive. Overall, 6 chambers were preserved at different stages of naturalization and an extensive overhang at the larger length of the former mining wall. We did not identify relics after the manual disconnection in the surface areas or stone quarries chambers. Scratches after chopping by the pick axe have already disappeared as a result of weathering. The overhang was on average buried up to 5 m; its height was about 4 m, which is approximately the thickness of a quality stone layer of the tufa sandstones. At present, most of these overhangs have already been destroyed by the collapse of entire large blocks of overlay layers to the former work courtyard of the quarry. The most massive overhang has been

Fig. 15 The wall of the northern quarry (photo by P. Hronček)

Fig. 16 Part of the wall of the southern quarry (photo by P. Hronček)

preserved in the northern part of the wall. It begins 446 meters from the southern edge of the stone quarry and is a demonstration of the transition between the surface and subsurface mining in the stone quarry. The length of the overhang that is the beginning of the next underground chamber is 27 m, the maximum depth is 6, and the maximum height is 3 m. It is considerably reduced by weathering and sliding of overlay layers.

Approximately 160 m from the southern edge of the wall of the stone quarry is the portal of the first underground chamber. The largest chamber has a rectangular ground plan; the entrance is 19 m wide and 4.6 m high. The height of the wall above the entrance portal is about 8.5 m. The chamber has a maximum width of 24.5 m and a maximum depth of up to 28 m. The rear wall height is 5.4 m. As a single chamber, it has almost no foot-wall without boulders fallen from the ceiling. With a volume of 3220 m^3, Kysihýbel is the second largest underground chamber in Slovakia. In the back of the chamber, there is a rock step about 50 cm high and about 4 meters long beneath the wall, which is a relic after the manual disintegration of stone blocks.

The second chamber with a rectangular ground plan and a volume of 1368 m 3 lies 329 m from the southern edge of the wall of a stone quarry. The entrance portal is 19 meters wide, and the chamber does not extend inwards. The height of the entrance, greatly reduced by the overhangs, is 3 m, the wall height increases to 4 m at the rear wall. The maximum depth of the chamber is currently 13.5 m. It was originally a depth of about 20 m because before its entrance there is a whole block of overlays, which broke into four smaller blocks in the fall. This chamber is immediately followed by the third in the order, the smallest

chamber in volume (184 m^3). It is separated by only a 5 m wide pillar from the second.

Fig. 18 The entrance portal of the biggest (the first) chamber of the stone quarry wall of Veľká stráň (photo by P. Hronček)

Fig. 19 The first (the biggest) chamber in the stone quarry of Veľká stráň (photo by P. Hronček)

Fig. 20 The entrance portal to the second chamber of the stone quarry wall of Veľká stráň (photo by P. Hronček)

Fig. 21 The second chamber in the stone quarry of Veľká stráň (photo by P. Hronček)

This chamber of the elliptical ground plan is largely covered by a slide overlay, so the input is high 1.5 m at maximum with a rear height of 3.2 m. The entrance to the chamber has a width of 10.5 m, and its maximum depth is 7 m. Another large chamber is an underground space with an elliptical ground plan. Its maximum depth is 19.2 m in width at the entrance is a maximum of 30 m. The height of the chamber at the rear wall is 4.2 m. The height of the entrance portal ranges from 4.5 m to 7 m, at the point where the overlay layers were removed. The entrance portal of the third most abundant chamber in Slovakia (2295 m^3) is located 396 meters from the southern edge of the stone quarry wall. The last but one, the fifth chamber in the order (1282 m^3) is the underground space following the above-described overhang, from which it separated by only a 3 m thick pillar. The portal to the elliptical ground floor is 476 m from the southern edge of the stone quarry wall. It is 3.2 m high and 28.5 m wide. The maximum height of 5.5 m has a chamber at the rear wall. The maximum depth of the chamber is 12 m. The last sixth chamber is located on the northern edge of the wall of the stone quarry. Its current depth is only 5.5 m, but the original was about 10 m. The width is 15 m, the maximum height is 4 m, and the volume is 600 m^3.

Thanks to the total volume of all six chambers it is the largest historical underground quarry (excavated until the middle of the 20th century) in the territory of Slovakia. The total volume of underground spaces is approximately 8900 m^3.

For the comparison, the total volume of underground spaces of the quarry in Kysihýbel is about 6100 m^3 and the total volume of the extracted chamber in underground stone quarry Körmedyho cave is about 2250 m^3.

Fig. 22 The interior of the fourth chamber in stone quarry Veľká stráň (photo by P. Hronček)

Fig. 23 The fifth chamber in stone quarry of Veľká stráň (photo by P. Hronček)

Fig. 24 The sixth chamber in stone quarry of Veľká stráň (photo by P. Hronček)

CONCLUSION

The issue of underground quarries and their possible use for mining tourism purposes is a fascinating area that can support the development of mining tourism in practice. At the same time, it provides theoreticians the opportunity to analyze the problem from all geotourism, mining tourism, and mining heritage. Introduced Slovak locations enrich the offer of destination management as well as globalizing regional offers.

In the following, we present a simple model of mining tourism in the Veľká Stráň area. The largest Slovak stone quarry Veľká Stráň has situated in Nature Reserve Pokoradzské Jazierkaand it is part of the state administration for nature protection of Cerova vrchovina Mts.The nature reserve is an unusual area with sloping lakes, an open-air slope with the rock formation called Kamenný Janko, and the mining chambers analyzed above. Since it is a protected area under the fourth and fifth degree of protection, it is necessary to provide regulated mining tourism (or geotourism) activities in this area. Tourists can reach the stone quarry and mining chambers without any problems following the red tourist sign from the Vyšná Pokoradze to Maginhrad and by the short unmarked turn-off to the old access road. The trail is easy, with an elevation of 155 m and a distance of 5.3 km.The easy trail, the good system of trail signing and free access for tourists are the reasons why in some parts of the underground stone quarry of Veľká Stráň unorganized mining tourism is taking place.Speaking about the safety of the tourists, but also to preserve the best condition of the underground spaces, it is necessary that the individual municipalities in the district of Rimavská Sobota would deal with the problem.

Mining tourism and geotourism situated

Fig. 25 The hiking trails and the accessibility of the underground stone quarry located in the Nature Reserve of Pokoradzké Jazierka (compiled by authors)

to localities with the presence of underground quarries have not to be dedicated just to researchers and scientists.The re-use of underground spaces is also a major asset for sustainable tourism. In locations where mining is completed or significantly lower than in the past, it can bring new job opportunities and financial resources.The possibilities of using such underground spaces are very variable (creating museums, educational, environmental centers, concert halls, massive projections, etc.). Thanks to the wide-spectrum use of the quarries, mining tourism could be interesting for various target groups of tourists.

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