

Local quarries and how to use them in geotourism

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ABSTRACT

We are focusing on main possibilities of quarries use in geo-tourism, first of all in the mining research. We have pointed to the use of quarries in sports and recreational activities, their use according to nature conservation, and we introduce quarries as parts of geo-sites and geo-parks, as well as important paleontological and mineralogical sites. We are introducing quarries as parts of nature trails, which can be considered the oldest utilization of quarries as geo-objects. We have pointed to the possibilities of quarry museums and their attractiveness directly in nature and we have analysed the use of quarries in school education process.

Key words: geo-tourism, quarry, geo-objects, anthropogenic geomorphology, research, frequency, availability

INTRODUCTION

Quarry can be generally characterized as a surface open space (open pit) on the deposit, primarily designed for mining and quarrying. Quarry area can also serve for processing of mined mineral resources and production of crushed stone or blocks of stone. Usually they open on the deposit, which is on the surface or near the surface.

In the English-written literature is the term quarry used only to designate stone mining space, usually of small dimensions. The most frequently used terms are *open pit*, alternatively *stone pit*, *clay pit*, *gravel pit*, *sand pit* respectively *cooper (open) pit*, *coal (open) pit*, *gold (open) pit* etc.

Quarries as destination objects of geo-tourism have been researched by us according to the newest accessible papers and studies from geotourism (Hose, 1999; Buckley, 2003; Schejbal, 2005; Dowling & Newsome, 2006, Joyce, 2006; Dowling 2009; Rybár et al., 2010; Hronček, 2012).

USE OF QUARRIES IN GEOTOURISM

It is possible to examine quarries as relics

of the surface mining and quarrying within geotourism, respectively montane geotourism. In order to use quarries as montane tourism objects, they need to be carefully and systematically examined in the context of anthropogenic geomorphology and montanistics at first (Hronček, 2007; 2009b).

Historically, geologically and geomorphologically significant quarries may thus become important destinations for geotourism clients. Only a small amount of scientific studies is dealing with the use of quarries in geotourism, for example works of Beláček (2007), Weis (2009), Hronček (2009a) and Hvizdák et al. (2012).

During the research, processing of the individual analysis of the quarries and subsequent use of quarries in geotourism and montane tourism, we must act in accordance with the laws of the Slovak Republic. The key is to comply in particular with the provisions of the Mining Law on the Protection and Use of Mineral Resources no. 44/1988 Coll. (Anonymous 1988), the Law on Protection of Nature and Landscape no. 543/2002 Coll. (Anonymous 2002), and also the Law on protection of monuments no. 49/2002 Coll. (Anonymous 2002a).

In this work we have introduced the possibility of using quarries in geotourism in Slovakia. The potential of quarries as targets of tourism in Slovakia has been underrated and underused so far. Quarries in other countries serve as target objects of montane 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 are 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).

We must not forget 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.

Given the number of quarries in Slovakia is about 11,359 quarries, with an average density of 0.23 quarry per km² (Hronček, 2012), quarries are becoming an important potential target of geotourism. It goes without saying that the vast majority of these does not have the potential to become a touristic destination because of lack of attractiveness as spatial objects. A large number of quarries is disqualified for geotouristic use because of complicated accessibility of the terrain or a total absence of infrastructure. Building of infrastructure (restaurants, accommodation, accompanying various attractions, transportation) for the clients is often economically unprofitable. Conversely, a touristic insignificant quarry can become a touristic attraction through a secondary anthropogenic interference. Such examples are given within the 13th category of assessing the potential for geotourism (secondary use of quarries as targets montane tourism).

We have divided quarries into basic categories in terms of their potential as a

target destination for montane clients based on the latest available domestic and especially foreign literature and our own long-term field research (Hronček, 2012) as follows:

1. quarries as geological sites,
2. quarries as morphological site
3. quarries as paleontological sites,
4. quarries as mineralogical sites
5. quarries as archaeological sites,
6. quarries as parts of Geosites a Geoparks,
7. quarries as protected sites,
8. quarries as parts of nature trails,
9. quarries as sports and leisure sites
10. quarries as sites for educational practice and scientific research,
11. musealization of quarries,
12. other secondary use of quarries as targets of montane tourism.

In the following part of the study we present typical examples of quarries from Slovakia from each category.

Quarries assigned to the first five categories are included immediately after their opening and do not require any additional anthropogenic activities aimed at increasing their attractiveness for tourism. These include quarries which are important geological sites and contain a collection of various types of jointing rocks, folds, flexures, and similar. Quarries may be significant paleontological, mineralogical and archaeological sites and are unique in the fact that without mining in the locality the findings would most likely never be found.

In the sixth category are included quarries which are not among the significant geological, paleontological, mineralogical and archaeological sites themselves, but are an integral part of Geosites a Geopark because they allow visual insight into the Earth's crust. Their position within Geosites and Geoparks does not exclude that they are representing important sites in different aspects.

Quarries are protected under the Law on the protection of nature and landscape Act.

543/2002 Coll. in case that they are creating an important habitat, or a combination of findings, or that the quarry area became an important element of landscape or a habitat for protected species of flora and fauna.

In the 8th category are the quarries, which meaning is so important for the given landscape, that they are assigned as separate stops within nature trail. Scientific research and subsequent processing of a quarry as a stop on the nature trail is already a minimum interference to its space and building of primary infrastructure.

The most common mass use of quarries geotourism is for sport-recreational activities such as swimming, snorkeling, diving, motor racing, cyclocross, climbing and other activities. We have to observe these quarries in two perspectives - those operated by the mandatory official authorization, including the necessary infrastructure, and those that are used only spontaneously.

We have dedicated a separate category for quarries usable for school practice, as excursion destinations or for field observations. We can include every quarry, because it depends only on how the teacher prepares the methodology of fieldwork and the thematic focus of his lessons.

The twelfth category is the musealization of quarries, i.e. modification of quarries as spatial objects in a museum in nature. The infrastructure for quarry visitors has to be built under legislative regulations in its vicinity in order for the quarry to become a museum.

Rebuilding of quarries space for a secondary use in industry and energy industry, housing, agriculture, forestry, water management, transport and so on. The redesigned space of the quarry can get a new impuls as a target object of geotourism.

BASIC ANTHROPOGENIC-GEOMORPHOLOGICAL AND MONTANE RESEARCH OF QUARRIES ON THE EXAMPLE OF BRUSNO

The decline and gradual disappearance of underground mining during the 19th century begins to forecast mining and quarrying for construction works - quarry mining. Quarrying had been done only for local use. An important milestone in the extraction of construction materials was the year 1806, when the whole wooden Brusno burned down. Since then, gravel, stone and clay began to be used more frequently, which resulted in the formation of early quarries and surface mining sites. Opening of quarries and gravel pits began to be evident in the landscape in form of significant terrain scars - quarries.

This situation was also confirmed by the Vice-Regency Council Regulation of the Zvolenská Stool from 1780, which proposed the conservation of forests. The Regulation had not been followed by Brusno inhabitants, who continued to build their houses from wood. This is evidenced by the cadastral maps of the Brusno municipality from 1877, which depicts only two stone buildings (the mill and the inn) (Archives of the Brusno municipality Office). The situation was slightly better in Sv. Ondrej, where at that time stood 17 stone buildings, except the church, according to the cadastral map from 1866 (Archives of the Slovak Institute of Geodesy and Cartography Bratislava). The first brick buildings were built in the late 19th century, when the building material from the brickfield in Sv. Ondrej have already been applied. Brick buildings were built in greater numbers mostly after the World War I, but the main building material was brought from the brickfields in Slovenká Ľupča and Nemecká, and only to a lesser extent from Sv. Ondrej.

During the field research of the landscape in the cadastral area of Brusno we focused on the quarries as the surface mining relics. All surface relics incurred as results of surface mining, had been mapped and analyzed together with the currently existing sites. The used research methodology was originally processed in the 2009 scientific project (Hronček, 2009b). We have identified these quarries in the cadastral area of Brusno:

The quarry **Pred Bukovcom** was originally opened in the second half of the 19th century, approximately 500 m east from the municipality of Sv. Ondrej nad Hronom, on the left side of the road to Brezno. It is located on the right Pleistocene - Riss terrace of the Hron river, in a pothole created by an unnamed intermittent stream flowing from the site called Pred Bukovcom. The quarry had been identified in field on the basis of the Sv. Ondrej cadastral map from 1866. The map (Fig. 1) identifies the questioned site as *Pred Bukovczom* and the quarry itself is localized by a verbal description of the official Hungarian nomenclature as *Agyag bánya*, which can be translated as a clay mine - *Hlinisko*. The description refers to the parcel No. 850, which was owned by the local landowners according to the Register of Sv. Ondrej nad Hronom. The color fill of the parcel polygon has a vintage pink color, reflecting the land use type of the site as an unused („*neúžitok*“) and other undetermined land.

The brickfield owned by Gejza Rožňovák was situated on the left side of the main road from B. Bystrica to Brezno, approximately 1 km away from the Sv. Ondrej municipality. The complex consisted of a semidetached brick house immediately followed by a shed. The shed served for technical works and as a storage for burnt bricks. The plot contained an area with an almost perfect flat surface intended for the drying of bricks before the final burning. This space can be easily read on the ground even today, because it

constitutes significant boundaries of a privately owned land parcel. A space excavated into the hillside was connected to the north side of the brickfield campus, where the owner and brickmaker built two field furnace for brick burning.

Whole process of brick manufacturing was handmade. It started with the digging of clay in the nearby site called Hlinisko, and continued with the clay sifting and kneading. Next, the material was pressed into a wooden mold. Then it had been tipped into a wheelbarrow and transported to the drying area, where the bricks were spread and dried in the sun before burning. This process had been repeated until a sufficient number of bricks was made for the construction of a field furnace. The dried bricks were stored in the shed before burning. The dried bricks were then stacked to the shape of a dome shaped field furnace. The area under them was then lit and the fire burnt the bricks to the desired quality. After the burning, the body of the furnace had been dismantled and the bricks were taken out. This process was subsequently repeated. Thanks to the good quality of clay and the technological process, the bricks produced were purple and had a high quality and good durability. They had similar characteristics as the refractory bricks. Gejza Rožňovák sold them in the nearby surrounding. They were much better than bricks from the brickfields in Nemecká, Lučatín and Slovenská Ľupča, which used to fall apart in case of a rainfall and had been used for the construction of furnaces, chimneys and stoves. As the blast furnace lining, they were also used in the nearby lime factory in Nemecká.

From the east, the brickfield was bypassed by a nameless creek diverted from the valley of Baništja, which lay north of the brickfield. The creek served as a source of water for the kneading of clay, and separated the clay pit from the brickfield site lying east (cadastral map of Sv. Ondrej, 1866).

Original shape of the clay pit („*hlinisko*“)



Fig. 1 Quarry Pred Bukovcom on the map of 1866 (Archive of Geodesy, Cartography and Cadastre Authority of Slovak Republic, Bratislava)

could not be reconstructed. According to the description in the cadastral map from 1866 and according to Polák et al. (2003) it can be assumed, that the deluvial clays as a covering material of the older Riss terraces, had been exploited here. The field research probes show, that mainly the Riss fluvial sands, significantly clayed sandy gravels and gravels must had been used.

Only the southern part of the clay pit is preserved until now, because its central and northern part had been recultivated and destroyed by the earthworks of the construction of main road from Banská Bystrica to Brezno in the first half of the 70s of the 20th century. Clay pit relics consist of five holes on the hillside of the terrace with the shape of an irregular circle with a diameter of 10 m and a depth of up to 1.5 m. Between the holes is an undulating relief, which is non-native for the original terrain of the river terrace. The devastated area has a length of 50 m and a width of 30 m. At present, the whole of the original mining area is overgrown with an

impenetrable scrub vegetation.

Quarry in the Jablonka valley. This is one of the most important quarries in the history of Sv. Ondrej. The cadastral map of Sv. Ondrej from 1866 names the site as Baništija. At the beginning of the 20th century, this name was still used together with the name „Za veľkú baňu“. The quarry was opened on a dark and gray Triassic limestones (Maheľ, 1968), which disengaged or break well because of their block breaking. These limestones had been used from the very beginning for the construction of the base walls („cokel“) of the wooden houses. We have identified this limestone as the main building material of the oldest buildings in the municipality – the church and the notary office. The quarry was exploited even in the first years after the World War II.

The **Repište** quarry is located on the right side of the Sopotnica valley, 500 m south of the forester's lodge on the southern edge of the site Repište in the cadastral area of Brusno, in the part of Sv. Ondrej. Red to

pink Jurassic limestone was mined in an abandoned quarry wall (Polák et al., 2003). Quarry with the length of 15 m and a 3 m high wall was opened during the construction of the paved, later asphalt road in the valley of Sopotnica, in the second half of the 20th century. Currently, the quarry is overgrown with a deciduous forest with the vegetation dominated by the European beech (*Fagus sylvatica*).

The etymology of the name **Banište** refers to the old anthropogenic mining activity in the left side valley of Sopotnica lying approximately 2 km north of Brusno (local part Sv. Ondrej nad Hronom) (Fig. 2). The name “Baňa” – “Banište“ (mine) Quarry mining was previously used for the functional surface structures generated in the extraction of mineral resources, particularly for construction quarrying.

Whole Banište valley is a vast, complex shape mining “object“ consisting of several separate quarries. Five quarries had been verified by the field research.

All quarries in the Banište valley had been opened on a weathered bright Ramsau dolomites from the upper Anis (Triassic) (Polák et al., 2003). The surroundings of the anthropogenic devastated Banište valley is grown by a coniferous forest dominated by the Scots pine (*Pinus sylvestris*) and

Spruce (*Picea abies*).

At the site called **Pod Strážou**, which lies approximately 30 meters above Dúbrava, laid a small gravel pit. It was opened on fluvial and sandy gravels of the Mindel upper terraces (Polák et al., 2003). The shape and dimensions were determined by the analysis of basic topographic maps of SR 1:10000 (36-23-06) with a reambulation from 1974. The quarry with an elliptical ground plan had a longer axis of 35 m and the shorter axis measured 20 m. It was recultivated in the second half of the 70s of the 20th century.

Dúbrava gravel pit was opened on fluvial and sandy gravel terraces of the middle Riss period (Polák et al., 2003).

It was situated at the site called Dúbrava. We have determined the shape and dimensions of the gravel pit from the basic topographic map of SR 1:10000 (36-23-06) with reambulation from 1974. The quarry was recultivated in the second half of the 70s of the 20th century.

Quarries on the southern slope of **Hrb** (495 m a.s.l.), on the northern border of the Brusno intravilan, in the local part of Ondrej nad Hronom, consist of five separate wall micro-quarries with a length of 8 m and a maximum height of 3 m.

Present chaotic distribution of the

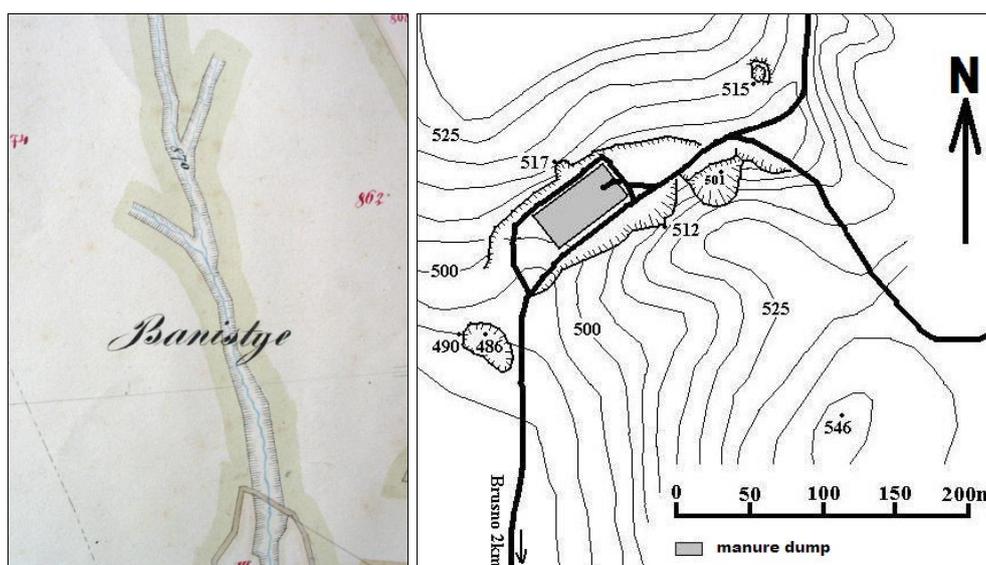


Fig. 2 Valley Banište (banistya) on the map of 1866 (left, Archive of Geodesy, Cartography and Cadastre Authority of the Slovak Republic, Bratislava) and quarries in the Baništija valley (right)

quarries on the slope is a result of land division, recorded on the historic maps. From the cadastral map of Sv. Ondrej from 1866 it is clear, that the quarries laid on the western border of narrow fields at the bottom of the slope, and meadows at the top of the slope. Fields parceled parallel to the contours started at Záhumníe and the cemetery. Individual owners (or families) opened them during the 19th century to acquire construction material for new houses and farm buildings.

Partly weathered gray to dark gray dolomite of the Triassic period, the late Anis (Polák et al., 2003), had been excavated here.

Wall quarry **Brusnec** laid on the left side of the Brusnec valley at the mouth of the Brusnianka valley, behind the original Spa chapel dedicated to Our Lady of Lourdes. Quarry was opened on weathered gray to dark-gray Cretaceous marly limestones (Polák et al., 2003), at the foot of the western slope of Kopok (744 m a.s.l.). The excavated material was used as a construction gravel and sand. The quarry had been recultivated at the beginning of the second half of the 20th century and is now located on a private land.

The quarry **Kúpele** had been identified from the cadastral map of Brusno (cadastral

map of Brusno from 1877, Archives of the Brusno municipality Office), because it is in a state of naturalization, which makes it impossible to identify without historical documents. The quarry laid on the northern border of the Spa area on the north-western slope of the Brusnianka valley, behind the „current“ Spa house Paul. It had been opened for the extraction of gravel and building stone for the purpose of constructing stone buildings in the Spa since the mid-19th century. The quarry was opened on the conjunction of fluvial gravels of younger Riss period, with massive gray dolomites from the Middle - Upper Triassic period (Polák et al., 2003).

Quarry **Hladušová** (Fig. 4) is located on the right side of the Hladušová valley at the foot of the southwestern slope of Kopok (744 m a.s.l.). It is accessible by approximately 250 m long forest path leading directly from the technical areas of the Spa. It had been mined for gravels on a weathered gray dolomites from the Middle - Upper Triassic period (Polák et al., 2003), which had been used as a low quality building materials for local purposes and for road construction. The largest extent of mining was reached in the seventh and eighth decade of the 20th century.

The wall of the quarry (Fig. 5) is 85 m

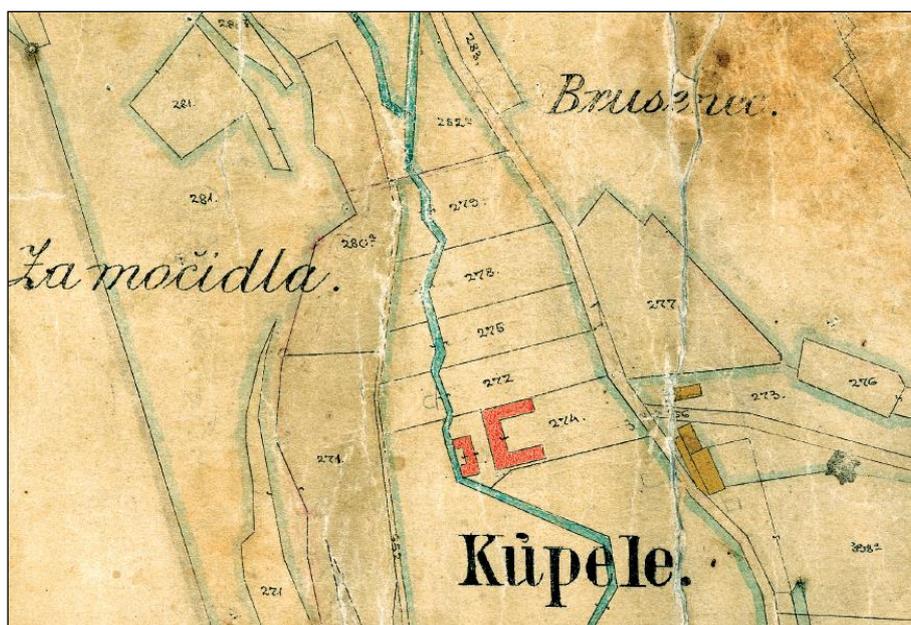


Fig. 3 The spa area on the cadastral map from 1877, right quarry Kúpele (Archive of Municipal office Brusno)

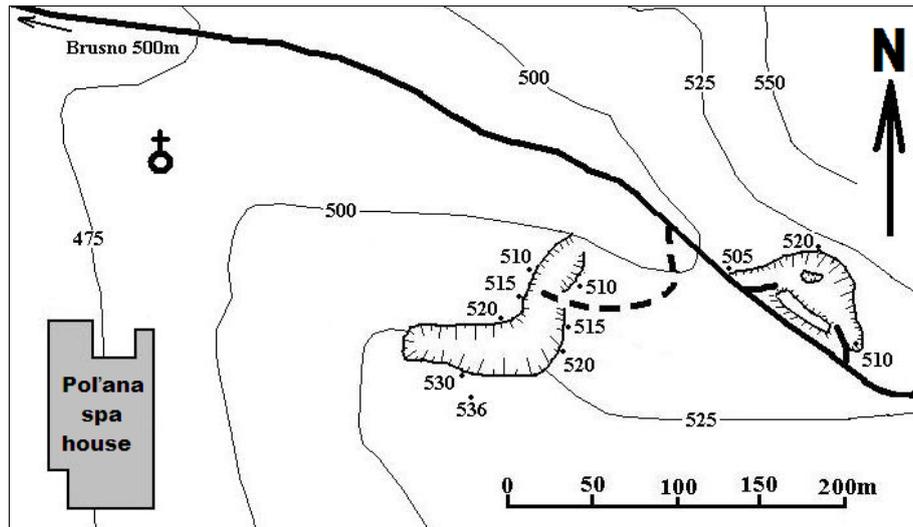


Fig. 4 Quarries in the Hladušová valley



Fig. 5 Hladušová quarry

long and 18 m high, with a maximum horizontal depth of 15 m. The influence of gravitational and frost weathering processes developed extensive conical talus deposits at the foot of the quarry walls.

Quarry Hladušová lies on the northwestern and western slopes of Hladušová (536 m a.s.l.), on the left side of the Hladušová valley. The quarry was mined for gravel and stone from layers of the Medium - Upper Triassic gray dolomites (Polák et al., 2003). It has a shape of a quarry complex consisting of

three vertically separated parts. Based on the written material, maps and fieldwork from our historical - geographical research, we can assume it had been closed in the mid-20th century.

The quarry had an extremely unfavorable transport accessibility, as it laid on a slope with an inclination of 40 – 45°, and the maintained access road in approximately 1 m deep gully lead in the first half of its length almost perpendicularly to the contour lines.

It is also 1.5 m narrower than gully relics

of a classic horse-cart roads. This road communication allowed access for only a small towed cart. A 100 m long linear gully with a triangular profile oriented perpendicularly to the contour lines is preserved in the present terrain. It currently connects the quarry with the valley bottom of the Hladušová valley. Based on the analysis above, we can conclude that it is most likely a transport corridor gully. We can therefore assume, that an approximately 120 m long wooden through („zvážna“) was installed in the gully, which was used to gravitationally transport material from the quarry to the bottom of the Hladušová valley, where it was loaded on horse-carts.

The wall quarry laying on the right side of the **Bračová** creek valley, directly above the erosive base, was used as a source of material for the local construction purposes benefiting from the weathered shale with thin inserts of siltstones, fine-grained sandstones and dolomites (Polák et al., 2003). The nowadays unused quarry is 10 m wide, with a horizontal depth of 12 m and 15 m high walls.

The abandoned wall quarry **Pod Jeleňacou** is located on the right side of the Bračová creek valley at the site called Pod Jeleňacou, which lays above the access road. Stone for local building is mined from the stone base of the Triassic dolomites (Polák et al., 2003). Relics after the quarry is 25 m long, 8 m high and has a maximum depth of 3 m.

The quarry **Za Hrabínami** is located on the right side of the valley Brusnianska, opposite the Čierna valley, at the foot of the western slope of the Dielec hill (623 m a.s.l.), on the southern boundary of Hrabiny. Nowadays it recalls a communication cutting created during the construction of a new asphalt forest road. It was opened by local residents, who occasionally mined gravels and sands up to the 40s of the 20th century, due to transport accessibility and suitable mineral material. The quarry was opened on the basis of sandy and gravelly Holocene coluvial deposits (Polák et al., 2003).

The quarry **Nad Čiernou dolinou** laid on the left side of the Brusnianska valley on the eastern slope of Nad Čiernou dolinou (755 m a.s.l.), and is in such stage of naturalization at present, that it practically corresponds with the morphological ravine formed by the Brusnianska creek. The quarry was originally accessible directly from the road connecting smelters at Trosky (Peklo) with Brusno, which lead on wooden bridge structures in this narrowed part of the valley. The original road was led on the left side of the valley, while the present road was built late in the 19th century on the right side of the valley. The quarry was opened on the Triassic brown-grey siliceous sandstones and quartzites (Polák et al., 2003).

CONCLUSION

As geotourism has become worldwide phenomenon, many aspects and objects of natural or antropogeneus origin are cosidered as a possible places of interest within this form of tourism. Based on the geotourism potential of many quarries, as also presented in this paper, it can be assumed that these man-made objects deserve more attention. Their proper geotourism based presentation may lead to overall geotourism development, including locals' involovement and sustainable development, as mentioned in many geotourism related definitions and papers.

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