Summary

Introduction

Limestone plateaus of the Slovak Karst region, its characteristic surface with sinkholes, chasms, caves and sinking streams do not resemble any other mountain range in Slovakia. Moreover, it has secrets hidden underground, long ancient history and some kind of mystery that we can feel, while it remains nameless. This karst underground, immensely rich, has been registered in the World Natural Heritage since 1995. Thereby this region became worthwhile not only in Slovakia and Hungary, but within Europe. Natural resources can be preserved as a form of cultural legacy only if it is worth for the majority of society. The Krásnohorská Cave belongs to the most beautiful jewels of this heritage. By presenting it in a form of monograph we would like to contribute to its preservation.

Caves of Slovak Karst as the World Natural Heritage

Caves of Slovak and Aggtelek Karst were included on the World Heritage List upon joint nomination project of the Slovak Republic and Hungary. The main reason for listing this natural territory to the World Heritage is unique richness and heterogeneous character of the underground karst phenomena. Subject of the notation includes all caves found in this area (in time of inscription, the number of caves was 712; nowadays, we know 1 020 caves only in the Slovak territory). 20 of these caves were chosen as representative localities of this phenomenon and were described in the project in more detail. In Slovakia these were: the Domica-Baradla Cave System, the Diviačia Chasm, the Drienovská Cave, the Gombasecká Cave - the Silická ľadnica Ice Cave System, the Hrušovská Cave, the Jasovská Cave, the **Krásnohorská Cave,** the Ochtinská aragonitová Cave, the Obrovská Cave, the System of the Skalistý potok Cave - Kunia Chasm, the Snežná diera Cave and the Zvonivá Chasm. In Hungary the localities were: the Baradla-Domica Cave System, the Béke Cave, the Kossuth Cave, the Meteor Cave, the Rákoczi 1. sz. Cave, the Rákoczi 2. sz. Cave, the Rejtek Chasm, the Szabadság Cave, the Vass Imre Cave and the Vecsem-bükki Chasm.

The extent of known underground karst area is the result of a long time exploration and research from the 18th century up to the present. On the Slovak side we know about 53 km of underground passages. At the time of publishing this monograph, 731 known caves had their length of more than 5 m. The list of these caves is presented in Tab. 1 divided by respective plateaus. Due to activities of voluntary cavers not only the number of discovered caves and the length of the underground increased compared to 1995, but also significant progress in documentation and research of karst phenomena was achieved. This process should continue because it is one of the ways of preserving natural heritage.

The longest cave in the area of Slovak Karst is the Skalistý potok Cave with its length of 5 689 m and superelevation of 317 m. Exploration of this cave, belonging to the karst of the Jasovská Plateau, required enormous effort of speleodivers and the cave still amazes us and gives us new information for research. The highest number of caves, that altogether form the longest system of cave passages, is located in the underground of the Silická Plateau, which as the largest plateau forms such a core of the Slovak Karst. There are several cave networks inside Silická Plateau, but only the Domica-Baradla Cave system is considerably explored. The Dolný vrch Plateau and the Plešivecká Plateau can be considered as the land of chasms. There can be found many vertical corrosion cavities on the plain surface and a number of karst springs at the foothill. However, we know only two shorter spring caves under Plešivecká Plateau for the moment. Other plateaus have not been much explored by speleologists yet and the length of known spaces in there is just a fragment of the real underground world.

Inscription of the Slovak Karst on the World Heritage List is actually the result of long-time exploration of this phenomenon. The inscription is only the crest of this process. Professional interest in caves started in the 18th century with works of Georg Buchholtz jr. and Matej Bel. The beginning of systematic exploration in the area of the Slovak Karst refers to the discovery of the Dobšinská Ice Cave in 1870. Every important discovery gave an impulse for new investigation. Emil Fábnik overcame his fear of the unknown and organised exploration of the Zvonica Chasm situated on the Plešivecká Plateau. Till the end of the 19th century, A. Sholz was considered as the most notable cave explorer. Before the 1st World War, exploration of the Slovak Karst was managed also by Hungarian Geological Society. By virtue of this society, Gábor Strömpl made a register containing data about 77 caves. After the discovery of the Demänovská jaskyňa slobody Cave in 1921 new epoch of cave exploration began. Július Zikmund was exploring the Jasovská Cave from the year 1923. He found new chambers and in 1924 the cave was open to the public once again. In 1925 two very important descents to the deepest that time known chasms in the Slovak Karst were realised. Soldiers from Rožňava station under the command of lieutenant colonel Gustáv Dufka descended to the 142 m deep Malá Žomboj Chasm and Jozef Drenko explored and made a map of the Zvonica Chasm.

A new era of speleology in the Slovak Karst started in 1926 with the discovery of the Domica Cave. Its discoverer Ján Majko became the most notable caver who had been, with short pauses, engaged in karst exploration till 1962. Until the 2nd World War, he discovered also the Archaeological Dome in the Silická ľadnica Ice Cave and the Majkova Cave. From 1931, cave research was managed by the Czechoslovak Tourist Club that established a Karst Commission under the supervision of prof. Radim Kettner in 1933.

During the war, caves in the Slovak Karst were investigated by Hungarian cavers from the Tourist Association of Universities in Budapest (BETE). They explored about 50 caves and chasms mainly on the Silická Plateau from 1942 to 1944.

The first one to start cave exploration after the war was J. Majko. His greatest discovery from that period was the Milada Cave (1946). A group of young speleologists led by Viliam Rozložník succeeded in discovering the Gombasek Cave after they had decreased water level in the Čierna vyvieračka spring.

Further professional investigation in the Slovak Karst was organised by the national corporation Turista. It established several professional and also non-professional workstations. The most important discoveries from that period were: the Jaskyňa na Kečovských lúkach Cave (1952), the Nová brzotínska Cave (1954), the Ponorná Chasm (1955) and others. The corporation stopped its activity in 1963. After that, cavers from Rožňava allied to the Mining Museum and consolidated their activities. The main works took place at the Buzgó spring and led to the discovery of the Krásnohorská Cave. Czech cavers together with Mikuláš Erdős were exploring predominantly chasms up on the plains.

New situation started with the revival of activities of the Slovak Speleological Society in 1969. There were 2 regional groups established in the area of the Slovak Karst: Group1 - Košice-Jasov and Group 3 - Rožňava. Young members started to develop speleoalpinism, and thus created conditions for new trends in speleology. The first great discovery was the Hrušovská Cave (1978). Significant progress was also achieved up on the plateaus in cooperation with Czech cavers. At the end of 1970s there were 77 caves known at the Dolný vrch Plateau and 80 at the Silická Plateau.

Speleological survey in the Slovak Karst was intensive in 1980s, too. For example at Jašteričie Lake, where effort of breaking through to other cave spaces was not successful until 1986, when cavers finally got into continuation of the cave named Jaskyňa v ponore Jašteričieho jazera. Young cavers from the group of Jasov found the Kunia Chasm. Significant progress was achieved by speleodivers in 1981 when they broke through the siphon in the Krásnohorská Cave. The exploration of the Skalistý potok Cave also carried on successfully under the leadership of Zdenko Hochmuth. This cave continually became the largest in Slovak Karst.

A break through a karst spring is a certain way of getting into the underground although it needs a lot of effort. Cavers from Rožňava together with their Czech friends from Tětín therefore came back to Zugó spring in 1990, and finally got into the Zugó Cave after 30 years of hard work. But the most important locality that time was the Skalistý potok Cave where very good results were achieved under hard conditions by speleodivers. This period is also characteristic for the survey on the plateaus' surface, where sinks - initial depressions - were investigated, and thus many corrosion chasms were discovered.

History of exploration

The history of the Krásnohorská Cave exploration can be divided into two periods: the survey of the Buzgó resurgence until discovery of the cave in 1964 and subsequent cave exploration.

The resurgence had been investigated from 1953 by Viliam Rozložník and his fellow workers. They first started to dig a drainage canal like at the Gombasek Cave in 1951. However, they were more interested in the Gyepű resurgence then, were they found a new cave in 1954, so works at Buzgó were going slowly. Cavers could not get into the underground but they significantly affected cave's hydrological regime by draining a lake from the area as far as behind Prvé jazero (First Lake). In 1956 water level in the Buzgó spring was dropped by workers from waterworks because of preparing the water-supply for a nearby village. After that, cavers could come back and Rozložník was able to swim inside and enter the first little chamber of the cave. Further on he encountered an impassable tight siphon and debris in an inclined chimney. As water workers disapproved of further cave exploration, it stayed untouched until 1963 when cavers from Rožňava with leaders Štefan Roda and Ladislav Herényi started a new survey.

At the beginning, cavers used a map drawn by Rozložník in 1956 and after decreasing the water level they got to the first chamber. When getting 30 m inside the cave they had to stop at a narrow passage - the 1st critical place. From that point they had been digging through a 100 m long passage until they finally reached the underground Buzgó stream on July 18, 1964.

After the discovery, it was essential to make a survey and documentation and dig a new artificial entrance to the cave, which would provide easier access into the underground. Documentary works were managed by Arpád Abonyi. He first made measurements in the entrance parts of the cave and drew a project of an artificial tunnel leading to the cave. Because of the decision to open the cave to th epublic, works carried on quickly and the building of the artificial entrance was finished on February 2, 1965. The cave was made accessible by wooden footbridges. At the end of summer 1965, the main trace was explored and documented.

Chances for new findings were possible at the left-hand inflow and behind the ending siphon. Hungarian divers started the underwater prospecting of Marikino Lake already in April 1964. After several failure attempts they finally passed the siphon on May 30, 1981, when Jozef Kucharovič rose up on the surface of a large lake in the Jazerný Dome. Divers successively discovered about 250 m of new passages ending in the Suťový Dome where no other straight-through passage was found.

This achievement gave rise to further interest in the Krásnohorská Cave exploration. Logical place for other important findings was a tight crawlway up above the left-hand inflow where strong air draught was vanishing. Works on enlarging that passage began in autumn 1982. Behind the corridor, cavers discovered the marvellous Heliktitový Dome and also got to the active flow of a side stream. Despite the great effort at that place they did not succeed in finding another considerable parts of the cave system.

The survey in chimneys that began in 1970s and lasts to the present has not brought any significant discoveries, so nowadays, we know only 1 356 m of the Krásnohorská Cave system.

Geology of the cave and the surroundings

The Krásnohorská Cave is located at the northern foothill of the Silická Plateau, an area of high geological interest. About 800 m wide and 1 km long zone south-east from the Krásnohorská Dlhá Lúka village is the only place of the northern slope of the Silická Plateau where Lower-Triassic schists and Verfen strata sandstones are tectonically reduced and limestones reach down to the erosion base of the surface streams of the Rožňava Valley. It is therefore obvious that these geological factors together with evident tectonic predisposition in that place caused a concentrated flow of karst waters to plateau's foothill.

Predominant part of the cave from the entrance to Sieň obrov (the Hall of Giants) is formed in gutenstein dolomite and dolomitic limestones with singular limestone layers. Only back parts of the cave - Chodba perál (the Pearl Passage), Veľká sieň (the Great Hall), Zrkadlová sieň (the Mirror Hall) and probably also parts behind the ending siphon are located in chemically pure steinalm limestones.

In the less soluble dolomites, significant passageways like Veľký kaňom (the Great Canyon) were formed as a result of striking tectonic faults in a tectonically highly affected area. This also helped to form large chambers in the back part of the cave. The presence of highly affected tectonic zone is proved by recrystalised, breccial and microbreccial carbonate structures, too.

Veľký kaňom (the Great Canyon) can be considered as one of the most typical tectonically oriented cave passages in Slovakia formed at a tectonic fault.

Local rich dripstone decoration in the cave has been created due to the occurrence of chemically pure steinalm limestones in the superincumbent beds of gutenstein carbonates. A different rock composition with the prevalence of limestones in the rear part of the cave (the Pearl Passage, the Great Hall, the Mirror Hall) is characterised by higher quality and quantity of morphological shapes there.

Cave Morphology

Spaces in Krásnohorská cave can be, according to their different character, divided into 4 parts: **entrance part, Veľký kaňon (the Great Canyon), large chambers' part and spaces behind the ending siphon. The entrance part** includes spaces up to the beginning of the **Great Canyon** which, due to its tectonic singularity, is an independent part. Compared with the character of the described parts, **4 large chambers** differ in their spread, and, considering the presence of paleokarst phenomena, probably also by age. **Spaces behind the siphon** are known only from the description of speleodivers, thereby they have not been incorporated in this chapter.

The entrance part of the cave starts at the discovering passage. Nowadays, we use the artificial entry tunnel to get into the cave. The natural passage has a vertically broken relief with a number of straits which were extended by discoverers using explosives. It was presumably developing in shallow phreatic zone, although such character of passageway can also form high above erosion base. The main water-course had, until 1953 when the tufa barrier in front of the cave entrance was removed, a character of one large lake. During floods, the lake was reaching as far as to the fall of boulders named Veľký vrch (the Big Mount). The hydrological function of interesting Východná chodba (the Eastern Passage) is so far unknown.

The Great Canyon is tectonically the most interesting passage in the cave. It is formed at an almost vertical fault (80° - 85°) in direction 225° and with the length of 170 m. Due to this fault, the cave came 130 m closer to the edge of the plain. Horizontal distance from the cave entrance to the edge of the Silická Plateau is 300 m and a midpoint of Abonyiho dóm (the Abonyi Dome) is nowadays situated straight under plateau's edge.

Large chambers' zone is very different from the previously described parts. It is composed of 4 chambers and the 5th Heliktitový dóm (the Helictite Dome) on the lateral inflow. This zone differs from others not only by a spread of chambers but especially by age. This fact can be confirmed by the presence of paleokarst phenomena. The 1st chamber, called the Abonyi Dome, is almost 40 m high and has the floor projection of 37 x 33 m. Its entrance part is filled with a fall of older decoration and residues of massive sandstone stratum, which can be found also 8 m above its today's bottom. Considerable in this chamber is the growth of todorokite coralloids. The back part of the chamber is filled with water. The lake is called Druhé jazero (the Second Lake).

Sieň obrov (the Hall of Giants) is the highest chamber of the cave with its height of 45 m and floor projection of 36 x 25 m. The bottom is filled with residues of fallen predecessors of Kvapeľ rožňavských jaskyniarov (the Dripstone of Rožňava Cavers) and with a collapse breccia rock fall, which is the chamber's western demarcation. In the southern part of the chamber there is huge Gemerská galéria (the Gemer Gallery), belonging to the most beautifuly decorated places in the cave. In the NW direction, the chamber is connected to the ceiling of the Abonyi Dome through Herényiho galéria (the Herényi's Gallery).

Further, we pass through fluvial Chodba perál (the Pearl Passage) to another chamber named Veľká sieň (the Great Hall). With its dimensions of 22 x 27 x 18 m (w x l x h) and shape it is almost ideal underground hall. It is formed on two parallel tectonic faults with W-E direction, which are in addition crossed by less significant joints of NNW-SSE system. The cave bottom here is filled with massive rock boulders lying on clay sediments of water flow. The flow comes to the hall from Sifón potápačov (the Divers' Siphon) linked by Marikino jazero (Marika's Lake). The lake is situated in Zrkadlová sieň (the Mirror Hall), which is characteristic by a beautiful sinter decoration, especially helictites on the ceiling. A separate part of the cave formed on the left-hand inflow secretes one of the most beautiful chambers of the Slovak Karst underground called Heliktitový dóm (the Helictite Dome).

Cave hydrology and microclimate

The 1st chapter describes general hydrology. Large plainlike karst has high permeability. All water which does not evaporate penetrates to the underground not only through sinks but also through the whole plateaus' surface. To determine the measure of karstification and karst classification, experts in last decades accentuate the rate and character of permeability, which changes under the impact of dissolution (corrosion). The elargement of tiny crevices, bedding planes and residues of older porosity leads to the creation of karst passages and caves in the end. Only after the extension of underground conduits, the surface streams can disappear; sinkholes, blind valleys and other surface karst phenomena can arise. Karst is defined as an area where the permeability is strongly affected by the presence of karst conduits. In non-karst regions underground water flow does not change the permeability. On the contrary, it is typical only for karst that water enlarges and remodels primarily inconsiderable and almost impermeable crevices and bedding planes by dissolution into tubular conduits, which drain water from infiltration zone to a place of drainage.

Karst conduits are created within two stages. At first, continuous proto-conduit, few mm in diameter, develops between the zone of infiltration and the drainage zone. This process is very slow (1 km within 10 to 100 thousand years). That is the longest stage in the process of cave formation and it lasts until the 1st proto-conduit reaches a place of drainage. Thus, water pressure shortly decreases and flow rate multiplies, and the conduit widens quickly. It starts to collect water formerly flowing to drainage zone and other conduits change direction to that canal until they all finally join together. Gradually, other conduits are connected until a large karst area is drained to one spring or a group of several springs. This process creates a drainage system with centripetal character, similar to the shape of surface drainage pattern. Such drainage character is typical for most karst regions including the Slovak Karst. Although karst conduits make less then 0,1% of karst volume, they drain away above 95% of water. In conduits' surroundings, fissure permeability dominates and water flows much slower. During high water level, water from overflowed conduits infiltrates to the surroundings and flows back after the water level decreases. This causes the characteristic flow regime in resurgences.

The Krásnohorská Cave is an active fluvial cave with autochthonous underground stream. There is not a concentric drain from its drainage area (8 - 10 km^2) like in the majority of known caves but a multiple bifurcation occurs in the unknown and also in the known parts of the cave system. On the other hand, there are several small and one significant inflow in the known part, too. We can visualise the hydrological system as a wide patulous tree with two main and several lateral stems. Trace tests showed the connection with the Rakaťa Zsedem kút area, where also smaller non-karst springs are located.

Considering microclimate, the Krásnohorká Cave is a dynamic cave with unknown upper entrance. During winter, an effect of open-air environment can be registered up to Prvé jazero (First Lake), where the temperature is balanced to the cave average of 9°C. There is constant 100% humidity almost during the whole year. Occasional deviations (min. 98%) occur in wintertime, when intesive draught blows inside. The average CO_2 concentration in Sieň Obrov (the Hall of Giants) is approx. 0,5 vol. % and in Veľká sieň (the Great Hall) 1,0 vol. %. That corresponds well with the fact that the draught deviates before the Great Hall to the crawlway leading to Heliktitový dóm (the Helictite Dome). Measurements right in the main water-course were not made.

Interesting forms of decoration

A cave itself is only an empty (evacuated) space in base rock created by different forms of speleogenesis. This space is partially, sometimes also completely, filled with secondary cave infillings, which were transported into or formed right inside a cave. Variety of shapes of cave passages and secondary cave fillings creates a unique exciting place.

Sinter decoration in caves is formed by the precipitation of mineral content from karst waters in cave's open spaces. Karst water enriched with carbon dioxide reacts with the carbonate compound in soils and with the rock surface, which is thus dissolved by the so-called hydrogen-carbonate dissolution. This process is quantitatively dependent on CO_2 concentration in the solution, which depends on partial CO_2 pressure in the ambient air. When saturated solution enters the open cave spaces, where CO_2 concentration is essentially lower than in the soil, a part of dissolved CO_2 escapes into air and particles of the dissolved carbonate precipitate in a form of sinter.

The rate of sinter formation depends on many factors that also influence the growth of different forms of sinter cave filling. In the Krásnohorská Cave this process is notably intense.

Helictites are considered to be the most interesting forms of sinter decoration in the Krásnohorská Cave. They are different eccentric forms of speleothems growing in any direction without accepting the principle of gravity while forming under capillary action. The Krásnohorská Cave is one of the most significant localities of these forms in our country. Helictites are mostly translucent or white, often with opalescent appearance. They rarely have light-yellow or cream colour. Recorded lengths of these speleothems in our caves differ from fractions of milimetres to tenths of centimetres. Significant numbers of helictites were also found in the Hrušovská Cave, the Jaskyňa na Kečovských lúkach Cave and the Natrhnutá Cave. There are several places in the Krásnohorská Cave where helictites appear. The most diverse forms can be found in Heliktitový dóm (the Helictite Dome) and in the adjacent passages. We can also see some in Sieň obrov (the Hall of Giants) above Kvapeľ rožňavských jaskyniarov (the Dripstone of Rožňava Cavers) and on the ceiling of Veľká sieň (the Great Hall), too.

Another interesting sinter forms in the Krásnohorská Cave are **stegamites**. It is a specific form of seepage dripstones. Stegamites are created by seepage waters coming up (very often under high pressure) from fissures or cracks in a cave floor and walls. They precipitate along both sides of the limestone fissure, and by this way they create a sinter mound growing not from dripping water but from water rising as seepage through a fissure from beneath. Recently, we only considered sinter shields and drums as stegamites. A need for defining stegamites as a particular group of seepage dripstones was caused by their morphological and genetic singularity. They do not, though, resemble shields but mostly have a shape of mound, weeping willow or angel wings. An important role in the growth of stegamites is probably played by a possibility of linear seepage through primeval fissure (Cílek, 1999). A stegamite about 11 m long and about 5 - 7 cm high must have developed by a linear seepage from the fissure of similar length. As for cave shields, they presumably form by pointed inflow from one source what reflects their concentric structure. In the Slovak Karst, stegamites are mainly known from the Domica Cave, the Jasovská Cave, the Hrušovská Cave, the Drienovská Cave and also other caves. In the Krásnohorská Cave there were found three types classified as stegamites.

The Dripstone of Rožňava Cavers is one of the biggest sinter forms in the world. A formation with such parameters (hight 32,6 m, weight about 2 000 tons) in temperate climate conditions and within a rather short period (approx. 13 000 years) evokes many questions. Its average growth rate is about 150 kg/year. Such growth intensity needs extraordinary conditions. A huge amount of solution pouring on the dripstone is collected by a large sinkhole situated just above that place on the surface of the plateau. Due to high CO_2 concentration in the soil on the plain's surface, the solution is much saturated. In the Hall of Giants, carbon dioxide concentration is 6 times lower, what makes sufficient partial pressure for intensive sinter precipitation. CO_2 content in drops falling from big heights decreases. Thus a drop is supersaturated when dripping down and a lot of sinter precipitates from it. After dripstone has grown up, the growth process changes to the formation of surface flowstone crust. Despite the very good conditions for sinter growth, the Dripstone of Rožňava Cavers is the evidence that there is something very special, not investigated enough yet, happening with sinter formation in the Krásnohorská Cave.

Living organisms

The Krásnohorská Cave represents oligotrophic system with limited food sources for cave biota. The cave is inhabited by small bat colony belonging to Lesser Horseshoe Bat *(Rhinolophus hipposideros)*. Low number of bats during the vegetation season is the reason why guano is almost missing in the cave. Consequently, fauna associated with this substrate is absent (guanophiles, guanobites). The permanent stream transports several representatives of the above ground fauna to hypogean spaces, enhancing the species diversity of cave organisms.

In the entrance spaces of the cave, entomopathogenic fungi *Beauveria brongniartii* occurs, creating small white colonies directly on the rocks and on the surfaces of speleothems. During the investigations on cave fauna in 2003, totally 44 forms of terrestrial invertebrates were registered in the cave, including entrance passages, while in deeper parts 19 taxonomic forms occurred. Collembola (Hexapoda) had the highest species diversity of all faunal groups. Intact cave microhabitats are documented by populations of troglobitic species *Deuteraphorura* cf. *kratochvili*, *Pseudosinella aggtelekiensis* and *Arrhopalites aggtelekiensis*. They are characteristic inhabitants of caves of the Slovak Karst region, where *A. aggtelekiensis* belongs to rarer species. Bat tick *Ixodes vespertilionis* may be classified a troglobitic species, too. In the Krásnohorská Cave, species of the genus *Mesaphorura*, new to science, was discovered during the study, which underlines the importance of this locality with respect to faunal diversity. From aquatic fauna, stygobitic crustacean *Niphargus tatrensis* dominates. The planktonic fauna of the pools and streams is rather poor. The occurrence of several representatives of terrestrial and aquatic fauna in the middle part of the cave (the Abonyi Dome) indicates its communication with the above ground.

The fauna of the Krásnohorská Cave possesses typical features of intact subterranean environment, e.g. low diversity of communities and high relative abundance of troglobitic species. The threat to the local fauna during the opening period for the public is not expected if small groups of visitors enter the cave.

Cave minerals and sediments

The chapter deals with non-carbonate cave minerals and sediments. The most interesting feature of local speleothems are up to 36 mm thick flowstones and approx. 8-14 mm long coralloids formed by manganese oxides that were determined as todorokite (X-ray identification). The todorokite flowstones have laminar structure and inhomogeneous chemical composition (Table 1). Some laminae are formed by a mixture of iron and manganese oxides and hydroxides (goethite). They often contain allochtonous minerals such as quartz, smectite, illite and hematite. The thick, partly destroyed todorokite flowstones represent a senile feature of cave deposits but recent or even contemporary thin manganese coatings are abundant in some parts of the cave.

Rusty goethite pebbles of 2-6 cm diameter are common in the active stream under the Great Hall. They contain quartz, rare anatase, kaolinite and illite. The ironstone pebbles are mostly derived from ferruginous fluviatile sands - the relics of fine-grained layers are sometimes visible, while other samples are from more than 90% formed by „pure“ goethite. We believe that the provenance of these sediments is either connected with contact limonites of large sinkholes or with the upper unknown cave etage. The manganese flowstones and coatings indicate the connection of the cave with surface waters because manganese quickly precipitates in carbonate environment.

The cave sediments are mostly formed by silty clays (Tables 2 and 3). Very probably they represent a mixture of relict Miocene sands and Quaternary aeolian sediments washed down to the cave and redeposited several times. Paleokarst infillings are developed as a 20 m high zone of collapsed breccias, grey relict sandstones of unknown origin and fine-grained ironstones.

Karst evolution in the vicinity of the Krásnohorská Cave

A large number of published papers and unpublished reports were focused on the karst evolution of the Slovak-Aggtelek Karst (SAK), but many of them are based on presumptions and hypotheses, and not on the actual fossil record. We lack any reliable Pre-Quaternary dated karst infillings from the studied cave, but its vicinity may provide some clues to its history.

Mesozoic: The oldest datable (palynology) karst infillings of sinkholes and shallow lakes are represented by Gombasek layers of Santon-Campanian origin (Upper Cretaceous). The fresh shallow water flyshoid strata of the calcareous siltstones and dark anoxic shales of the Campanian-Santonian age, corresponding to alternating hydrological conditions (probable monsoon cycle), was found in the Gombasek and Hosťovce Quarries in the Slovak Karst. The Gombasek strata contain a mixture of two different pollen assemblages of the Campanian and Santonian age, respectively, while pollen-poor Campanian layers were found in Hosťovce. We expect that the plateaus of the Slovak Karst may represent an inclined, generally flat, exhumed limestone surface, originally covered by unevenly developed, weakly consolidated fluvial-lacustrine sediments (shales, siltstones, calcareous siltstones, sandstones) and continental weathering products of the limonitic-bauxitic types. While Gombasek finds represent semiautochthonous relicts of the former sedimentary cover, the Hosťovce sinkhole is developed as single Upper Cretaceous lakelet, where in situ layers are almost touching the side walls of the undisturbed paleokarst structure. The occasional fallen blocks (up to 30 cm) of Triassic limestone suggest the existence of vertical wall close to the lakelet and thus to the (sub)tropical karst development.

Tertiary: In Paleogene, the SAK area probably represented a rather monotonous plain covered by mostly insignificant elevations. Several cycles of marine transgressions and lacustrine phases took place at the southern margin of the SAK or under the slopes of the plateaus. The evidence of humid and warm Paleogene period of karstification is scarce in northern part of the SAK but abundant in its lower (Hungarian) part. The original Upper Createaceous limestone plateau was inclined from its highest point in the north to the south. The uneven uplift during the Tertiary led to differential denudation, thus the southern (Hungarian) part of the SAK contains abundant Paleogene sediments, which were denuded from the northern Slovak part. Even the general underground drainage pattern led from the contact zones in the north close to the Slovenské Rudohorie Hills to partly submerged limestone strata in the southern Pannonian lowlands. We thus expect that some caves of the plateau slopes may represent the relicts of former cavities, which have almost nothing in common with the present relief.

One of the most important milestones in the SAK evolution was the formation of broad but steep valleys approx. 400 m deep during the Pannonian in the Upper Miocene that separated individual karst plateaus. The intensity of uplifting and thus downcutting probably exceeded 400-500 m in the north but only less than 100 m in the south. The last event of this crucial erosional event was concluded by rapid sedimentation of diamictites of the Poltár layers (the Uppermost Miocene, probably the Lower Pliocene). The valley bottoms of the Slovak Karst may contain as much as 120 m of these sediments but the Poltár layers can be sometimes found as high as 150 m above the present floodplain.

The consequences of the Poltár aggradation are undoubtly of basic importance for the underground development: the uplift was connected with vertical karstification and formation of the new generation of cave systems, whose lower ends could be located more than 100 m below the present surface of floodplain.

Quaternary represents only last 2 Ma (millions of years) in at least 70 Ma old history of the SAK karstification. On one hand, we may expect that maybe the majority of large cave systems contains some older (Upper Mesozoic - Pliocene) elements but on the other hand, the erosional activity of Pleistocene climatic fluctuations led to the formation of new cave levels. On the basis of the given evidence, we may expect that the Krásnohorská Cave is formed by polycyclic processes that might have started not later than during Paleogene. They smoothed, remodelled or emptied older cavities possibly (according to the river terrace system) during last 1-3 glacial cycles. While large chambers can be attributed to the Pre-Quaternary paleokarst, a narrow passage under the plateau's slopes is obviously related to the Late Pleistocene river terrace system.

Process of opening the cave to the public

Ideas of opening the cave to the public appeared soon after the discovery. The first concrete vision was proposed by A. Abonyi already in the 2nd half of the year 1965. The cave should have been made accessible in a form, which could nowadays be classified as tourist-available. However, such form was in conflict with a plan to bring thousands of people to see the cave, being open to wide public.

The first project was prepared by Ing. Mikuláš Erdös, who worked for the speleological section of the East Slovakia Museum in Košice. According to his project, 155 m long entrance tunnel should have been built, starting in old stone-pit and entering the cave behind First Lake. Great canyon should have been made available by a footpath staked by consoles. The project laid out minimum crackdowns into cave walls. Nobody knows whether such an idea could have been realised in the planned form. The project's poor technical state indicates unknown final version with resolutions made just on the place. The project also had an alternative. Digging a footpath - a semi-tunnel - into the cave wall instead of building a footbridge in the Great Canyon. In 1967, another project was proposed by Geologický prieskum (the Geological Survey). Its aim was to show visitors the four most beautiful chambers accessible through the artificial tunnel. The length of projected tunnels had to be 350 m. The last project was prepared by Ing. Hric in November 1979. Selected investor should have been Správa slovenských jaskýň (the Slovak Caves Administration). This project copies previous versions; new is the entrance approximately half away from the stone-pit to the present cave entrance.

From today's view of cave preservation and exploitation, the form in which the discoverers wanted to open the cave is drastic and unacceptable. None of these projects was realised. The main reason was that the character of the Krásnohorská Cave is not suitable for classic opening without causing serious damages to the whole cave.

In 2000, a light tourist route built to make the cave accessible with a guide service during years 2000 and 2001. From 2004, the cave has been opened again according to new legislation.

Tufas

Tufas are fresh-water limestones that often form bodies of Holocene age in front of karst resurgences. What is their origin? Rainfall seeps through soil cover of limestone plateaus. The content of carbon dioxide in soils is generally approximately 40 times higher than in the atmosphere. Carbon dioxide dissolves in water and forms hydrocarbon acid. It dissolves limestone and widens limestone fissures and channels, but when entering the cave environment, carbon dioxide degasses in the cave atmosphere. The solubility of dissolved carbonate is thus lower and part of carbonate precipitates as flowstones, stalagmites and stalactites. More than 90% of dissolved carbonates travels with underground streams and usually precipitates some 30-100 m ahead of karst resurgences. There, it forms complex bodies up to 10-20 m thick that reflect the Holocene history of the climate and the environment. Basic sedimentary pattern is the same for all Central European deposits. Sedimentation usually starts about **9300 years ago and ends in 300-500 BC.** The lower part of tufa strata usually represents the homogeneous hard tufa sometimes called travertine. It testifies the warmer and more humid Early and Middle Holocene climate. These tufas/travertines were often used as a building material. The younger part of Holocene strata is more complex and often reflects prolonged drought periods (especially 1250-700 BC).

The Slovak Karst was once famous for its tufa deposits, but after 1950 almost all of them were destroyed during the construction of water conduits for local villages. The large flat tufa body in front of the Krásnohorská Cave is one of the few remaining, living and well preserved tufa bodies of the whole Slovak Karst and possibly the best example of such phenomenon in the area of the Slovak and the Czech Republic. The tufa body is thus maybe as important as the cave itself.

Cave Sanctuaries, Waters and Earth, Images and Words

An ancient legend is living in Gemer about a spring of Rimava river. There is a spacious cave deep under Vepor and Rimava spring takes its rise in it. The strange a source of the river is, and unusual story goes the round...

J. Turan, Slovak Myths

Czech cognitive scientist I. M. Havel expressed a strong belief that there are many more individuals with philosophical nature and with the sense for mystery among speleologists than among rock climbers. Climbers move in a clearly defined space in daylight. Havel has touched upon one of the basic questions of not only contemporary speleology, but of karst as such. Perhaps it is not just discovery of new caves, chambers and chasms, but a feeling of solemnity or mystery that lured men of various cultures including ours into the underground and to subterranean rivers. A lot of prehistorical sacred sites connected with the Slovak Karst, for example the Majda-Hraškova Abyss, the Besná and Múriková Caves on the Silická Plateau, the Kostorná Cave in Zádiel, the Domica and Ardovská Caves and many more may confirm this opinion (cf. e.g. Bárta, 1958). The mystery is not a fossil phenomenon we have already overcome, but something that lives and continuously reminds us of its existence. Archeologist V. Matoušek (cf. Matoušek, 1997) discovered a cave sanctuary in a narrow karst dike in Bacin, the Czech Karst, which was founded by ancient residents of the area several thousands years ago. It seems that they „had read" a sacrosanct path in the landscape that we are unable to find.

For speleologists, the Krásnohorská Cave generally represents a clearly defined problem: where is the continuation of the cave, where from and in what quantity does the inflow of water come, where are the passages connecting it with the surface? But the mystery of the subterranean flow probably has several aspects: why was the Holy Virgin sanctuary built up just at the lateral karst spring of the cave? Is it only a memory of the Lourdes Cave or is it a place unique for some unknown reason? Why is the most famous pilgrimage site of the 20th century - Lourdes - placed at a karst spring? Perhaps there is something speaking to us across centuries and the situation is repeated here, only in a slightly different form, like in the Domica Cave, where a passage to the underground river Styx is a gate to mystery.

It may seem that „the co-existence of the man and the cave" is a closed chapter. Today only speleologists and archeologists enter caves. From the dawn of times, the cave used to be a home and shelter for supernatural beings, at least in folk imagination - for example for nymphs or „little hairy men" (in detail Melicherčík, 1959; a modern analogy cf. Michálek, 1991). Exactly, caves used to be a part of human life from people's first steps - they had served as a shelter, a habitation, and a grave. The veneration of caves was connected with communication with underworld powers - chthonic divinities and divinities of fertility. The Goddess was a symbol of the continuity of life in the nature. (cf. Gimbutas) She is the most potent and most persistent feature in archeological records of the ancient world.

The Goddess was venerated in many depictions - as a bird, a fish or a snake, because its shape reminded a wavy line of waters or her body - and the upper waters of the heaven or underworld waters were her mythological dwelling. On account of this, many caves (especially these with subterranean waters) used to be consecrated to the goddesses, who were later identified with the Maiden, the Virgin, a Core or Lady of the Spring (cf. Kerenyi and Jung, 1995).

Prehistoric art, after A. Leroi-Gourhan (1965), cannot be interpreted separately but as a part of the whole ornamentation including so-called tectiform patterns. Abstract symbols represent grammar and syntax of a kind of an old European religion metalanguage.

The issue of wall drawings in Domica

These wall drawings belong to the very first finds in Central Europe. Science had not given consideration to the meaning these drawings had in previous works about Domica Cave and in neolithic period. Abstract schematic drawings found in Domica Cave (completely unique not only in Slovakia, but in the whole Central European region) can be perceived as prime images of discovered and manifested world. There are also rich findings from the Bükk culture, about 6400 to 6100 BC, including pottery, bones and remnants of a circular building structure. Charcoal drawings, found in depths of the cave, indicate spiritual or ritual activities that took place there. These abstract patterns were interpreted on the basis of an ornament found on pottery of Bükk culture as „bucranium" - bull head and horns and a simulacrum of a woman's uterus, symbol of regeneration.(cf. Lichardus.)

As the Mystery of the karst we usually consider the obvious things - cave elongation, disappearing of water stream, the genesis of abysses and chasms, information obtained from the filling materials in caves. But perhaps the core of these scientific questions and adventurous speleological research is only a desire to be near a sacred mystery and to be able to touch it at times.

On whom the flowing Waters, ever the same,
course without cease or failure night and day

Atharva Veda
translated by Raimundo Panikkar

History of near surroundings

The Krásnohorká Dlhá Lúka village was settled when the Bebek family started to build the Krásna Hôrka castle. The first known records from 1338 name the village as Hoziureth. The name was probably derived from a long meadow stretched along the Čremošná stream. From 1907, it was called Várhosszúrét and in 1928, it was given today's Slovak name.

A note in the village chronicle from 1900 says that there was an ordinary wooden chapel in the Buzgó part of the area as a monument for the revelation of Virgin Mary to two girls. According to the chronicler, there had also been an older chapel before, which burned down and was sanctified again in 1748. In 1895, the chapel was completely rebuilt on demand of Dionýz Andrássy.

The new Buzgó chapel was built under the initiative of a priest from the Úhorná village during years 1937- 1938 as a cave portal. From that time, local churchgoers organise annual procession on the first Sunday after 15th August. The current look of the chapel pattern was made by a local wood-carver Štefan Ulman jr. with his colleagues in 2000.

The water mill situated at the place where the instructive tourist trail enters the forest is also remarkable. The mill was driven by water force of the Buzgó resurgence and the Čremošná stream. from The Buzgó spring waters only seldom freeze even at very low temperatures, the mill was therefore able to operate during winter as well. The older mill had two wheels with upper afflux. In 1919 people from the village installed a dynamo driven by one of the millwheels. The dynamo was able to light up some 100 bulbs.

Slovak Karst and its genius loci

In ancient Rome, genia loci were real beings, often depicted as boys with fruits or a snake.

Genius loci now seems to belong to the heritage of the 19th-century Romanticism, but in the contemporary world, which is becoming more and more „flat" and globalised, it represents an authentic essence of any site. Places are sometimes visited for their beauty and grandeur, but more often for their atmosphere. We try to preserve not only the geo- and biodiversity, but also the landscape character and something even more sublime and almost sacred - its genius loci.

The Slovak Karst represents two areas in one: the area of deep, fertile and watery valleys is completely different from the area of dry pastures, stony soils and deciduous forests of the karst plateau. The industrial life seated in the valleys could have been easily controlled by aristocracy or local governments, but life in the mountains used to be always more arduous and free. Local legends there speak of on hidden treasures and decent robbers resembling Robin Hood.

People of the karst plateaus are like the land itself. They are open and friendly but at the same time cautious to strangers and they do not reveal much about themselves and their lives. They have never talked much about the secrets and special skills of living on a limestone plateau. They seem to have hidden spaces and subterranean rivers within themselves. The basic feeling of the Slovak Karst is the feeling of its mystery - deep chasms and beautifully decorated limestone caverns, large prehistoric settlements and many ritual places of several distinct archeological cultures. The Slovak Karst is situated in the space created by the tension between the wilderness and the man. The essence of local nature - pastures with sinkholes - was in fact created at the end of the Bronze Age period. No other Slovak region has so many cultic places - the Dome of Mysteries in the Domica Cave, a number of caves, where relicts of man were found, cannibalistic sanctuaries, orifices leading to underground gods or goddesses, Neolithic geometric drawings on cave walls, masks made from human skulls. Real, physical mysteries of cave systems and underground drainage are accompanied with metaphysical mysteries of forgotten cults.

How can we preserve the atmosphere of this land and by which means? Pasture should continue, ecotourism and traditional crafts, such as bell-making, should be welcome, some caves should be open to the public not as show caves with electric illumination but as guided-tour caves, where small groups of visitors will get something beyond all values - their own experience and understanding of this magnificent, secret world.