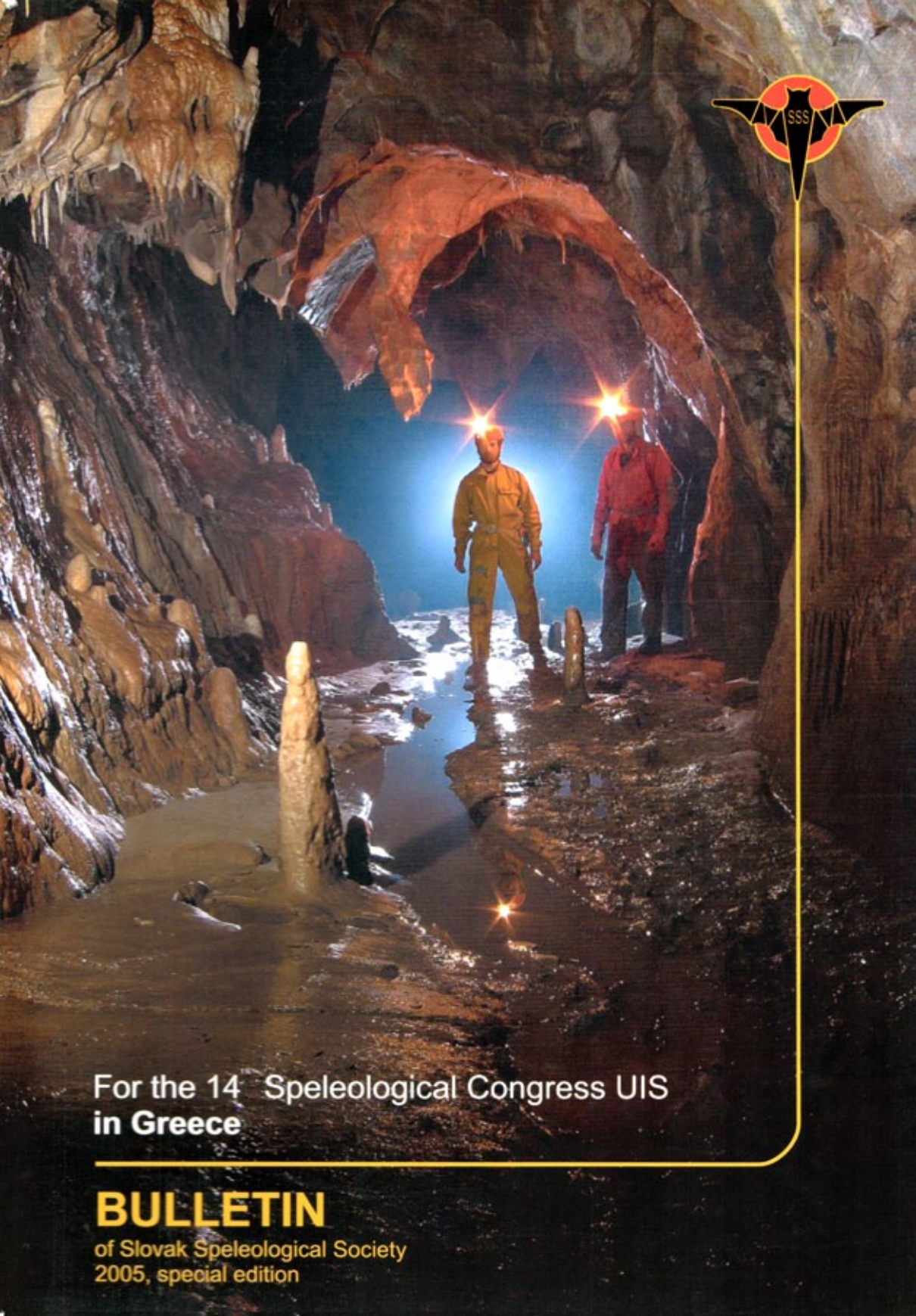

For the 14 Speleological Congress UIS
in Greece

BULLETIN

of Slovak Speleological Society
2005, special edition

Dear Bulletin readers, colleagues cavers,

Slovak Speleological Society (Slovenská speleologická spoločnosť, SSS) was established in 1949. It belongs to the founding members of the lnternational Speleological Union. In 1973 SSS together with Czech Speleological Society organized the 6th International Speleological Congress in Olomouc (CZ) and Liptovský Mikuláš (SK).

Nowadays, SSS has more than 750 members – volunteer cavers who work in 46 caving clubs all over Slovakia. They take an active part in exploration and research of caves and karst together with protection of nature in the Slovak Republic in close cooperation with the Slovak Caves Administration. Thanks io them there are more than 5,000 caves known in Slovakia up-to-date.

Exploration, research of caves and other activities are in progress not only in Slovakia, but also abroad. Slovak cavers have recorded some important achievements in caves and chasms in Slovakia, in Europe and also in other parts of the world. Some of these achievements are presented in this bulletin, others can be found in the Bulletin of the Slovak Speleological Society which is issued four times a year and in books on speleology.

I will be glad if you find the content of our bulletin interesting for you.

Bohuslav Kortman,
Chairman of SSS

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Bulletin of the Slovak Speleological Society, special edition 2005

CONTENTS

Cover photos: 1st page: Hadia chodba (Snake room) in cave Velika Klisura. photo by M. Audy
2th page: In the new deep Slovak cave Measčný tieň. photo by M. Audy
3 th page: Editors this issue Bulletin under the massif Chimanta, Venezuela. photo by B. Šmída
4th page: Galería Lena, Cueva Charles Brewer, Venezuela, photo by M. Audy

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Cueva Charles Brewer (Chimantá)
Cueva Ojos de Cristal (Roraima)

the greatest quartzite caves of the world (table-mountains, Venezuela)

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Abstract: *This contribution-article discusses about quite new discoveries (2002-2004) of the most extensive quartzite caves the world by leading cavers and scientists from Venezuela, Slovakia and Czech, who in 2004 created common numerous international South American-Middle European working team, specialized in the research of the subterrain portion of plateaus of Venezuela (so called tepuy). Because of the limited possibility of the length of this article does not allow the authors to write broader about the latest findings and explorations ojthe spaces, already longer than 13 km (on the massifs Chimantá and Roraima), sofresh and diversified, that it would take (and it will) whole compendia, we will struggle in the next lines to point only to the most substantial part for now, what touches to the history of the discoveries about the morphology of the quartzite caves discovered by us and to mention expressively couple of curiosities around it. People who are interested in this specific, however exceptionally valuable knowledge of the problem, can find more in already published articles in world speleo-magazines (as Spelunca, NSS News, Descent, Regards, Speleoforum, Journal of Sydney Speleological Society and so on), or in the monographs already published, or being prepared by us.*

INTRODUCTION

The modern speleological research in the area of Venezuela's *tepuy* is of very young data. Great progress to the knowledge about this fascinating table-mountains was provicled by the photographic pictures from the air and by the possibility to use a helicopter. The expeditions there however remain relatively expensive and difficult in logistics: plateaus, like Cerro Duida, Marahuaca, or the very Chimantá, are deeply inside the country, and they are isolated from the surrounding impenetrable jungle and from the savannas by vertical (or overhanging) walls of hundreds of meters. Expeditions to here therefore are still not numerous.

The first such known legendary action was performed to known Cerro Autana, by the well-known researchist Charles Brewer-Carías. In mountain climbing way he got to the wall about 150 m

A view of the well known tepuy Roraima, from Rio Kukenán, photo: B.Šmída

under the top, he found in this marvelous, about one kilometer high tower, caves and tunnels of the same name, already in 1971, crossing the massif in the length of 653 m (Brewer-Carías, 1976a). Basically it was the discovery of the first quartzite cave, additionally with evident fluvial modeling. In 1974 then, the also by him, in the cooperation with the scientists from SVCN, the giant abyss at the plateau Sarisariňama was the first time explored, known as Sima Mayor, with the depth -314 m and with monstrous oval mouth, 350 m in diameter, which had the internal volume 18 million cubic meters (Brewer-Carías, 1976b). Other remarkable discovery at this area was performed at the plateau Auyantepui: the dimensional abyss Sima Aonda (-383 m) was explored by the Venezuelan cavers from SVE (Galán, 1983). At the same massif, later (1992-1996), the Italian cavers from the association La Venta (for example Bernabei et al., 1994), were exploring here the system in quartzite Sima Auyantepui Noroeste (2950 m/-370 m) which was not long ago the biggest one, or other dimensional collapses, crevices and collectors (Sima Churun and so on).

By this article we would like to introduce to you, at least briefly, the last important period of the speleological research in the area of tepuy (or of the Lost World, how it was poetically named in the famous novel by Sir A. C. Doyle, 1912). Since 2002 we discovered at the mountains Roraima and Chimantá the greatest quartzite caves of the world, which are immensely interesting, not only by the parameters of the length, or of the volume, but also for it‘s unique genesis, spectacular fillings of biogenic origin, or by the endemie fauna.

CUEVA OJOS DE CRISTAL

During short tourist visit of the famous plateau Roraima (40 km^2), at the borders of Venezuela, Brazil and Guayana, on 4th February 2002, Marek Audy and Zoltán Ágh, by the logical disappearing of water (but otherwise in fact accidentally) found the entrance to the subhorizontal inflow cave. Because they were also excellent cavers, they entered to it‘s trace, in the length of about the first 300 m, where they found smaller waterfalls and quite dimensional passages with an underground river. For the further exploration of the underground they were not ready in the time. They had just basic headlamps and no mapping tools (Audy, Šmída, 2003).

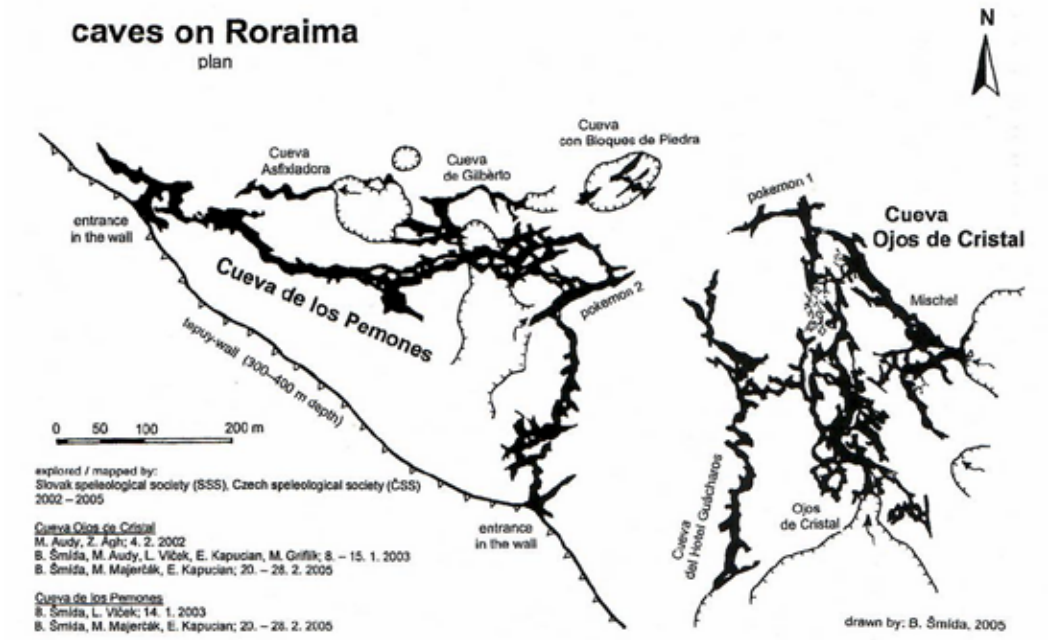
Because it seemed that the cave could continue, they organized a serious speleological expedition

Typical passage of the cave Cueva Ojos de Cristal photo: M. Audy

to there one year later. During the expedition in the days 8th-l5th January 2003, we explored here in the group of five: M. Audy, B. Šmída, E. Kapucian, M. Griflík and L. Vlček (members of SSS and CSS, Slovak speleological society and Czech speleological society) not only the cave named as Cueva Ojos de Cristal (in Slovak or in Czech Kryštálové oči, in English Crystal eyes), in precise scaled map (scale 1:500) the length 2410 m, but also other new caves, with the total length of underground discoveres 3,7 km (Audy, Šmída, 2003; Šmída et al., 2003; Smída, 2004; Vlček, 2004).

During the next expedition in the days from 20th to 28th February 2005, we continued in the speleological exploration of this area, already in the cooperation with the speleologists from SVCN (Grupo espeleológico de la Sociedad Venezolana de Ciencias Naturales). The system Cueva Ojos de Cristal is formed by the three evident main lines: Mischel, Cueva del Hotel Guácharos, and the first known Ojos de Cristal, which were connected into one complex with the length of 3164 m and with the elevation -48 m (Šmída, 2005).

Speleothemes ”carrots“ from Cueva Ojos de Cristal photo: M. Audy



Their main passages are 4-7 m wide and 2-3 m high in average. Locally however they reach the width 15-20 m, and maximum 10-12 m of height. The greatest known space is Sala con catarata (40 × 20-25 m). The inflow rivers flow through the branches Ojos and Mischel, at the circumstances when the passages are comfortable for the exploration (during relatively dry season January-March), with water flow 0,5-3 l/sec. (In the time of rain, the flow can increase to tens of l/sec.) Only slight increase of the water flow during raining will cause flooding of wide and relatively very low passages, which are not available for crawling then at the ends of the branches, which are, though relatively wide, but they are just 0,5 m high in the profile. Cueva del Hotel Guácharos is the one with the higher position, originally surely the older branch of the hollow basin depression (100 × 180 m), where as if blind end of the valley is in fact the main entrance to the branch Ojos. The passages of the system are connected by some mutually parallel passages which are smaller in dimensions, they are separated from each other often only by narrow rocky barriers and connected to the labyrinth. Their direction is much subhorizontal, as if little bit oblique, but otherwise almost without remarkable steps (the highest is about 4 m high, the other steps are about up to 0,5 m high) – the average cadence in the straightened cut is only about 2-3 %.

The cave tunnels go subparallel with the surface, not deep below the surface (20-30 m). The passages have mostly quite flat rocky floor, with micro-cuts, deepening, or somewhere with turbulent hollows (diameter up to 40 cm) and with swirl holes (so called "ojos de cristal"), which were engraved by quartz pebbles (originally crystals of pure quartz brought from the surface) – the name of the cave is by this phenomenon. The passages are otherwise mostly without sediments, somewhere there are rocky bridges, or fallen pieces of ceiling (by the plate separation or the separation of ashlar shapes). In the fossil levels, or in the wider passages it is evident side "plastic" separation of the lengthy quartzite plates. The passages are generally significantly wider than high, commonly in the ratio of the width to the height 4:1 (somewhere it is at the edge of being available, and the ratio is 40-60:1!!). The speleothemes are rare, however if they are present, they have often lovely shapes, they are directed by relatively strong drafts: no once they are concentrated nests of dark very solid stalactites in the shape of spiky carrots up to 0,5 m long. Some speleothemes appeared here by the decay of moulds or by unique decomposition and lithological hardening of some down from the little birds of *Zonotrichia* genus.

The cave was created by the secondary corrosion of the layers, which are the least resistant of the almost 98 % ortho-quartzite (mainly at interlayer dis-

continuities, and on the planes of hiatus), which is caused by the sophisticated enrichment of the water in organic materials, coming from the products of metabolism and from the decay of special endemic flora at the surface (for example also carnivorous plants). The repeating inflows of the water, during enormous rain seasons (the most of the year), apply significantly at the removal of the material from the block areas.

The cave has five entrances discovered till today, 3 of them are standard and 2 are in the form of remodeled vertical crevices (the deeper of them is about 100 m long and -18 m deep).

The discovery of the cave is unambiguous and undoubtable, because we did not find any traces of human activity inside Cueva Ojos de Cristal neither in 2002 (what was possible to verify also in the fossil passages, where there are very creep untouched little crusts developing thousands of years). The entrance to Cueva del Hotel Guácharos was known to the local indians Pemons, however even they did not enter to the tract deeper than the first 100 m, where we found their pictogram – further the sancty floor of the passages was untouched and the rocky floor was quite clean (Audy, Šmída, 2003; Šmída et al., 2003).

CUEVA DE LOS PEMONES AND ANOTHER DISCOVERIES IN THE KARST AT RORAIMA

The cave Cueva Ojos de Cristal likely has some genetic and hydrological connection with the next interesting cave in the close area named as Cueva de los Pemones (for the tribute of already mentioned indians – Pemons). These locations were not connected in the time of our research in February 2005, by physical personal passing through them.

One of the entrances to this second biggest system at Roraima, called as Pokemon 2, we had known already in 2003, it had been found by the duo B. Šmída and L. Vlček, on 14th January 2003 (Šmída et al., 2003). Other potential entrances to this genetic subsystem we also partially explored in 2003 (Cueva de Gilberto, Cueva Asfixiadora). The location, which was visited by the cavers from Oxford(?) just before us (not by very clean and ethical way, using our knowledge), we mapped precisely in the days from 20th to 28th February 2005, in the scale 1:500, while we discovered here some great extent of passages not visited by anyone and ever (again by the not existing footprints) and also some crevice entrances, mainly in the South-East ascending tract.

The passages of the main line Cueva de los Pemones, descending in the direction to the West, are 10 m wide in average, somewhere however even 15 or 20 m (or even more). Their height is also 2-3 m. The connection of the crossings and passages here also forms locally almost chaotic labyrinth of disorientation (mainly in the middle part of the cave). The main passage of the system is more compact, in the middle part (analogically as in Ojos de Cristal) with oval, also with ashlar shapes, and also with deeper lake pools, which must be passed around, by the several meters higher situated fossil parallel passages. (There are nice hollow pits in them.) There are also some collapsed little domes here. The biggest of the spaces is the lengthy passage-like hall, the dimensions are about 20 × 30 m and the height is 8-9 m. Two of the entrances are formed by about 100 m long collapsible crevices, about 25 m deep. Further similar, but little bit more shallow crevices (covered by high-mountain jungle) create the entrances to the south-ascending branch of the system.

In the cave several smaller inflows connect together in the shape of delta, to one concentrated little river, with the minimal flow about 30–100 l/sec. (In the monsoon season, or at intensive rain, the flow can increase at least to several hundreds l/sec.) This river disappears in the cave in the floor with collapsed boulders, only some 80 meters from the vertical wall of the plateau. The most probably it feeds some strong spring at the heel of this wall, called by the indians Tuná Deutá, which is approximately 350–400 m lower (at the beginning of the access ramp to Roraima). The way to this remarkably vertical hydrological system unfortunately was not found yet.

Cueva de los Pemones has the mapped length of 2070 m for now (200 m of less significant branches and spurs are drawn only for the orientation for now). The elevation of the cave is -73 m (Šmída, 2005).

All the remarkable genetic system of the caves at Roraima has 13 known entrances for now (in the altitudes around 2600 m above the sea level): two of them are heading directly to 300-400 m high wall at the south edge of Roraima, about 30-50 m below the top plateau. (They were found by the exploration from inside and they are beautiful places, with impressive view from some kind of amphitheaters, with special flora.) The other 8 entrances are collapse crevices remodeled by the water (relatively direct, or only slightly curving), which are up to 25 m deep, from 1 to 3-5 m wide, and even more than 100 m long. Because they are by their characteris-

tics different from the others and from the common "not cave creating" crevices at Roraima, we use for them not genetic term, so called pokemon (Šmída et al., 2003). These are oriented roughly in the directions WSW-ENE, and if they did not collapse to the underground totally there are higher longer halls created under them in the caves, with the falls of with the surface water in the form of dispersed drops falling down.

The length of the common genetic system of the caves Cueva Ojos de Cristal and Cueva de los Pemones, which could be later connected into one location, is 5,3 km now. At the close area of the plateau (roughly 500 × 1000 m) there is not impossible even to discover other less visible sub-branches and labyrinths, after the precise mapping of the branches maybe another kilometer of the length could be reached. Even the connection with the other close locations here is possible, for example with the cave Cueva de Gilberto (505 m long for now), Cueva Asfixiadora (125 m), Cueva Fragmento Marginal (78 m), or Cueva con Bloques de Piedra 2 (75 m). Beside these, we discovered bigger number of another caves at Roraima, 80-150 m long for now. Already in 2003 we explored some of the huge crevices, for example Grieta de Diablitos Volantes (-120 m), where some numerous colony of the blind birds live "guácharos" (*Steatornis caripensisi*, or Cueva con Puente (-80 m).

CUEVA CHARLES BREWER – THE GREATEST QUARTZITE CAVE OFTHEWORLD

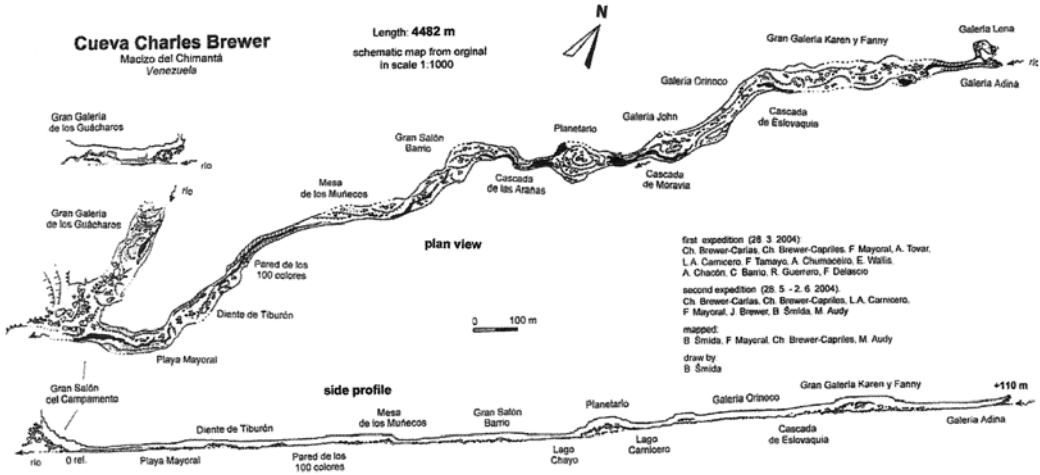
The entrance to this unique, directly monstrous quartzite cave by its dimensions, was observed by it's discoverer, Mr. Charles Brewer-Carías, the best expert on the research of tepuy in Venezuela (he performed about 150 expeditions here!), for the first time on 11 th January 2002, during the flight above one of the plateau of the dismantled massif of Chimantá (1470 krn). After the analysis of the flight photographs by stereoscope and after another posi-tion determining flight, then they finally entered on 27th February 2004, together with a group of 11 friends, as the first humans in the history at all, to a giant cave, and then (on 28th February) they passed approximately the first two kilometers, where they were stopped, as they were not prepared for such dimensions of the cave, the 40 m long and relatively deeper lake (Lago Chayo) stopped them in further proceeding. In the group under the leadership of Ch. Brewer-Carías, there were: Ch. Brewer-Capriles, F. Mayoral, A. Tovar, L. A. Carnicero, F. Tamayo, A. Chumaceiro, E. Wallis, A. Chacón, C. Barrio, R. Guerrero and F. Delascio.

The next already very well organized and unusually successful action was performed here not much later, in the days from 28th May to 2nd June 2004, while at this action when Cueva Charles Brewer completly mapped in the length of 4482 m and with the altitude difference 110 m (Šmída et al., 2004, 2005a, b, f), again under the leadership of Ch. Brewer-Carías also participated: Ch. Brewer-Capriles, F. Mayoral, L. A. Carnicero, J. Brewer, photographer M. Audy and B. Šmída.

For now the latest, this time very numerous, 25 member multi-disciplinary Venezuela, Slovak, Czech natural-science and speleological expedition was performed to this area (again under the leadership of Ch. Brewer-Carías and B. Šmída) relatively not long ago, in the days from 6th-17th February 2005. Also this was exceptionally successful and we are just processing now the wide results, knowledge and the samples obtained.

Cueva Charles Brewer is a spring in fact, with the entrance that has enormous dimensions (30 × 120 m!) in some kind of amphitheater valley. The main branch of the cave is up to 50 m wide, already at the beginning. However in spite of that (from the reason

Gran Galería de los Guácharos has volume 320 000 cubics photo: M. Audy



of barrier of huge blocks being at the entrance) in the time of strong rains during few hours a lake can appear here up to 200 m long, 7-8 m deep, which is like half-siphon (or a real siphon?). The entrance to the cave is closed then, and it is better to be outside in that time... At the time of absolutely dry weather at least 300 l/sec. flows through the cave, otherwise however commonly 500-800 l/s. We suppose that at the sudden inflows of water the capacity of the river floor can take much more (maybe up to 20-30 m^3 sec.!!), the traces of corrosion at the walls from water, and the first speleothemes preserved and growing (also in wide passages!) show, that the level is even 8-10 m above the basic flow level. Because of the huge dams formed by the fallen blocks, surely big and deep lakes are created along the whole cave passage in that time.

In the cave two types of galleries appear and they repeat relatively regularly: 1. dome-like (width 40-100 m! height is 10-40 m, with huge asymmetrical debris areas; they are hard to pass, the walk through the cave to the end and back with some light equipment can take several hours), 2. canyon-like (width 10-15 m, height 15-20 m, which have the river flow in the whole width; therefore these are dangerous places during sudden water inflows). There are some super-dome widening areas, with the volume commonly more than 50 000 m^3, and more places with above 100 000 m^3 (for example enormous oval hollow Planetario, 90 × 150 m). The biggest space of the cave is 355 m long, and up to 70 m wide portion of the passage Gran Galería Karen y Fauny, with the calculated volume of about 400 000 m^3. It is the biggest natural underground space in Venezuela, and the biggest underground quartzite chamber in the world. (For the comparison even the smallest passage profile in Cueva Charles Brewer reaches 5 × 15 m!)

There are turbulent waterfalls in the cave (highest, Cascada de Eslovaquía, is 5 m high), and the forms of the underground quartzite corrosion which are possible to imagine (mantels, lake ??? and cave "pokemons", rock bridges, selectively separated columns, "ojos de cristal", lateral flood floors), as well as various fillings (for example sandy beaches). There is a unique diversity of the speleothemes:

Waterfall Cascada Vanessa photo: M. Audy

Champignons, Muňecos (Puppets), Carrots, Guácimos... (Brewer-Carías, 2005, in press). This classification and typology has it's reason, because each of the mentioned types was created in a different way. For example, the big hard white balls (diameter up to 15-30 cm), in the form as if "mushrooms" or "footballs" are created as alive(!) accumulations of Cyanobacteria (Aubrecht et al., 2005, in press), creating in aphotic conditions big wall colonies (after the lithological hardening of their growth layers opal stromatolith appears). Another researcher (Marcano et al., 2005, in press) has found other autotroph and undescribed symbiotical organisms... Other speleothemes of coral shapes appear as a result of drafts, with heavy aerosol and at the same time there are places with culmination of the organic material by spiders building their webs everywhere.

Also the initial proto-channels of the cave Cueva Charles Brewer were created at interlayer and hiatus predisposition (for example the old beach scallop surfaces) of the quartzite sandstones. These could be created at least from the Cretaceous period, so it is a very old cave. So, it is in fact accidental connection of two big hydrological drainage areas and at the crossing point the enormous entry collapse appeared. The cave passages of Cueva Charles Brewer are about 100-150 m below the surface. Their basis is created by much silicate containing ortho-quartzite mass, and the widening of the passages to 40-50 m appeared at the somehow rhythmical position of the more soluble silicates with belts, which is about 10-12 m thick. The enlargement of the passages to the height then appeared after the lateral widening, and by the consequent collapse of the ceilings (or better said by the side breaking of the huge masses of the rock) and by the attacks of the water at the turbulent water conditions, to the displaced fragments (Šmída et al., 2004, 2005a, b, c, d, e, f).

In this exceptionally valuable cave, the discovery of which can be compared to the discovery of the highest waterfall of the world, Salto Angel, we performed during the last expedition intensive scientific research – making geological profiles of the walls, connected with taking and analyzing samples, hydrogeochemical studies, climatological observations and analysis of the air, watching the hydrological regime, we performed also detailed mapping (the mapping of the cave and drawing the map was in the scale 1:1000), we created morpho-genetic model of the development of the cave, we picked up rich cave fauna: the giant up to 8-12 cm long scorpions of *Broteochactas* genus, which are relatively abundant here, and everywhere in the cave(!), troglo-bionte bugs, big cave crickets *Hydrolutos*, probably new species of cave leech, *Isopoda* and so on. The results of this expertise and very complex research are just being processed now, but they will be published soon.

ANOTHER NEWLY DISCOVERED CAVES OF THE MASSIF OF CHIMANTÁ

During our common expedition in February 2005 (all the authors of this article participated in it) at the plateau Chimantá, we explored also further big caves, which might have some connection with the hydrological system of Cueva Charles Brewer:

1. Cueva del Diablo (Devil's cave). This cave complex is created by the central abyss-like collapse (80 × 200 m), -80 m deep, from which some robust tunnel passages lead to all directions. To the North, approximately 500 m long fossil gallery, with average profile 30-40 × 15 m, ending by dome-like cavity, with 80 min diameter, 60 m high, reactivated by the river at the South, giant corridors, 50 × 20 m in profile, at one place almost 80 m wide. There are up to 3 m long(!), very massive stalactites, built by organic material, "mouldy and bacterial" speleothemes, or fossil "mushrooms". The system is 2,3 km long for now.

2. Cueva del Caňon Verde (Green canyon). Prom the enormous collapse, -80 m deep, there was explored dimensional tunnel-like gallery to one direction, 800 m long, and locally up to 30 m wide. We did not explore the continuation to the opposite side yet. The lower end of the gallery is closing by the peripheral area to Cueva del Diablo.

3. Sima Noreste (North-East abyss). It's enormous lengthy collapse-crevasse (so called *grieta*) has the dimensions 400 × 60 m and the explored depth is -130 m for now. There was evident a deep continuation here, at least to -170 m. Still the hypothetical basis was not found, where the source of the main river floor of the branch of Cueva Charles Brewer could be expected.

THE PERSPECTIVES

By our discoveries at the plateaus Chimantá and Roraima the view on the style of karst creation in the quartzite and on the underground potential of similar massifs of table-mountains is changed principally.

The cave Cueva Charles Brewer was prolonged to 4732 m by some short progress against the flow at the end of the main gallery, as well as by finding of the continuation through the collapsible end of Gran Galería de los Guácharos connected with the surface.

But in the potential underground hydrological drained area of Cueva Charles Brewer it was explored by us altogether more than 8 km of the cave passages, crevices and abysses (Šmída et al., 2005). By connecting them, which is really supposed, plus by the discoveries and explorations of the new caves, which have entrances (and mainly some access to them) that we already know, it will appear unprecedentedly and for long time the biggest known karst system in quartzite. It depends on the next expeditions how fast we will get to it, and we are already planning them.

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Lukina jama-Manual II (-1392 m), Slovačka jama (-1320 m), Meduza (-707 m)

and the share of the Slovak cavers at discovering some of the deepest abysses of the world and of underground super verticals in Velebit (Croatia) in the years 1990-2004

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***Abstract**: Directly along the beautiful Jadran riviera there is more than 150 km long mountain area of Velebit, of which not an extensive territory at the North, the limestone wildness, where there are huge holokarst mega-depressions and karst pits, it became in incredibly short time literally a world term in discovering more than thousand meters deep caves, mainly with immensely deep shafts and verticals. What is less known, and what is necessary to emphasize, is that on the exploration results of this area is considerable, if not the substantial share of young members of Slovak speleological society (SSS), who started with the systematic works, basically as the first ones (since 1990) and since then they performed 14 expeditions to here, inject with fantastic results. By this contribution we would like to introduce to you the objective history of the first discovering of the deepest caves in Croatia, the systems Lukina jama-Manual II (-1392 m) and Slovačkajama (-1320 m), which belong also to the deepest of the world, and also the look at the discovery of the abyss Meduza (-707 m), with it's giant underground shaft, at least 450 m deep, whick is the second deepest underground shaft of the world.*

ROŽANSKI AND HAJDUČKI KUKOVI

Velebit culminates with it's height at the south, with the point Vaganski vrh (1757 m). But also in the northern wildly dismanteled limestone zone of this mountain area, the peaks reach relative heights from the sea level more than 1650 m. (The highest peak here is Gromovača, 1676 m.) This amplitude is at the same time the possible potential of the altitude difference of the not so long ago discovered, more than 1 km deep, and to all that immensely vertical cave systems: significant part of the massif is build by Jurassic limestones and by carbonate Paleogene cover (Jelar-breccias), it is drained by huge springs in the sea under the sea level (so called *vrulje*).

The central part of the northern Velebit, not an extensive territory (18 km^2) where two partial massifs Rožanski kukovi and Hajdučki kukovi, seem to be the most perspective from the speleological view. Their most characteristic feature are huge depressions (it could be said collapse areas), commonly with the depth over 100 m and with the diameter more than 200 m. In the massif of Rožanski kukovi there is about 60 of such huge mega-depressions. They are ended by extensive block areas at the bottoms, in the areas of significant thermal inversion there is snow cumulated during the whole year. The interior of the depressions is often complete holokarst, it is hardly penetrable, often with vertical walls between the levels. The external edges of the depressions are covered by spruces or by impenetrable scrub. The individual depressions are separated from each other by cone-like peaks, walls, rock towers, or by compact cones (*kuk, toranj*), while 50 of them is higher than 1600 m. From the microforms there are groovy scarps here, often perfectly created.

The carbonate bedrock in this area is strongly damaged by the tectonics. The most often vertical faults are evident directed NNE-SSW. Just on these ones the intensive corrosion took place (and is going on), there was created enormous number of slots, cracks and abysses, from which there is explored maybe more than 250 today. The overwhelming majority of them is relatively not deep, couple of tens meters, ended by icy or snowy enclosures. But few of them belong not only to the deepest in the country, but also to the deepest all over the world.

A view on the Rožanski Kukovi, photo: I. Demovič

For these abyss cave systems the deep, relatively homogenous but mainly direct shafts and verticals are typical, which are close to each other, often separated from each other only by narrow rock barriers and by windows, or connected with each other by curving meanders. There are also huge domes in the abysses. The underground shafts are mostly without calcite decoration, but almost always in the zone which is close to the surface (100-200 m) they are very strongly filled with ice (icicles, monoliths), and therefore they are also really dangerous. The exploration is also limited by the season: in the top summer, when theoretically no rains can be expected, eventually in the winter, however in the winter there appears the problem with the access to the area.

The abysses and the systems in the northem Velebit are of significant alpine character, with low temperature (from minus to maximum 3-4 °C). The exploration of the deepest of them required connection of bigger teams of experienced cavers and speleoalpinists, as well the exploration demanded establishing remote underground camps.

THE FIRST EXPEDITION OF SLOVAK CAVERS TO VELEBIT IN 1990

Slovak cavers were present at the territory of Rožanski and Hajdučki kukovi since 1990. Until then it was almost completely unexplored area. Though the entrances to some deep abysses are visible literally from the tourist paths(!), nobody neither visited them, nor explored them. The only explorative activities until this time were only short journeys of the cavers from the Croatian speleological club "Ursus spelaeus" who in 1980 and 1981, in the area of the peak Crikvena (1641 m), explored several abysses, the deepest ofthem (Crikvena 1) to -120 m (Ostojić, 1999). Beside this the huge collapse area of the cave Vamjača was known here for a long time (after our explorations in 1996 it was explored up to the depth -120 m) and the tiny abyss filled with ice next to the road, called by the local meteorologist from the Zavižan station, Vukušić jama.

Our first 12 days of actions from 4th to 15th August 1990 where participated (it could be said the pioneers of the discovery of this worldly known speleological terrain): Branislav Šmída (the head of the actions), Zoltán Ágh, Erik Kapucian, Marcel Griflík, Mário Vrábel and Igor Poláček (our average age was only 19 years in that time!), brought in that time mainly introduction knowledge and unexpected perspectives (Šmída, 1991): in the massif Rožanski kukovi we did recognizant actions to already known abysses around Crikvena, but we did discover also new ones, from them the deepest for now became the abysses Platňa (-96 m) and in the huge 150 m deep depression Jerković dolac, directly on the opposite side from the little cottage Rossijeva koliba, there was Punoleda uniquely filled with ice (-157 m; in the year 2001 we did recognizant action here after more than 10 years). During one day of this pioneer expedition on 9th august 1990, we in a group of five visited also the virginal territory of Hajdučki kukovi, while by the descent from it's logical peak (in 1650 m) we got into the terrain (B. Šmída and M. Griflík) some 150 m from the entrance to today's system Lukina jama. Of course we did not even anticipate it in the time...

The pioneers of caving in North Velebit Mts, lover from the left: B. Šmída, E. Kapucian; upper from the left: Z. Ágh, M. Griflík and M. Vrábel

LUKINA JAMA – MANUAL II (-1392 m)

The massif Hajdučki kukovi was before our first visit in 1990, in spíte of the incredible possibilities absolutely untouched by the speleological means. In addition, what is paradox, one of the first entrances which we localized here, was the lower entrance to the tenth deepest cave today...

It was 28th September 1992, when we during the second expedition of Slovak explorers to Velebit, the group of five: Zoltán Ágh, Stanislav Gajdošík, Marcel Griflík, Erik Kapucian and Branislav Šmída, started from the hollow basin Lomska duliba, basically "blindly" during intensive rain, to NE slopes of the massif, and here, in the oblique step-like area scratched by scraps, in the altitude 1438 m, we found huge crevice well, where the thrown stones fell with-out hearing the sound... and where

we could see at least 80 m into the depth. On 29th September for the first time E. Kapucian abseiled into this shaft. On 30th September he repeated the abseil together with J. Meluš and with S. Gajdošík and they proceeded up to -145 m. As the autumn rain season was culminating, we determined the further exploration again to 2nd October (Z. Ágh, S. Gajdošík, B. Šmída and E. Kapucian), when we reached the depth -240 m, pendulating to side snowy meander. Under us a never ending abyss appeared, at least 200 m deep... however after exploring the abyss we did not continue exploration at this action. Strong rains ejected us from the mountains, with flowing dangerous waterfalls underground carrying pieces of broken ice. This fact discouraged us. Neither the last abseil on 5th October 1992 (E. Kapucian, Z. Ágh, S. Gajdošík) was not more successful – the explorers were caught in the depth -230 m by such an intensive sudden stormy inflow, that they hardy climbed out of the abyss... (Šmída, 1993, 1996).

We informed the local cavers from the club Željezničar, on the way back through the city of Zagreb, about finding the perspective abyss, which we assigned technically as S0.1 and we named it as Manual (or Manuál). These cavers came here during the next summer in July and August 1993, then they organized national expedition, where about 60 cavers from many Croatian clubs participated. Because the abyss Manual continued quite freely and at the same time immensely vertically, the depth -1355 m was reached very quickly by the help of two bivuacs in -748 m and in -958 m (in huge dome 50 × 100 m).

We leamt about this action and about the unbelievable progress in fact accidentally, just at our passing through Zagreb in the autumn 1993, when we planned to continue in Velebit in the started explorations. It was a real surprise for us... The abyss Manual was at the same time renamed by the Croatian cavers to Lukina jama, by O. Lukić, who died in war.

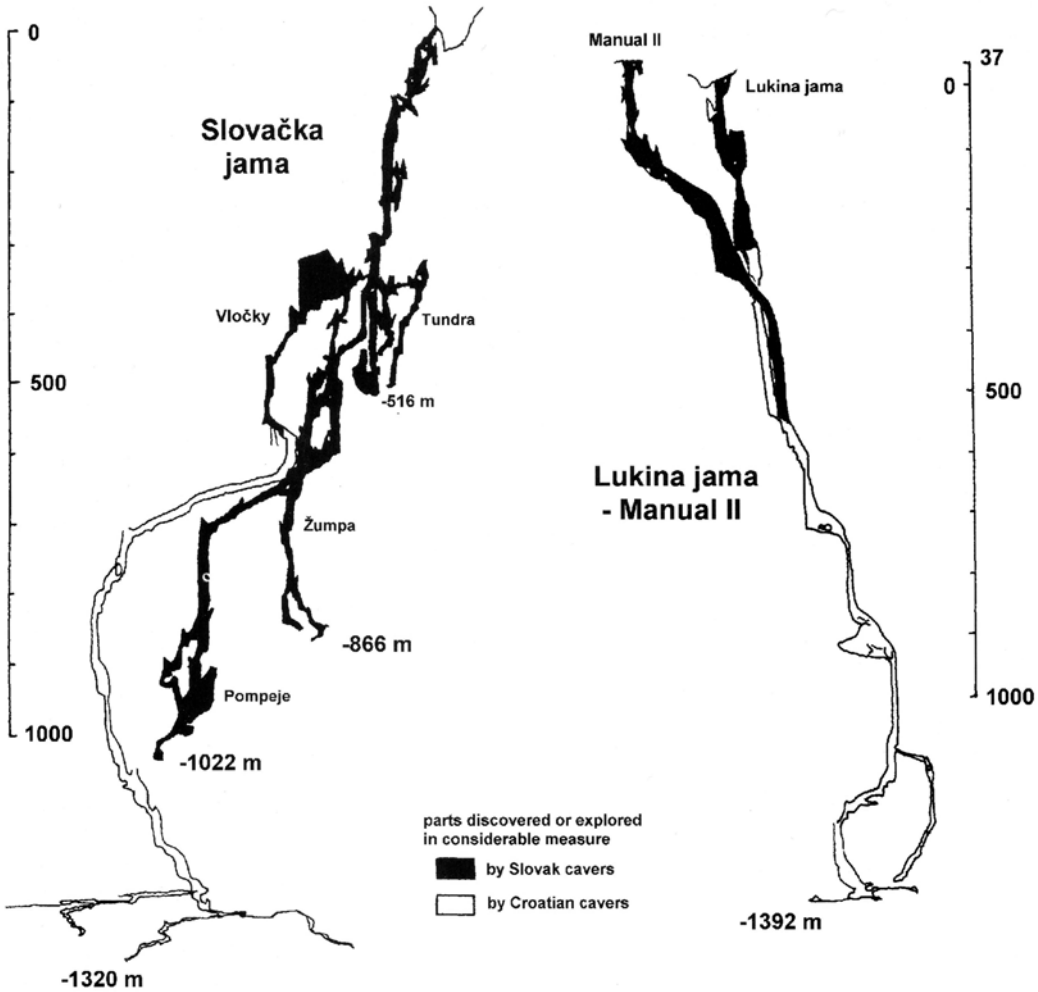
However it could be said that our Slovak team managed to make an excellent tricky success just at the expedition in the next summer 1994. By the entrance which we had known from two years ago (it was discovered by Erik Kapucian and by Branislav Šmída, on 4th October 1992), in the altitude 1475 m and about 120 m from Manual (Lukina jama) to SE, and we had assigned is as SO.2, we managed to deepen the system, in fact by the higher branch, the common system got deeper up to -1387 m! As the first ones abseiled to this location, named for certain symbolic as Manual II, on 23rd July 1994 Z. Ágh and M. Griflík, they reached the depth -190 m. After 5 days of exploration we then managed to lower at the end of 160 m deep Monzúnová šachta (Monsoon shaft), up to the depth -582 m, where on 27th July 1995 the trio Z. Ágh, M. Griflík and D. Kotlarčík found the connection to the shafts of Lukina jama (Šmída, 1994a, b, c, d).

(Next to this we would like to emphasize that though the Croatian cavers sometimes call the branch Manual II also as Trojama, it is not correct, neither ethical, because none of them, during the first explorations, and in fact neither till now, did visit the cave, neither passed through it. It should be thus used the correct name and also by us fully accepted name of the common system: Lukina jama – Manual II.)

During the same expedition in 1994 we helped to Croatian cavers also at the exploration of the branch of Lukina jama itself, by the work progress (transport of the material for diving) by the lower entrance to the system, 1355 m deep, up to the lakes and siphons at the bottom (1 st-3rd August 1994, the group of five: Z. Ágh, E. Kapucian, M. Griflík, B. Šmída and J. Vykoupil). After the diving of T. Barišić and Z. Stipetić the system Lukina jama – Manual II became -1392 m deep (Jalžić et al., 1994).

SLOVAČKA JAMA (-1320 m)

The entrance to the second cave in Velebit, which is more than one kilometer deep, discovered by Slovaks, we found on 28th July 1995, by the duo Branislav Šmída and Marcel Griflík. The entrance is positioned in the altitude 1520 m, not far from the cone elevation Mali kuk (1565 m), the relative altitude is about 250 m from the meadowy hollow basin Veliki Lubenovac, where the basic camps of all the expeditions were since 1995, while exploring in the close area. The entrance is little bit untypical for the Velebit conditions: it lays in the side wall of the depression and it‘s introductory, not big collapsible zone, did not tel1 the appearance (except the strong pulsating draft) that this could be once some exceptionally deep system... On the 29th July the same duo, B. Šmída and M. Griflík, removed from the entrance squeeze (Fučák) couple of boulders and abseiled to compact vertical Pokojná (P55). The cave led freely only to -96 m in the time. On it‘s bottom there were however two narrow branches with evident draft and pizolits. At first we decided to dig in the higher branch (with the help



of an ascender as a shovel), but after pulling out big blocks from the meander of the lower well Grepová (P11), finally at the third day of the exploration (30th July), the lower narrow allowed some progression (participants of the probing: Z. Ágh, M. Mišík, K. Kýška a M. Griflík). The spaces then misled us incorrectly down, to the blind meander and even the exploration of the window in the hall above was not successful... Just on 31st July 1995 the group in the composition:

E. Kapucian, M. Mišík, K. Kýška and B. Šmída, widened another narrow passage above S5, and E. Kapucian and B. Šmída pushed themselves through ascending edges of the meander, to the position above the huge 194 m deep well (Cez celú zem, Through the Whole Earth). The preliminary bottom of the cave, in the depth -516 m, was reached then by the duo E. Kapucian and J. Vykoupil, on the 2nd August 2005. At the mapping of the lower giant well of the location, named Poseidon (direct vertical P213) on the 4th August B. Šmída noticed an important window, which he estimated as a perspective one for the further exploration. The new deep cave was named to the credit of our explorers as – Slovakia (Šmída, 1996, 1997a).

One year later as the Croatian cavers recommended to us to change the original name of the location to the new one – Slovačka jama (what we accepted), we organized another very progressive expedition to the cave. The mixed team was formed from 14 Slovak an 7 Croatian explorers (who performed 78/13 abseils altogether). The breakpoint was already the third day of the expedition, the 22nd July 1996, when J. Vykoupil

and Z. Ágh did traverse to the window mentioned before, and they discovered there some whole maze (Koridor) of big domes and more abyss branches. We then based an underground camp, in the depth -360 m, from where the pairs of the researchers started every day to the two sub-branches (so called Črevo-Intestine and the branch of Kankula). Though in the branch of Kankula, where the two brothers J. Kankula and M. Kankula widened the narrow little window, with the help of a drill and bullets (Vločky), our explorers stopped above in fact free continuation, above the great meander with an echo (the deepest point about -600 m, J. Vykoupil and M. Sova), they did not abseil deeper, because we needed to support our team in the neighboring branch. In the other branch, after some days, we managed to pass through lengthy and pretentious narrows (Šaleny meander, Crazy meander) and we managed to abseil under the next enormous vertical, Patkov skok (PI 70), on the 3rd August 1996, up to the depth -1000 m (D. Kotlarčík, J. Vykoupil, B. Šmída and M. Sova), where a huge oblique dome Pompeje was discovered (Šmída, 1997a, b, c; Bakšić, Šmída, 1999).

On our expedition in 1998, the Croatian cavers continued in the exploration of the branch of Kankula, where they managed to abseil from -600 m to -1268 m. We, as the Slovak team deepened the branch Črevo to -1022 m (J. Stankovič, J. Kankula, B. Šmída and M. Griflík), while the second remote bivouac was placed in the depth -1000 m, and we explored also the side shafts around the first camp, where we reached -504 m in the branch Tundra (Bakšić et al., 1999).

We concentrated our efforts during our last expedition till the next time, which was allowed to us to perform in 1999, to the branches of Hermanova studňa (reached depth -530 m) and Žumpa, the continuation of which was found directly under the bivouac I. by M. Sova. (Originally it was "the place where we left the remains of our metabolism..." at the bivouac I.) Here we reached the depth -850 m (on 4th August, P. Medzihradský, M. Griflík), and - 866 m (5th August, J. Ondruška, B. Šmída). In this branch there is another great shaft created, 156 m deep Adriána (Šmída, 1999).

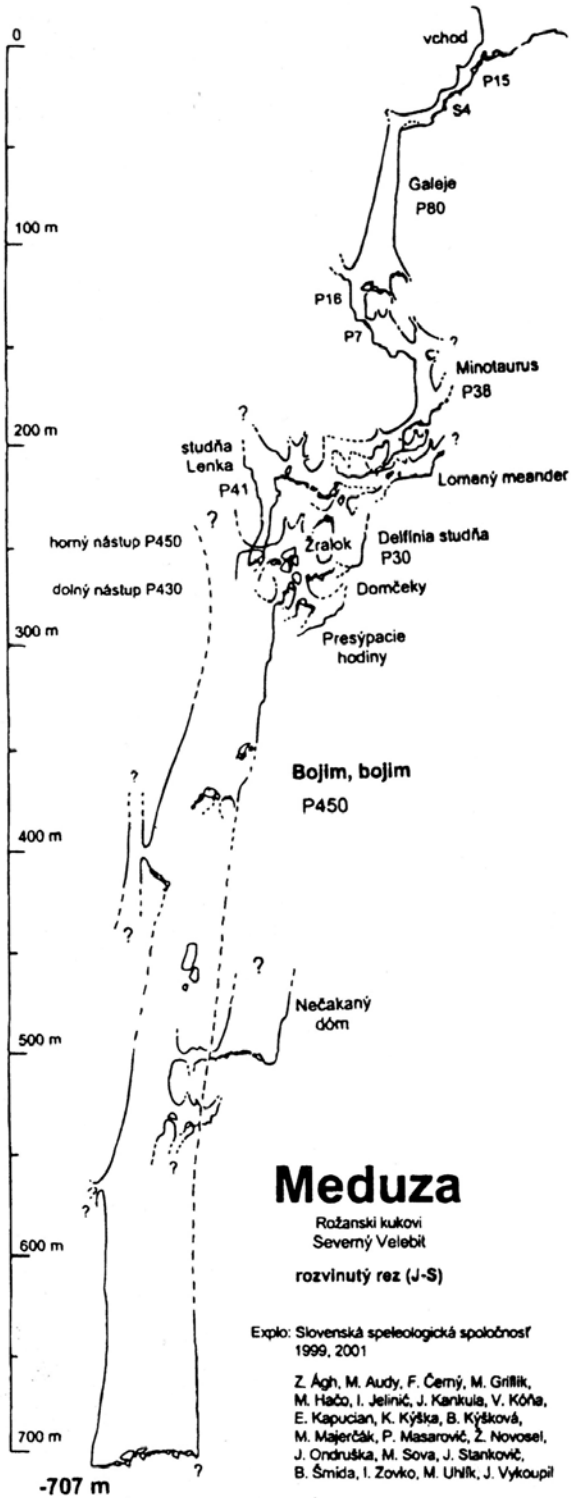
Slovačka jama has the total depth -1320 m today, which was reached by the cavers from Zagreb in the summer 2002, at the bottom of the Kankula branch. It is necessary only to remind that thanks to the endurance, high enthusiasm at the widening of the rock narrows, finding the decisive points and generally to the whole effort of the Slovak explorers, who discovered about two thirds from today's extent of the location, which is more than 5,5 km(!), and that because of that, Slovačka jama today still belongs to the twenty deepest abysses of the world... It's name is thus absolutely truthful and for us it is the best, fully deserved reward.

MEDUZA (-707m)

This cave, today the 4th deepest cave of Croatia, was also discovered, the first time climbed and in fact completely explored, almost exclusively by Slovak cavers. The entrance to Meduza (by the way quite resembling to the entrance of Slovačka jama) we found on 28th July 1999 by the duo Branislav Šmída and Jozef Ondruška. The entrance is situated at Rožanski kukovi, couple tens of meters from the touristic path Premužićeva staza, in the side of not a deep depression, in the altitude 1580 m. The first abseil to the broken entry little shaft of Meduza, to the depth about -30 m, was performed by M. Griflík during the same expedition. The progress was blocked there by a squeeze, from which however some intensive draft blew.

During the next pretentious winter expedition we widened this squeeze with the help of a drill and bullets in the days 16th – 17th January 2001, in the composition: J. Stankovič, V. Kóňa, M. Griflík, B. Šmída, E. Kapucian and Z. Ágh (all six from Slovak speleological society), while B. Šmída abseiled further through dimensional shaft (P80), where at it's bottom, after short raking among blocks, he got to position where he was above another smaller step (P7) in the depth -145 m, where the cave evidently continued by the hall-like widening and by the black crevice.

During the next summer, during the complex expedition we continued in the detailed survey of the abyss Meduza (as the original work name we usedat first also the name "The second"). On 7th August 2001 B. Šmída and K. Kýška abseiled to -200 m. The first one managed to pendulate at the bottom of the impenetrably narrow shaft to a window and he managed to climb from there through some pretentious squeezes to the beginning of some meander with long echo... The next progress was performed on 8th August by the Moravian photographer M. Audy, who continued alone through the narrows to the labyrinth of passages and lower areas behind the Žralok meander, up to depression collapse halls (Domčeky, Houses) in -260 m. F. Černý with K. Kýška on 9th August found in the



narrow of the bottom of these halls the entry to a very deep, well... On 10th August this, really immensely deep, and somewhere really big-profile (up to 15-20 m) well was passed through for the first time by J. Ondruška and by P. Masarovič, who used about 300 m of ropes in it, but in spíte of that they did not hardly see any bottom... The abyss was called for it's enormous dimensions as "Bojím, bojím", or I am afraid, I am afraid (Šmída, 2002a, b).

The bottom of this monstrous shaft (in the profile up to 15 × 50 m!), which is also the definitive bottom of the abyss Meduza in the depth -707 m, was reached the first time by B. Šmída and by K. Kýška, on 11th August 2001.

During this actions we performed also the making of a remote bivuac at the bottom of the abyss: M. Griflík, J. Ondruška and M. Uhlík, who tried to probe in the debris of the bottorn, but without any success, and on 15th August B. Šmída with P. Masarovič pendulated to the windows which were positioned somewhere in the depth under -500 m. These windows were later explored by M. Sova, again with the assistance of P. Masarovič (16th August), when the bottom of the parallel well Nečakaný dóm was found. In the same day B. Šmída and F. Černý found the higher entrance to the well Bojím, bojim.

Croatian cavers with the assistance of the French cavers re-explored the abyss Meduza in the year 2003. However without progress further to the depth, neither in other aspects this numerous action to the abyss Meduza, reportedly of 59 members, did not bring any remarkable progress. (The participants reportedly did not even find the upper entrance to P450 Bojim, bojim.)

The shaft Bojim, bojim (P450) is today the second deepest direct vertical inside a cave in the world. (In the time of the discovery it was even the first one.) The deeper one is only the shaft so called Divka Gromovnica (P513), which was found in the abyss Jama Velebita (-580 m), accidentally just in the neighboring massif Crikvena, by the cavers from Zagreb in 2003.

However! Above the upper entrance to the well Bojim, bojim (the lower has the vertical P430 deep) there is a high chimney (in fact a shaft, just aiming upwards...), where it is possible to illuminate it at least further 30 m to plus...

SIRENA (-281 m)

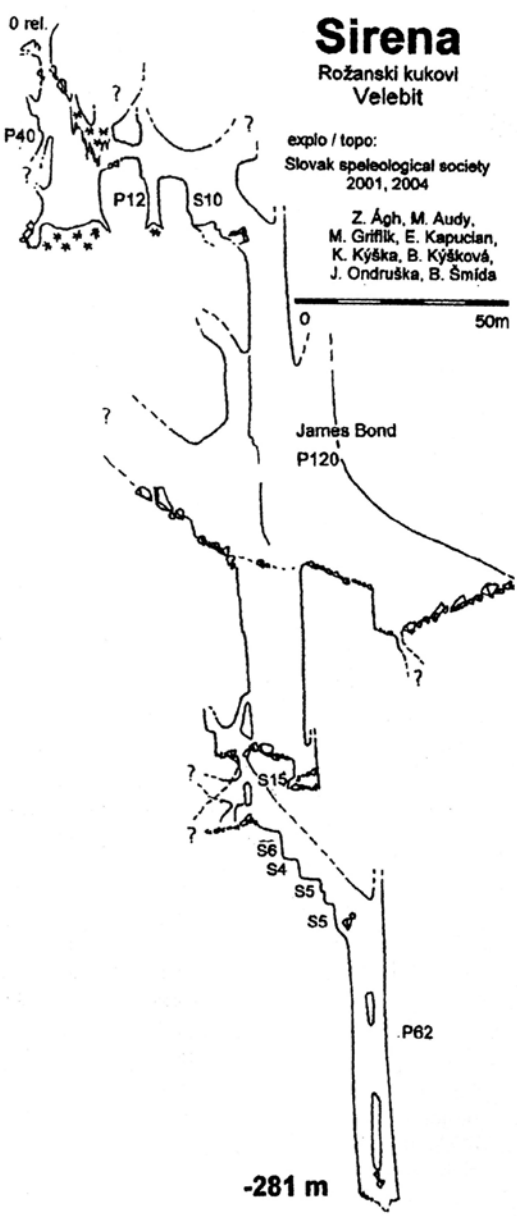
Also the entrance to Sriena this was discovered by Slovak cavers. It was 13th August 2001 when B. Šmída climbed through one of the depressions of Rožanski kukovi and he got to some kind of valley where there was cold air flowing out of there and where some more alive moss grew. (By this moss the work name of the location was "Moss slope"). The first exploration was done here by B. Kýšková and K. Kýška, they abseiled only to about -30 m. More serious exploration of this location again by the team composed almost exclusively from Slovak cavers (Z. Ágh, M. Griflík, E. Kapucian, J. Ondruška, B. Šmída, plus the Moravian caver M. Audy) was performed during the next pretentious expedition in the days 5th-8th January 2004. The bottom of this abyss was reached in the depth -281 m by J. Ondruška, on the 7th August (Šmída, Audy, 2004).

LEDENA JAMA (S.U.K.)
U LOMSKOJ DULIBI (-536 m)

In 1992 we found at the bottom of the hollow basin of Lomska duliba also extensive cave depression (50 × 60m). This abyss was preliminarily explored before us, longer time ago, however only into the depth of -62 m where the progress was blocked by the icy filling. However we found holes and passes in this icy cone melted after time by the draft and so on the 6th October 1992 the trio Z. Ágh, I. Ághová and E. Kapucian abseiled even deeper, to about -90 m, to the place where there was a huge deep well with an unknown depth... This 180 m deep shaft, somewhere over 20 m wide in profile, was penetrated by the duo Z. Ágh, M. Griflík (on expedition 1993). There is a huge dome down there, 50 × 80 m, with the ceiling impossible to illurninate, and at it's end there was a series of smaller wells, where we reached the depth -432 m, during this action, after three abseils, on the 18th September by the group of four M. Griflík, Z. Ágh, L. Plučinský and B. Šmída (Jalžić et al.,1994). The abyss was reexplored later by cavers from Karlovac, who in 1996 penetrated through the bottom narrow to another well (P63) and they introduced the final depth -536 m (Jelinić, 2001).

OTHER REMARKABLE RESULTS
OF SLOVAK CAVERS IN VELEBIT

Another important location, which was discovered and explored by Slovak cavers at Rožanski kukovi (partial massif Vratarski kuk, 1676 m), is also the abyss Xantipa, -323 m deep (Šmída, 1994a). It's unusualy great entry, in the form of giant megadepression with the outer diameter almost 300 m and depth 150 m was found on 23rd July 1994 by Ján Vykoupil and Branislav Šmída. The abyss in which there is the well 210 m deep, dangerously covered with ice, was explored by us in 1994 and in 1995. Another interesting abyss named Marianna (-250 m) was found by Erik Kapucian and by Croatian female caver Sanja Cirić. In the year 1996 the brothers J. and M. Kankula widened some narrows here, and so they made available the pass to the 210 m deep shaft, which had the diameter



almost 30 m at the bottom. The bottom was reached on 23rd July 1996 (B. Šmída, J. Kankula). The other relatively deeper abysses in the reservation Rožanski and Hajdučki kukovi, which were discovered by Slovak cavers, and which we did not mention yet are: in the year 1992 – Pavúčia (-112 m); 1993 – Brutál (-108 m), Dvojvchodová (-102 m); 1994 – Uhu (-111 m); 1995 – Obor (-124 m), Hnedá (-101 m), Pri dvoch smrekoch (-100 m).

Until today Slovak cavers, members of the Slovak speleological society from more clubs (mainly however from the Speleoclub of the University of Comenius Bratislava) explored about 150 caves and abysses in the northern Velebit (which is at least half of the total number!!, if not more than half of the number of all the know localities here...). These results were published in the complete monograph (Šmída et al., 1999) as well as in ten articles, in Slovak, Croatian, Czech, French, or English speleomagazines, from which only the most important are mentioned here (in chronological order):

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THE DEEPEST ABYSSES
OF ROŽANSKI AND HAJDUČKI KUKOVI

		Depth	The first year of discovery
1.	**Lukina jama-Manual II***	1392 m	SSS (1992)
2.	**Slovačka jama***	1320 m	SSS (1995)
3.	**Meduza***	707 m	SSS (1999)
4.	Jama Velebita	580 m	SOV (2003)
5.	Patkov gušt	553 m	SOV (1997)
6.	**Ledena jama S.U.K***	536 m	SOŽ (?)
7.	Olimp	531 m	SDK (1998)
8.	Lubuška jama	521 m	SBZ (2000)
9.	**Xantipa***	323 m	SSS (1994)
10.	**Sirena***	281 m	SSS (2001)
11.	**Marianna***	250 m	SSS (1995)

* abyss discovered or explored in considerable measure by Slovak cavers (SSS)
SOV – Speleološki odsjek PDS Velebit (Croatia)
SDK – Speleološko društvo Karlovac (Croatia)
SOŽ – Speleološki odsjek HPD Željezničar
SBZ – Speleoklub "Bobry" Zagań (Poland)

Velika klisura (Gryka e Madhe) in Kosovo - the discovery and exploration of one of the biggest cave systems at Balkan

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INTRODUCTION

At the border of Kosovo, Crna Gora and Albania there is a huge massif Prokletije (Damned Hills) with area about 3 500 km^2. By the geological structure it is a part of the internal Dinarides, while this is not a continuous ridge, but a structure of huge plateaus (Brada, Maja Rosit, Djeravica, Nedžinat and so on), localy with the relative altitude up to 2000 m. Same big portion of the coverformation of Prokletie is built by limestone sequences (mainly of Triassic and Jurassic age) in the nappe position. which are locally altered by the metamorphosis (penetrations of younger volcanic rocks). The highest peak of these hostile mountains, rarely inhabited by shepherds, intersected by steep valleys in Albania is the mount Maja e Jezerce (2694). The plateaus are meadowy in the upper positions, and some groups of peaks and ridges come aut of them, locally with high-mountain holokarst of alpine type.

Directly behind the pleasant Kosovian town Pejë (or Peč, 525 m) which by it's beautiful position at the edge of the hills very much reminds the city of Salzburg under the hills Tennegebirge, there starts a unique canyon:

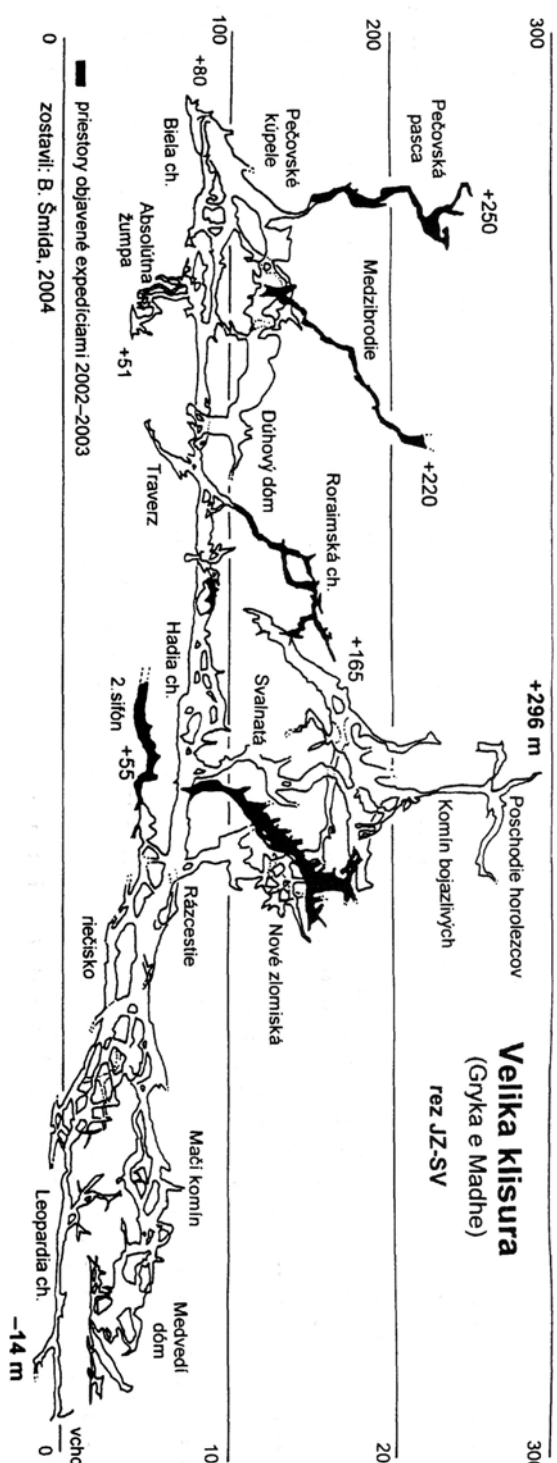
The mountain river Bistrica formed the canyon in the length of 25 km, while the valley is one of the wildest and maybe one of the most fascinating at Balcan, it is called also Rugovska Klisura, it has a character of a huge canyon, with walls up to 800 meters high, locally almost vertical and with towers even 400 m high. Approximately in the middle of this path, where the river cuts the block of the limestones with steps and rapids, there comes out at the Lumbard plateau (cca 70 km^2) significant autochthonous hydrological vein, in the form of abundant lifted spring, which is in fact the beginning of unique cave system. It is today called as Velika Klisura (in Albanian Gryka e Madhe, or Great Canyon) after eight Slovak expeditions of the members of the Slovak Speleological Society. It reaches the lengtlt almost 10 kilometers, which makes it one of the longest at Balcan. Which is more interesting, is that this cave is practically from the entrance above the spring of the underground river continuously leading up. By the difficult climbing proceedings in the chimneys and in the higher levels the relative surpass is for now 310 m. (+ 296 m, -14 m). And this makes this unique cave also the highest at Balcan.

EXPLORATIONS

The entrance to the cave Velika Klisura was localized in fact in May 1992. (Of course, it's visible spring area was known to the local settlers since ever. Group of five Slovak cavers (J. Šmoll, Ľ. Očkaik, P. Holúbek, J. Kleskeň and J. Vykoupil) in that time headed to introductory recognition journey to Macedonia, while at the way back they passed also through the canyon Rugovska Klisura and they noticed evident abundant offspring. It is situated in the left side of the canyon, about 50-60 m above the river, at the heel of surprising rock tower, which is about 350 m high. Up at the plateaus there was still enough snow at that time, which was melting, and the flow of the spring was about 6001/s. The higher water level in that time probably discouraged the explorers from entering to the tract... Though, little bit above, about 5 meters above the offspring, there was found a serious cave corridor, in which the explorers came to lake deepens after some 100 meters. Here they ended the exploration, it is hard to say why. Perhaps from the reason, that they were thinking, that the corridor which was necessary to pass by traverse above the deeper water at some places, would eventually end by siphon (Šmoll, 1995, 1996).

Else in the summer of the same year, on the way to the Republic of Black Mount (Crna Gora), the duo J. Šmoll and J. Vajs with their wives visited the location, but also, though the offspring was this time almost completely dry, they passed through the cave approximately to the same places as in May (Vajs, 1992; Šmoll, 2004).

The breakthrough in the view on the location, which was attractive by it's appearance in sub-con--science of the cavers, happened three years later. On the 29th of October 1995, the group of four cavers, P. Herich, J. Poliak, J. Šmoll and J. Vykoupil



got after the removal of some blocks in the lower so called flood offspring, which was dry again, to a cave with river floor and with siphons after about five hours of work. In the corridor above, in the same day they passed much further... There was no trace of water here and so the discoverers of the cave Velika Klisura entered into it's tract several hundreds of meters. Completly freely, it was just necessary to climb smaller steps from time to time... By the high crevice corridors, as if by some underground canyon they got to the end to somehow muddy semi-siphon, where the draft and the echo suggested some further interesting continuation after eventual digging through. At the main line of the cave they also lowered at this expedition to the underground river and they preliminarily explored some dark and dimensional chimneys and passages heading upwards (Šmoll, 1995, 1996).

The regular and serious expedition, connected wide the further exploration and with the cave climbing, also with the cave mapping, was realized in February 1996. In the group of twelve (As if the "Magnificent Seven"), at pretentious winter conditions (up to -10 ºC) we did bivak in the entrance to the cave, and the barrier in the further proceeding, the semi-siphon, we overcame with the help of plastic pail, in which we handed from hand to hand the water from the pool (in the life chain) and we spilt it into little dams, built from muddy sediments in front of the semi-siphon. Then we entered to beautifully decorated two-level labyrinth of oval corridors, by the direct distance it was 700 meters to the massif, where the cave preliminarily ended by the beautiful green siphons. From the known range, already 6 km in that time, the cave was precisely mapped during five days of the expedition in the detailed scale 1:200, the first 3424 meters were mapped (Šmoll – Šmída, 1996; Šmída – Šmoll, 1997).

Until the burst of the civil conflicts and to the military status in Kosovo and Serbia, which disabled us from continuing in the research because of the fear, we managed to perform else two explorational expeditions, always during the charming autumns, in the years 1996 and 1997. During these expeditions there was lot of mapping and climbing. In the middle portion of the main line of the cave some chimney areas were climbed, which connected again to sub-horizontal levels and oblique passages, no once there was enormously dense network or relatively dimensional passages and also abysses. In the deepest areas of the

Velika Klisura, the Biela chodba, photo: M.Audy

cave, in one chimney, there was also reached the relative altitude from the entrance +296 m and the whole known range of the cave exceeded to 8 km (Šmída – Šmoll, 1998).

After the war we dared to go to Kosovo because of the unclear situation, again just at the autumn of the year 2002. Just in that time we accidentally got to the contact with the local cavers from Pejë, which were enthusiastic about the discovery of Velíka Klisura, we got excellent, more than friendly relationship and cooperation with them. Since then in the cave there was some climbing performed to the other chimney branches, where there was reached relative altitude +250 m, +240 m and +165 m from the entrance, however with the possibilities of further proceedings (Szunyog, 2004; Šmoll, 2003, 2005). At one of these expeditions we already performed an exploration of the siphonal zones at the underground fiver floor (Gliviak et al., 2004). Also some surface prospecting of the plateau began, some smaller abysses were climbed (until now to the depth -75 m) and we also performed the first, very difficult alpinistic explorations of the steep slopes and walls, focused around the entrance to the cave Velika Klisura and preliminarily in fact in the whole limestone zone of the canyon Rugovska Klisura. The explorations are continuing.

THE MORPHOLOGY AND THE GENESIS OF THE CAVE

The cave system Velika Klisura is a typical, directly exhibitional example of partial phreatic zones which are lowering in time.

The passages of the cave are in the higher portions in fact paleo-siphons, with knee like shape, with the height up to 20-30 m. These corridors have oval, often elliptic profiles, they are more homogenous, and often significantly more dimensional than the lower levels of the cave, which have the character of as if continuous underground canyon with quite vertical walls, levels and debris. The higher levels are either without sediments, or with the sandy deposits, in the lover levels there is possible find bigger round stones, which got here by falling through individual passage horizons.

There is in the cave more clear and evidently developed roughly 5 cave levels: the first is the very active river floor. This reaches altitude about 66 m from the entrance. It has a dynamic, locally radical declination, in spite of that, that some bigger waterfalls are not developed. The highest step has roughly 3 meters. It is possible to go to the river floor at several places, by the oblique, steep, pipe passages, by the chimneys and collapsed areas. The area of the active flow was not passed in a continuous way, there are deep siphon pits at more places, it is possible to see nicely here how the today‘s higher levels evolved. The passages around the river floor are smaller, they are often quite rough, with lugs, no once in the form of flat oblique space. Locally there are sediments of colorful gravel.

The higher level, the main tract of the cave has quasi sub-horizontal character, and at the altitude cca +80 m and length 1 km there is only few steps, the higher has 10 m (so called Crossroad). The passages are comfortable here, it is possible to walk in them, they reach 2-5 meters in average, while their ceilings disappear in the darkness and in the crevices.

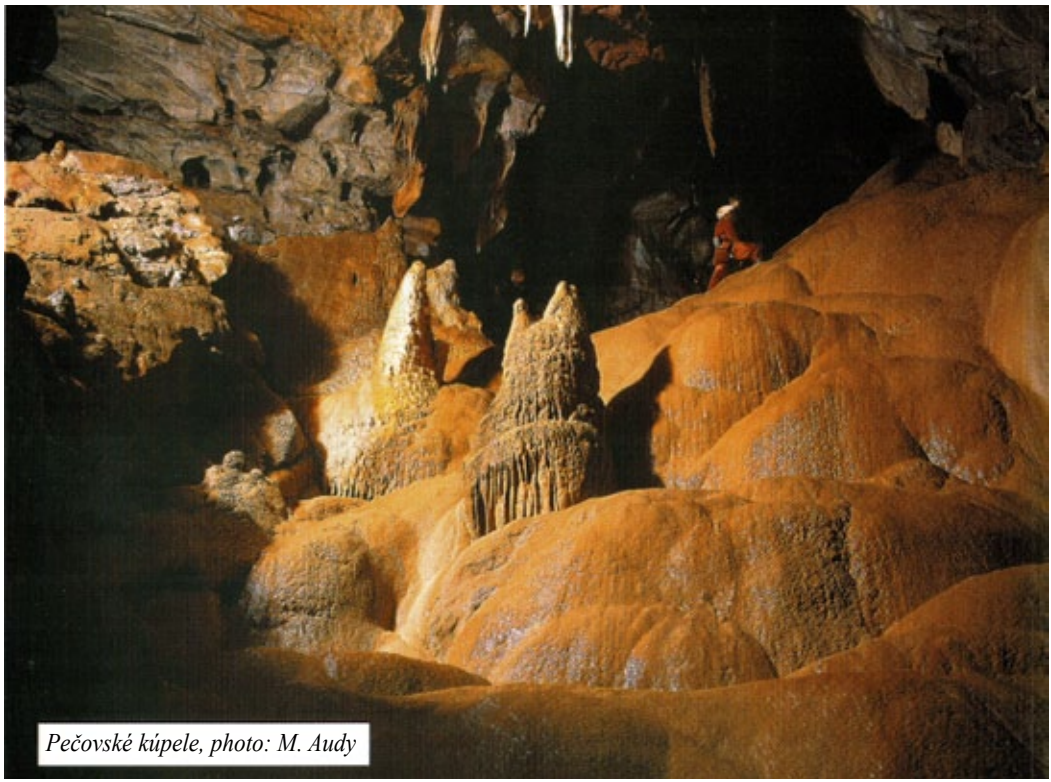
This level, in average 15-20 m above the active flow, it literally copies the level with the underground river. The passages of this level are in the frontal part of the cave (King‘s passage, Crocodile, Bear dome), pipe-like, of paleo-phreatic appearance, relatively dimensional, locally interconnected in a difficult way, up to labyrinth-like.

In the introductory part of the cave these two levels are symmetrically connected by three dimensional “chaos“ of smaller passages and connections, which are not properly explored until today, neither mapped (so called Passages of Rattle Snake). Some uniqe

portion of the cave is also Toboggan, originally phreatic siphon steep stope, where at the lowering of the water level, at enormous water conditions, the water was surely flowing through some rocky barrier step, and created marvelous, steep mooth ravines and grooves, two meters deep and one meter wide (some manger or toboggans).

The very strange fact in the cave is, that while in the frontal part of the cave any sinter decoration is missing (except the draft cave corals at the entrance areas), the further portion behind the Serni-siphon of Militias, is beautifully decorated, perhaps with all possible types of speleothemes, what is hard to imagine in the middle zone between the middle European and Mediterranean conditions in the underground: there are robust pagodas and columns here, up to several meters soda straws, flowstone stalactites and draperies, pile stalagmites, sinter little rimstone dams and lakes with pearls and crystallites. The remarkable things in the cave are mainly the cauldron like dishes, covered with crystals of calcite and clusters of crystals. The other interesting fillings are the sandy concretions with shapes up to balls, in the level above the Rainbow dome. In the entry passages (Leopard's passage) there are blast spots of vermiculite and stains after the fossil floods.

The other characteristic feature of the cave are the oblique spaces which are often with tiny flows. They are more flat, but very steep passages, almost chimneys (with the angle above 60 degrees) which have the bottoms sintered by little rimstone dams. In these chimneys, which drain the water probably also from the surface of the plateau, the flow can increase from deciliters up to 20 times and so we were surprised in one moment by the rustling, up to roaring, quite abundant river, and we worried whether the access semi-siphon in the rniddle of the cave will not be flooded... These active chimneys end usually by the narrows, or with tiny windows, which are necessary to be made wider (by the drills and by the bullets). The progress still higher and further is still possible here and it is very probable that in certain altitude these steep passages accidentally connect with the sub-horizontal levels. Such passages were found and recognized better above the middle portion of the cave, at the height about 150-170 meters above the entrance. The highest horizon in the cave is the Floor of Climbers, at the altitude about 260-270 m above the entry point to the cave.



Pečovské kúpele, photo: M. Audy

The cave Velika Klisura was created in the Middle Triassic limestones, mostly dark-grey, at the base almost purple-red, with little veins, locally marbleized. The position of the lifted offspring from the system is given by the impenetrable bedrock, with the shale of the Lower Triassic. (Up at the plateau we noticed already the Jurassic facies of carbonates, for example motley breccia.)

The system has the most probably clearly autochthonous genesis. The gravel fraction suggests this idea, it is created almost exclusively by colorful carbonates (mica, or tiny sandy round stones can come from Triassic inter-layers.

THE HYDROLOGICAL CONDITIONS AND THE PERSPECTIVES

The lowest level of the underground flow reaches (in the winter time) about 15 l/s. At the increased water level there were observed here flows of 800 or 1000 l/s, and it is possible to suppose that at the enormous water levels the flow of the offspring reaches even 2-3 m^3/s. The cave similarly as many other Balcan or Turkish caves gets relatively deeply to the massif, at relatively quasi small surpass (at the main drainage base). Also here some lifted siphons are created, an interesting inspiration for the speleo-divers.

The greatest abundance of the water in the chimneys was seen at Pejë Baths. After more intensive rain at the surface, which appeared in the cave as a sudden inflow after several tens of hours, here the flow reached 20 l/s.

(The inflows from 5 to 10 l/s then appeared also in the other parts of the cave.) If we consider that in the main river there was about 40 times more water, it is quite possible, that the source of the underground water flow of Velika Klisura forms several tens (!!) of chimney branches, the exploration of which can bring tens of kilometers of new spaces. It is therefore only up to the determination of the explorers, with the experience of climbers-alpinists, or up to the courage of speleo-divers, which will decide to overcome surely 100 meters long and maybe 25 m deep final siphon of the main underground river, whether the unique karst system here will be revealed, with the theoretical amplitude of the drainage surpass is perhaps more than 1500 m.

In a way this cave is an analogy of the deep alpine systems – just this one is known from the bottom, from the offspring.

Acknowledgement: Our sincere thanks belong mainly to our devoted friends, cavers from the Kosovian town Pejë, to Mr. Afrim Kelmendi and Mr. Agim Malje, who prepared for us unbelievable background, arranged the living, food, transport up to the plateaus, or whatever they saw in our eyes.

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Exploration of underwater caves of the Riviera Maya, Mexico 2003 – 2005

Zdeněk Motyčka

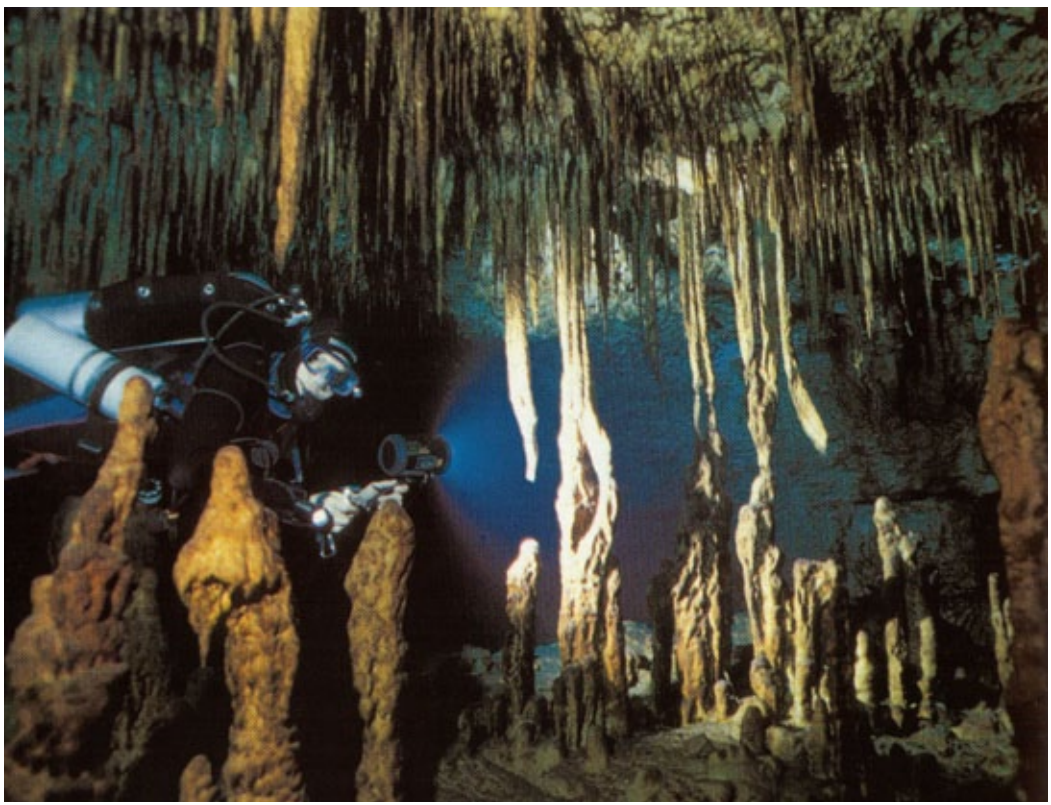
Riviera Maya is a part of eastern coast of Mexican semiisland Yucatan by the Caribbean, in state of Quintana Roo.

The area of carbonates is about 190000 km^2, They are esentially pure, deposited from Paleocen till Pliocen. Uplift of penninsula in Pleistocene predisposed karst platform to dynamic speleogenesis. Oft rains penetrated through the porous surface and created the shallow systems that leaded the water to the sea. In the next period there was another drop of the sea level and it caused the erosion broadened existing caves while eroding deeper passages. In the meantime the process of secondary karstification and collapsing of thin cave ceilings was running through and the cenotes occurred. 18000 years ago the sea started to rise to the contemporary level and these caves were flooded.

Today the surface is absolutely flat, covered with a jungle. There are no rivers, only lagunas and cenotes. Lagunas are big lakes, while cenotes can be small, often hidden behind the rocks. At the seaside there are calets where the fresh water flows to the ocean. Thanks to its attractive location it also became a favourite tourist destination.

The cenotes and caves are the really unique ecosystem. Hundrets species of animals were described in last century.

The first bigger system Nohoch Nach Chich was discovered in 1986 by the team of Mike Madden. It was the beginning of the invasion of divers and many other cenotes and kilometrs of corridors were discovered. At the present there are more then 140 cave systems where 580 km of underwater cave corridors were discovered.



System Ox Bel Ha is the longest cave system in the world with 134 km of corridors. The exploration of cenotes continues up to now by many projects. One of them in second longest underwater cave system of the world called Sac Aktun. The Members of SAET (Sak Aktun exploration team) leaded by Robert Schmittner and Steave Boegards establish that this system is now 77 183 m long. In 1990 The Quintana Roo Speleological Survey was establish by Jim Coke to collect all dates about caves in Riviera Maya.

Several expeditions of Czech and Slovak Speleological Society to the Mexican semiisland Yucatan were proceeded in last two years in cooperation with UNAM – The Mexican National University and QRSS – Quintana Roo Speleological Survey. The expeditions worked in the surroundings of the towns Tulum and Chemuil. First exploration brought discovery of new pasages in cenote Cangrejo, where total 1328 m has been discovered and documented up to now. The most important discovery was in cenote Joolis. The entrance was found in 2002 and 167 m of corridors have been known. During first exploration another 180 m long continuation was discovered and surveid. The following dives brought the discovery of huge, several hundred meter long tunnel "Esperanza". Within the first week more than 1 000 m of new corridors were discovered, while the second week brought the discovery of a new cenote, called Tatich. Totally 2405 m of new passages were discovered, documentated and joined them with other 3 neighbour cenotes – Polo, Hoyt a Chu-rnuch-cho. So the system long 3587m arose.

Later, two new cenotes were found, 600 m far from the end of the known parts of Joolis and 200 m far from the end of the another cave called Ich--Kin. In the first of them, called Nai-Bosch dueto the black walls, huge tunnel 200 m long was found. It leads directly to Ich-Kin. The second cenote brought a big surprise. Near the wall of the spread corridor old Mayan ceramic pot was found. Then the cavers discovered dry cavem with the small island in the middle of lake with the ruins of the stone wall nearby and connected to the cave. All these discoveries were documented.

Also other cenote called Zebra was found. Huge tunnel 30 m wide and 200 m long was found during first exploration. This tunnel leads to another big cenote. Tottaly 1819 m were explored and documented.

Near Tulum new cenote Dos Locos was found, explored and surveid 493 m of new passages there.

Totally 6860 m of new corrridors was discovered and surveyed by Czech and Slovak cavers in Riviera Maya up to now.

The important part of the expeditions was also the soil taking and and catching up of the troglobytes animals for the research of UNAM.

Expeditions participants: Motyčka Zdeněk, Husák Radoslav, Hutňan Daniel, Sirotek Jan, Megela Michal, Jančar Radek, Dvořáček Miroslav, Mariano Fuentes Silva.

Special thanks to all landowners from Union Pequeños Proprietarios Rurales – Crescendo Maas Chan A.C for their understanding and willing to allow us to explore new caves on their property and all our friends – Bil Phillips, Robbie Schmittner, Nadia Berni, Dave Sieff, Roman Šebela and Libor Matuška for their help.

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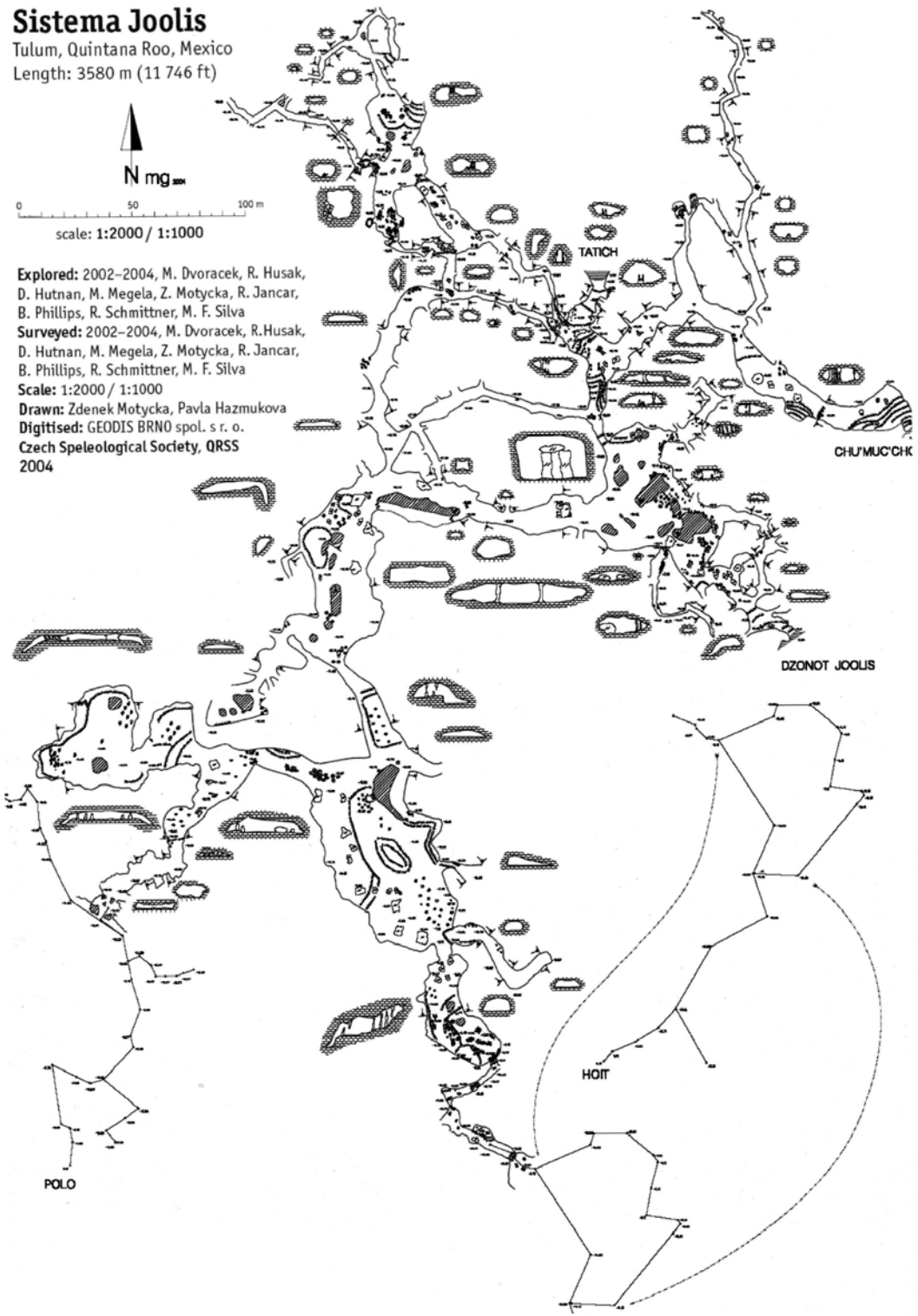
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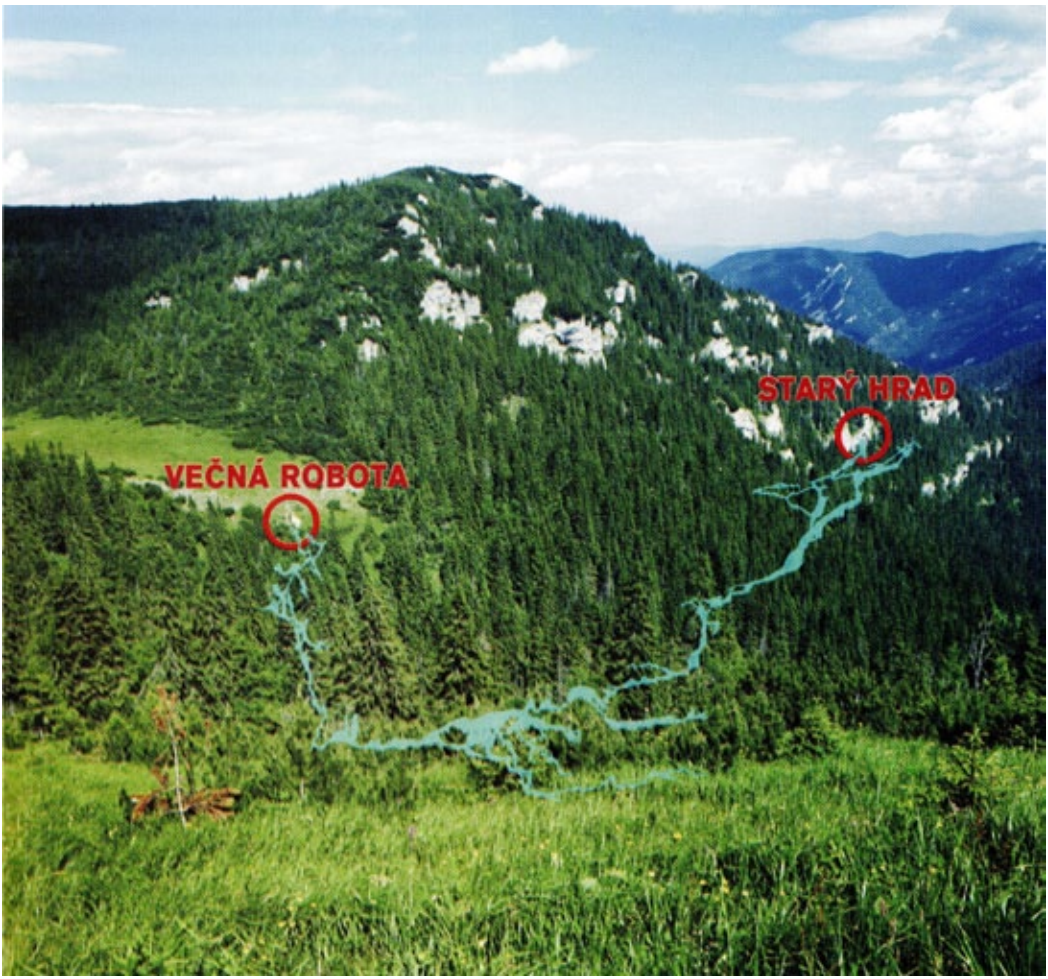
Večná robota + Starý hrad = The System of Hipman Caves

Elena Hipmanová
Club Speleo-Detva

Jaskyňa Starý hrad (The Old Castle Cave), situated in Krakova hoľa Nízke Tatry (The Low Tatra), was the deepests cave in Slovakia up to the year 2003. It was discovered by Petr Hipman, but in 1964 the entrance seemed to be an unpassable crack with a pulsing draught. Two years later it was widened to such an extent that the first man could enter it. In 1970 it was 152 metres deep and its high corridor was enclosed by a narrow hall, filled with big rocks.

It appeared that this was the end of the cave, so we worked in other localities. Eight years later, we again focused our interest on the cave Starý hrad. We managed to find the passage trough fallen blocks and descend through the series of abbyses down to a depth of 272 meters. Here we were stopped by a water trap. In 1980 we pumped water from the trap into a 19 ml rubber tank. We directed the flowing water up through a hose, so finally we could widen the trap. This was the way



Eastern crest of Krakova hoľa and the System of Hipman Caves, view of Jaskyňa Slnečného lúča. Photo: Petr Hipman

we managed to continue our research of Starý hrad using the dry path. In 1983 we were finally able to approach the underground river, Krakovka, which is the central river draining Krakova hoľa massif. The River Krakovka flows at a depth of 275 m from underneath the 20 m high Zával (cave-in). After 300 m it leaves the horizon of Veľký Kaňon (The Great Canyon) and through a series of rises and falls it drops to a depth of 400 m, where it hides beyond an impassable crack. From this point a low, by-now-dry trap corridor "Koleňáky" continues (a narrow corridor, through which you have to go on your knees, in order to pass) and descends another 24 m all the way to the surface of the not yet done trap.

In Starý hrad we tried to pass into depth and length at various points:

- Petr Hipman used the 30 m long waterfall as an engine for a small water powerplant and for 16 years we have been tunnelling the corridor in the cave with the water flow.
- During the winter activities, when there is the lowest level of water, we gradually broke through Zával, situated at the end of Velký Kaňon, 40 m against the flow of the river Krakovka, but flood waters often destroyed most of the tunneled parts.
- Diver Vašek Janska dived several times into the final trap. Under the surface he reached the depth of 8 m, so he changed the depth of Starý hrad to 432 m.

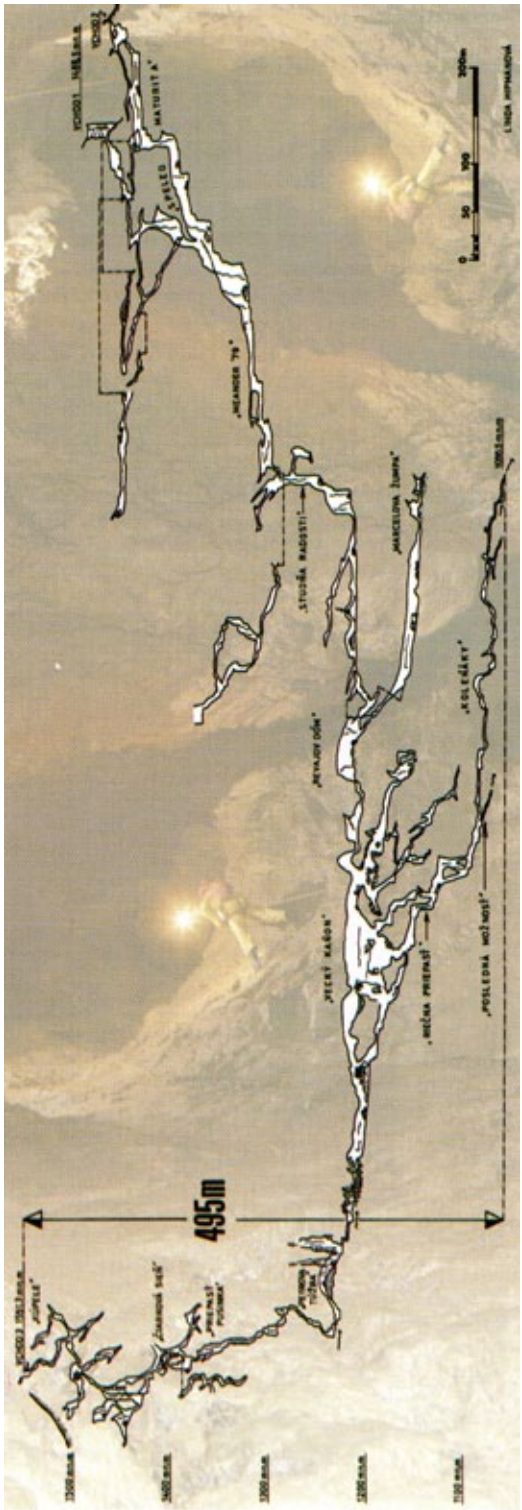
The Starý hrad cave had become the deepest cave in Slovakia, but the chances of overcoming the obstacles which nature has placed in front of us appeared to be nil.

In January 1988, when we managed to find a draught in the seat above Čierna dolinka, we could just hopefully believe that there would be some connection between it and Starý hrad. As soon as Spring came, we started to dig the probe into the grassy bank without any sign of crack. The distance between us and the final Zával in Veľký kaňon of Starý hrad was only 156 m as the crow flies. The fact that we had to descend only another 338 m lower, encouraged our enthusiasm. In the middle of Summer, during the period of highest temperatures and strong draughts, we managed to prove, with the use of merkaptan, that the new probe is the upper entrance of the Starý hrad cave.

Progress into the depth was long, and feelings of disappointment and defeat were not far away us at times. For nine years we had been struggling with cave-ins, which filled the underground voids. We had lost draughts for several times and we chase the easier, more comfortable corridors, which lead nowhere tough. We managed to descend all the way through an almost untouched cave-in to the depth of 60 m and we still called our dug hole just a probe. After nine years of slavery underground, we finally passed through to a looser space and we promoted our dug work to the cave. Because of its whirly character, sharply descending canals and years spent digging though cave-ins, the abbyss was named Priepasť Večná Robota (The Abbyss of Eternal Work). By 1998 we had descended to a depth of 224 m, but the cave remained

Tectonic flaw, on which the Večná robota abbis was formed.
Photo: Elena Hipmanová

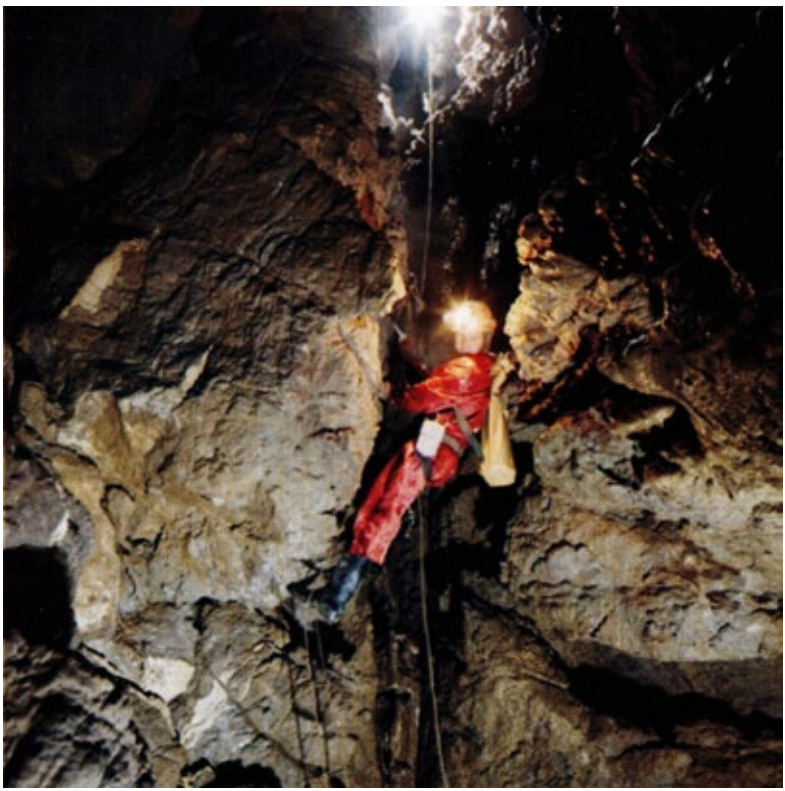
unchanged. It was formed from a highly unstable tectonic fault with a descending slope of 60 m and more. However, we came through some nice passages and larger halls, but cave-ins and huge blocks accompanied us all the way to the floor. At a depth of about 180 m we lost ceiling and walls for good and from this point on, we descended htrough a complicated series of enormous blocks. Moreover, we often got confused by the oneway draught, which here in the deep, flows upwards both in Summer and Winter. At the entrance, though, it reflects temperature, and air conditions. We preformed another merkaptan experiment, but the results were not satisfying. In February 2000 we finally managed to find the place where we could feel the scent of merkaptan, which we used in the Zával of Starý hrad. But this meant retuming 100 m higher and starting digging again. We hesitated for a while, but already in Autum 2000 we almost caved in into void 7 m lower and by Winter we discovered minster and abbysses down to a depth of 218 m. Again, we were stopped by a cave-in, but now, with a strong draught. The fact that the draught flows upwards throughout the whole year didnt matter to us anymore. We knew that the river Krakovka must be flowing somewhere below us and we assumed that it is the cause of this oneway draught. By the wall, we dug another 8 m deep hole. At the end of October 2001, when we managed to loosen the blocks situated on the floor of our excavation, we knew, that the cave would let us go further. Then came a 12 m long cave and the long Zóna nepokojných skál (The zone of falling rocks), where we had to face a rock-slide, which seriously injured one of us. Sometimes I had a feeling that the cave was determinedly trying to prevent strangers from entering its kingdom. Under the zone of falling rocks we descended trough the canyon to the depth of 307 m, but an accident and a caved-in accession path caused a pause of more than a year in work concerning Večná robota. The end of the canyon was caved in again, but we knew that the river was not far away. During the wet Autum of 2002 we heard its distant sound, which only increased the adrenalin in aur blood. When in Summer 2003 we finally got to the water, we felt that Starý hrad was just a stone‘s throw away, but years of constant struggle with obstacles held our optimism down. Above the small river, which flows through blocks and low dolomite corridors



we discovered a big minster 15 m wide and 28 m long. We named it Petrova túžba (Peter‘s Desire) as a memorial to Petr Hipman, who did not fulfill his dream by the end – connection of both caves. He died in April 1999.

On 26th of July 2003 we tried to overcome the last cave-in at the depth of 332 m. From our club Speleo-Detva the following people took part: Marián and Mariana Jagerčík, Ondrej Ratkovský, Elena and Linda Hipman and invited guests from the club Strážovské vrchy: Paľo and Tóno Kardoš and Jozef Krebes. It was enough to cope with the last block, and we could see almost 20 years old traces, which we left in Zával above the river Krakovka in the cave Starý hrad. With the connection of Priepasť Večná robota and Jaskyňa Starý hrad, The System of Hipman Caves has become reality. Its depth is 495 m.

Krakova hoľa is situated at an altitude of 1753 m and occupies about 18 km. It is a huge massif with carbon minerals in the slope from the northeast all the way to the bottom of Jánska dolina. There are springs situated in Jánska dolina at an altitude of. By means of kolometric experiment we managed to prove, 20 years ago, that the underground river Krakovka connects the current System of Hipman Caves with the springs at the bottom of Jánska dolina. The highest cave of Krakova hola is Jaskyňa slnečného lúča (The Cave of the Sunray), altitude 1689. At the end of May 2005 we managed to prove by another kolometric experiment, that there is a hydrological connection between this cave and the System of Hipman Caves and springs in Jánska dolina as well. But the human is not a drop of water...



Research of chimneys in Večná robota. Photo: Elena Hipmanová

Stegamites: first finds of the unusual cave formations in Slovakia

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Abstract:
Australian speleologists were the first cavers who noticed specific properties of these formations. In 1991 they introduced for these formations – because of their similarity with spinal scutellations of extinct species of Mesozoic period saurian named Stegosaurus – the name stegamites (Webb 1991). This term has becomed, at least in Australia, relatively frequent as testified by web quotations. The term however doesn't represent the whole array of the existing formations but basically it is a useful and appropriate designation. Other forms locally known as "angel wings" or "weeping willows" were found in Slovak Karst. The detailed research of previously overlooked flowstone formation lead to a discovery of a large number of stegamites. They are for the first time described for Slovak Republic from the area of Slovak Karst. They belong to the same group as cave shields but they occur mostly either on cave floors or walls. Their origin is associated with karst solutions that under certain pressure ascend up from the cave floor or walls. A characteristic stegamite is formed by two parallel flowstone plates or scales that are divided by central discontinuity. We believe that such formations are more common that was previously believed. They are likely to be found as rare but regular part of the dripstone decoration in other karst areas including Aggtelek Karst.

Introduction

Stegamites are created by seepage waters coming up (very often under high pressure) from fissures or cracks of cave floor and walls. They precipitate along both sides of the limestone fissure and by this way they create a flowstone formation resembling two scales that are divided by central gap usually several mmm thick. However the most important difference from the other types of flowstone formations is represented by fact, that their growth is controlled by seepage waters ascending up through narrow fissures in limestone bedrock or older flowstone. They may resemble in a certain sense "geyser stalagmites", but they develop under usual "cold" conditions. The term seepage dripstone was half a century ago for the similar formations introduced by J. Kunský and this term accurately characterizes the basic principie of their formations (Kunský 1942, 1950).

We can find formations in group of "seepage dripstones" that develop by similar mechanism, but they differ from the usual cave shields and sinter drums by parallel growth along vertical fissures, while majority of cave shields develops along horizontal or inclined fissures. Untill recently we thought, that they are rare exceptions, but during recent years we found several occurrences of these seemingly unique

Fig. 1 Drooping willow in Dornica cave is the most known stegamite in the karst territory of Slovenský kras. (Photo by J. Stankovič)

formations in caves of karst territory Slovak Karst (Slovenský kras). Due to their unusual morphological and genetic development we believe, that they should be dealt with as a special type of seepage dripstones and called "*stegamites*".

Australian speleologists were the first cavers who noticed specific properties of these formations. In 1991 they introduced for these formations – because of their similarity with spínal scutellations of extinct species of Mesozoic period saurian named Stegosaurus – the name stegamites (Webb 1991). This term has becomed, at least in Australia, relatively frequent as testified by web quotations. The term however doesn't represent the whole array of the existing formations but basically it is a useful and appropriate designation.

The term *stegamites* was recently used only for seepage dripstones projecting upwards from a cave floor in the form of two parallel calcite ridge, but we have found seepage dripstones on the vertical cracks in a form that can be described as "*angel wings*" (see Fig. 5). We therefore expand the term "stegamites" to the formations described and depicted in this paper.

Comparison of stegamites and cave shields

Sinter shields are defined by C. A. Hill and by Paolo Forti as circular or elliptical binary formations composed of two spherical parallel plates with thickness of about 1 centimetre, that are separated by medial capillary space. Both "scales" of the shield grow as concentric structures from one concentrated point of influx.

Stegamites does not fill these conditions exactly. They are mostly shaped as flat formations resembling a shape of "weeping willow" (if they project upward from cave floor) or in form of "angel wings" if the grow from vertical fissure. The initial phase usually takes a shape of two parallel banks often about 2 cm high and tens of cm long unified into one elevation without visible concentric structure. The capillary discontinuity between both scales was confirmed at several ocassions e.g. in broken senile stegamite of Drienovská cave. This up to 4 m high formation has central capillary space wide from several mm up to 15 mm. Its walls are formed by three distinct layers:

1. inner layer some 2-3 mm thick is formed by coarse grained plastic sinter (interior of the joint is filled by gentle wadding plastic sinter).
2. middle layer of fine-crystalline sinter with thickness about two mm.
3. external layer is formed by acicular crystals oriented by vertical direction towards the discontinuity area. Crystals are up to 12 mm long.

Stegamite evolution

Stegamites were found in several caves of Slovak Karst such as Jeskyně v ponoru Jaštierčieho jazierka caves, Hrušovská and Drienovská caves. Their occurrences cover the whole scope of evolutionary phases from initial stages through active growing macro-forms up to ramshackle waned formations.

Initial forms of seepage dripstones were found in Drienovská cave on the wall of the corridor between underground space called Stratený dóm and other dome named Kruhová sieň. At the present time we don't know if they will develop into shields or stegamites. They are projecting upwards with angle of their direction about 75°. They may be up to 8 cm high and almost 8 cm wide. Its width is almost similar. The bottom part 5 cm thick is formed by brown flowstone, while the top rim about 3 cm wide is composed by transparent calcite, in which the feathery radiating capillaries can be seen.

In Jeskyně v ponoru of Jašteričieho jazera cave in underground space called Dóm Fontány we can see stegamite named Fontána (The Fountain). The formation is developed as initial form of a narrow arched ridge with dimensions 40 × 20 × 5 cm (length × height × width). We observe on the top part tiny sprouts fed by secondary capillaries. Oriented flows of water are spattering up to height about 50 cm during high level of water table in

Fig.2 The initial stegamite from Drienovská jaskyňa cave. Notice transparent rim with capillaries (Photo J. Stankovič).

the lakelet creating temporary water fountain. The name of the formation originates from the described action.

A necessity of linear seepage through primeveal fissure plays important role in growth of stegamites also (Cílek 1999, wasg.iinet.net.au/steg.html). Stegamite about 11 m long and about 5 – 7 cm high must have developed by linear seepage from the fissure of similar length. Pointed inflow from one source leads to the cave shield formation and would be reflected by their concentric structure. Linear seepage through fissure can be focused to several points, that are indicated by tiny elevations that may be enlarged into flat bank, – the initial stegamite – like in Hrušovská jaskyňa cave.

However some aspects of the growth of stegamites (and shields as well) are still enigmatic. Central discontinuity fissure is often too large for capillary forces. The fissure must grow together with cave shield or stegamite and thus some corrosion must take place alongside with precipitation (Cílek, 1999). This corrosion must be concentrated on the perimeter, where both platters or scales are touching each other and the rest of the discontinuous fissure must be protected against corrosion. It seems that a propagation of central discontinuity happens as corrosion/precipitation front proceeds further from the influx point. While the water level of karst lakelet is in normal position, saturated karst solution slowly seeps through discontinuity and the construction of stegamite prevails, but during high seasonal inflow of karst solution we may expect the dissolution of central discontinuity and its propagation to the perimeter. We believe that seasonal rainfall distribution may be responsible for complex behaviour of karst solution ”locked“ in limited space of central discontinuity and its capillary pathways.

How we can actually demark stegamites from the others sinter formations? First aspect is its characteristic shape. Thickness is essentially smaller than other dimensions (the rule is ignored for embryonic stages). The other important aspect is position of stegamite. It is often located at cave walls, sometimes cave floor or along the fissures of the older flowstones and stalactites. Stegamites of cave ceilings can be distinguished from the other gravitational forms with difficulties only. The presence of pressure solutions may be indicated by temporary spurting microfountains as the third

Fig. 3. A view of the lateral profile of the senile stegamite from Drienovská cave. Total thickness is aprox. 40 cm. The nucleus of the stegamite consists of a pair of platters and central discontinuity. (Photo J. Stankovič).

Fig. 4. ”Weeping willow“ in Hrušovská jaskyňa cave. (Photo by J. Stankovič)

main aspect of stegamite origin. Floor stegamites are growing often in smaller cavities or close by to the cave walls. Solutions, that nourish them are conducted via tectonic or karst fissures and embryonic channels through these walls. On the top rim we can often observe tiny conic sprouts at places of capillary pathways.

The occurrence of stegamites in Slovak Karst

The most famous stegamite from Slovak Karst area is Weeping willow in Klenotnica (Treasure – house) in Domica cave. The formation is 2 m wide and aprox. 2 m high with maximal thickness of 30 cm. Weeping willow is growing up from sloping bottom of cavity located on the transverse tectonic fault. Unfortunately at the present time the formation is dead. When the cave was opened to the public the workers drilled a hole for illumination in cave floor. They unfortunately hit the source of the water and interrupted the water flow. The knowledge concerning the genesis of the formation would probably stop this devastation.

The second important stegamite of the ”angel wings“ type is located in Domica cave, in a part which isn‘t open for public. Unfortunately even this formation was damaged by building of the underground railway. Large stegamite was found in 1978 in Hrušovská jaskyňa cave at the end of corridor of the upper cave etage. It has almost similar dimensions and shape as *Drooping willow* in Domica cave. It is formed on the sub-parallel tectonic fault of the main fault. Stegamite stands close to the cave wall on an inclined flowstone slape. This formation is still active.

The biggest known stegamite of territory Slovek Karst can be found at the upper etage in Drienovská cave on the left part of corridor called Česká chodba. Maximal height of the formation is 5 m and its width is 4 m. It is composed of two parts. The first part has nearly ideal shape of stegosaurus scale with height about 3.5 m. The second part is 5 m high and it is standing on the parallel tectonic fault. We can observe close to this formation other senile stegamite some 4 m high.

Several other initial stegamites can be found in corridor connecting Stratený dóm (Lost dome) and other space called Kruhová sieň (Circle hall). Three other stegamites were recognised in Krásnohorská jaskyňa. One of them is located in the highest part of Helictite dome. The dripstone has shape of ”angel wing“ projecting from vertical wall. Column about

Fig. 5 ”Angel wing“ stegamite from Domica cave, Slovak Karst (Photo J. Stankovič).

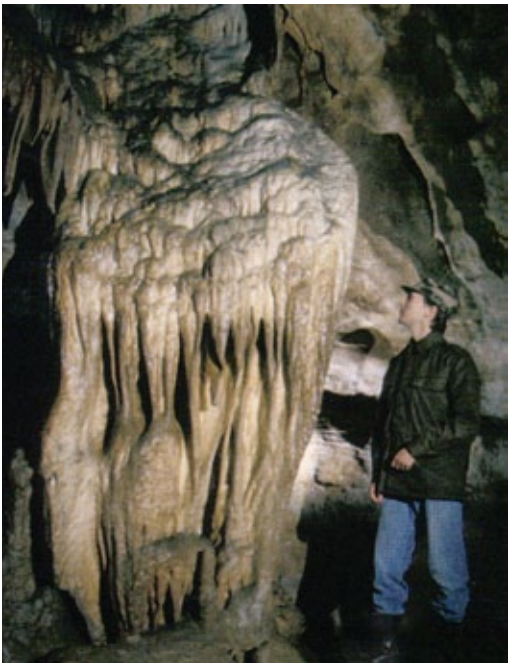

Fig. 6 Stegamite in Hudobná sieň (Musical Hale) of Jasovská cave. (Photo J. Stankovič)

3 m high was gradually precipitated in the farthest part from the wall. Close to this formation we can find next initial stages of seepage dripstones. The second stegamite was discovered in space called Skrytá izbička (Hidden little chamber) in ceiling parts of Abonyi Dome.

This stegamite is formed on the flowstone fissure on the right wall of corridor. It is composed by 10 heligmites about 15 cm high. This position

Fig. 7 "Branchy" stegamite from Krásnohorská jaskyňa cave. (Photo J. Stankovič)

suggestst that original stegamite is hidden under the flowstone mass and this formation belongs to the second generation stegamite. The top of the stegamite is covered by tiny spray false corallites. Other stegamites are located in some other caves of the karst area. For example interesting formation shaped as the wing can be found in Hudobná sieň (Musical Hall) of Jasovská jaskyňa cave. Two metres high formation called "Weeping willow" is growing up from the floor of the cave hall. Other interesting stegamite stands in Zikmundová kaplnka (Zikmund Chapel) of Jasovská jeskyňa Cave. Upper disc of classical cave shield cracked and on this fissure a new vertical stegamite was formed.

Conclusions

The detailed research of previously overlooked flowstone formation lead to a discovery of a large number of stegamites. They are for the first time described for Slovak Republic from the area of Slovak Karst. They belong to the same group as cave shields but they occur mostly either on cave floors or walls. Their origin is associated with karst solutions that under certain pressure ascend up from the cave floor or walls. A characteristic stegamite is formed by two parallel flowstone plates or scales that are divided by central discontinuity. We believe that such formations are more common that was previously believed. They are likely to be found as rare but regular part of the dripstone decoration in other karst areas including nearby Aggtelek Karst.

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THE LEVOČSKÉ VRCHY MOUNTAINS – PSEUDOKARST PARADISE

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Geomorphologically the Levočské vrchy Mountains build the western part of the inner Carpathian-Balkan arc. The Mountains are spreading in NW part of eastem Slovakia on the area approximately 714 km^2, in altitude from 460 to 1289 m. The Levočské vrchy Mountains is typical massive block mountain chain that is built by Paleogene deposits, numerous forks separated by deep valleys are expanding from this mountain [1]. The Levočské vrchy Mountains is possible to characterize as the typical highlands that is culminating on the Čierná hora in altitude 1289 m. The mountain is some gate to the region of the Spiš and Tatras. The typical sign of the mountain in the area of occurrence of caves is remarkable steeping of landscape and presence of sand soils with forests or veldts. The Levočské vrchy Mountains is the typical area with occurrence of sliding structures. One of such structures is bearer of the biggest pseudokarst cave ever found in Slovakia.

The large part of this area was a military zone. The area is underpeopled and touristically not very often visited, with beautiful nature, emblazoned with legends and secrets. The well-known legend deals with the cave the Moon shaft. The untouched nature offers highland meadows, deep forests, and plenty of mineral springs on the fault boundaries of the Levočské vrchy Mountains.

Although the area is not sufficiently explored from the point of view of speleology under the surface the great potential of underground spaces, that is slowly discovering its secrets, is hidden.

The great day for the Levočské vrchy Mountains arrived when the Speleoclub Šariš accomplish the spectacular discovery on the southern slopes of the Spišská hill (altitude 1056.5 m). In November 2004 the cave that is unique in Slovakia in size and morphology of underground space was discovered. Exceptionality of this cave consists in the fact that this pseudokarst cave with unusually

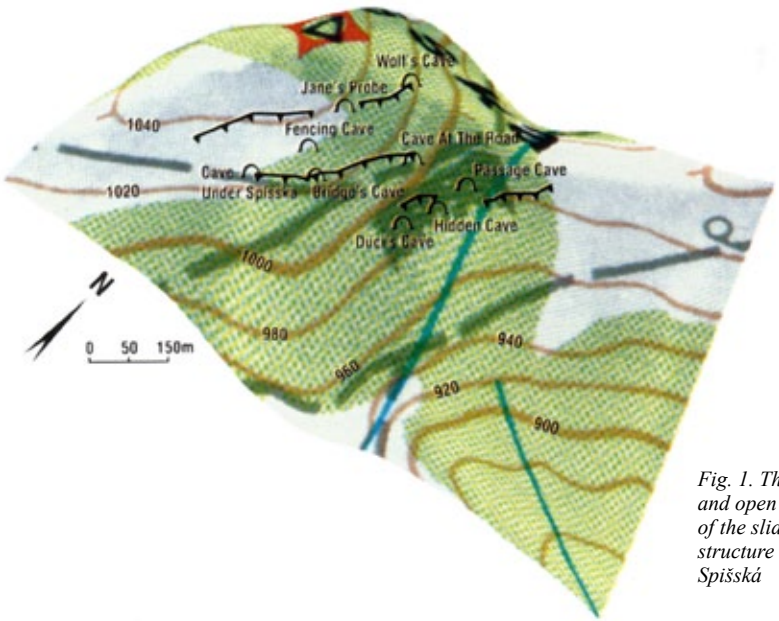


Fig. 1. The caves and open cracks of the sliding structure in Spišská

big underground spaces was created in massive sandstones. The length of the cave is 624,29 m. The height of passages reaches 8 – 10 m, width 3 – 5 m. No karst cave would be ashamed with such dimensions. The cave was named according the position on the hill The Cave under Spišská (Jaskyňa pod Spišskou) [2]. With the introduced dimensions The Cave under Spišská have gained the first place among pseudokarst caves of Slovakia.

For appreciation of value of this discovery it is necessary to state that up to this time the longest pseudokarst cave in Slovakia was the cave Stĺpová jaskyňa in Cerová vrchovina Highlands with length 182 m [3]. The Cave under Spišská overruns this length almost four times.

The first knowledge about the Cave are aged about 15 years ago when probably after the long period of rain the country road and veldts start sinking, and on one place a bottomless hole was created. The local shepherds just fence the hole but nobody found courage to enter it. The entrance shaft of the Cave was conquered by speleologists of Speleoclub Šariš till in November 2004.

The list of caves in Slovakia [4] introduces in the area of the Levočské vrchy Mountains totally nine caves, the best known are Jaskyňa pod Jankovcom 2 – around 100 m, Jaskyňa v Prednej Kohútovej – around 100 m, Jaskyňa v Derežovej – around 60 m, depth around 20 m, Jaskyňa v Čiernej hore – altitude around 910 m, length around 40 m, depth 15 m, Jaskyňa v Kohútovke – altitude 643 m, length 15 m, or Zbojnícka diera – altitude 976 m, length 15 m. This number on such big area probably will not fascinate anybody. Maybe this indicates the lack of interest to make speleology in non-karst regions. Through the discovery, that we accomplished, our paper wish to introduce the possible potential of the area that is definitely interesting from the point of view of speleology but not very known.

Geology of the region

Geologically the region of Levočské Vrchy Mountains belongs to the sediments of inner Carpathians. The close area of the Cave under Spišská (Jaskyňa pod Spišskou) is formed by Paleogene sediments of the Subtatric Group, namely by the Biely potok Formation of the Oligocene age. Several tens of meters to the N and NW from the top of the Spišská hill the tectonic line of the SW – NE direction separating the sandstones of the Biely potok Formation from layers of conglomerates and gravels with layers of sandstones is suggested

Fig. 2. Intraclasts of claystones in entrance abyss. Photo: M. Hajduk

in the geological map [5]. On the steep southern slopes of the Spišská hill also landslides and sandy-stony to stony screes of the Oligocene to Holocene age are presented.

The typical feature of the Biely potok Formation is dominance of the homogeneous sandstones. The Formation is formed by a complex of monotonous, predominantly sandstone strata, tens to hundreds of meters thick, in some places interrupted by layers of flysch or conglomerates. Comparing the occurrence of sandstones to claystones, the claystones are infrequent. Sandstones of the Forrnation produce 50 to 300 cm thick stratas that appear very homogeneous. The bedding is more observed when the rock weathers. In thick sandstone layers up to several dm large galls (intraclasts) of claystones siltstones, pelocarbonates and armored mud balls are occurring. On boundary of facies erosion wash downs are existing.

The more detailed survey of surrounding of the Cave helped to explain the origin of the Cave. The origin of the Cave is gravitational. The tangential forces cracking the rock in the area of massive landslide, created on the southern slopes of the Spišská hill, were acting on forming the Cave [6]. The mainstream line of the Cave is the open crack

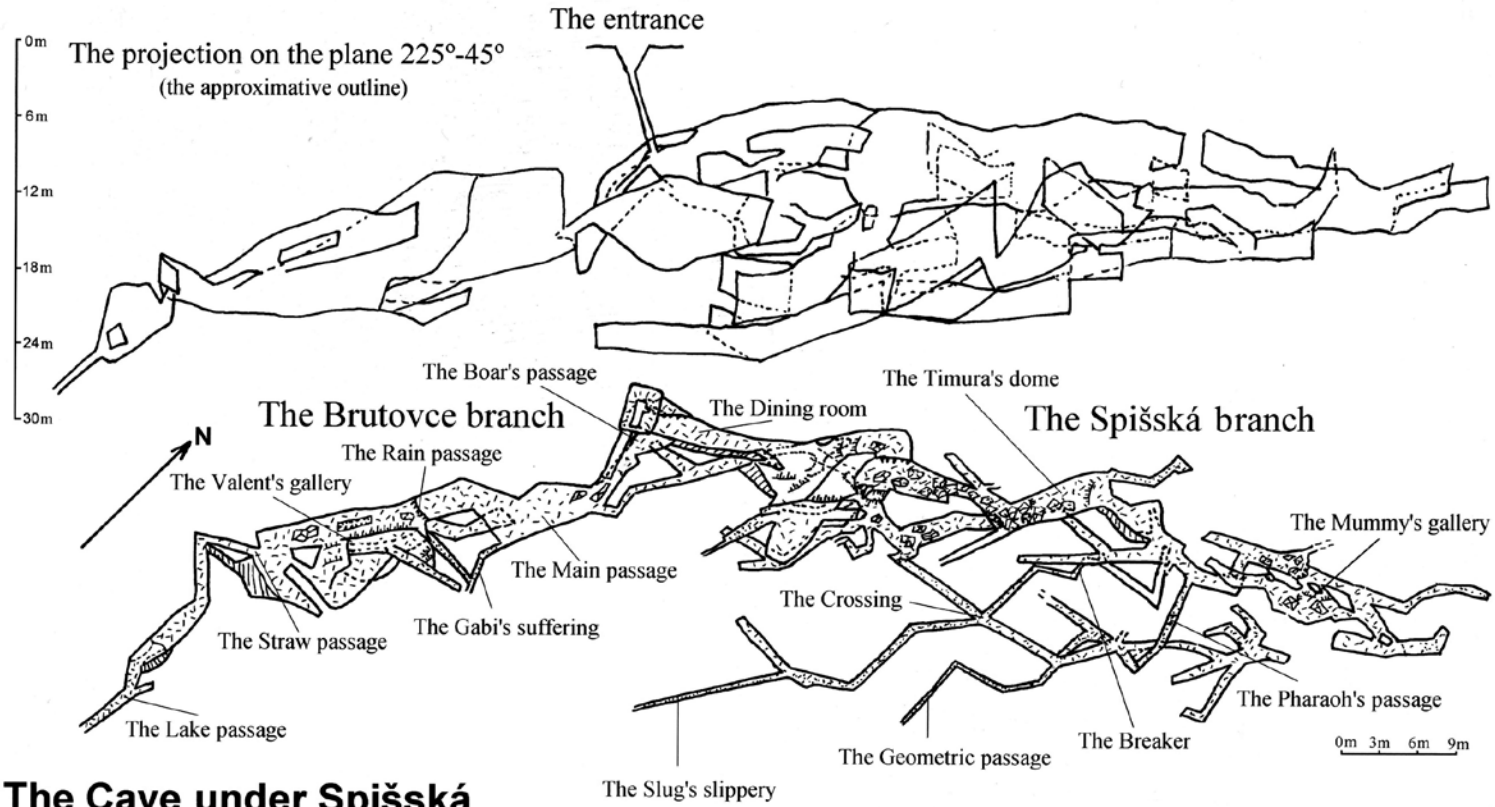
of approximate SW – NE direction originated in the separation zone of the landslide. Along this crack the most massive spaces were created. On the surface this crack appears as depression following the mainstream line of the Cave. This is not the only crack in the area. In the Fig. 1 it is possible to see the several cracks genetically associated with this landslide. Along these cracks the several caves were discovered. Practically the all cracks, as presented in the Fig. 1, are situated parallelly to the steep cliffs of the southem slopes of the Spišská hill that are forming the edge of the landslide. The all significant extensions of passages of the Cave originating on the lateral cracks are then leading to the south to the steep slopes of the Spišská hill into the area of the supposed head of the landslide. There are several cracks presented in the Fig. 1. The open crack that follows the main corridor of the Cave under Spišská is visible on the surface as marking depression of 2 to 4 m width. The open cracks situated under this line are more wide but with rarer occurrence of caves. The cracks above this line are narrower, presented on the surface as the depressions of 0.5 to 1.5 m width, with more often occurrence of caves.

Except the mentioned Cave under Spišská there are several caves in the area of the cracks, as you can see in the Fig. 1; for example The Jane‘s probe (Jankina proba) – length 18,3 m, The Bridge cave (Mostová jaskyňa) – 6,7 m, The Passage cave (Priechodná) – 7,14 m, The Fencing cave (Ohradková), The Hidden cave (Zatajená) – length around 30 m, Duci‘s cave (Duciho) etc. The survey of this caves was just preliminary, the reconnaissance activities were devoted mainly to the biggest cave. The course of the open cracks and position of entrances of caves were targeted and evaluated by mobile GPS equipment.

Description of The Cave under Spišská

The Cave is situated in altitude 1022 m, around 300 m to the south from the top of the Spišská hill (1056,5 m), on the SE periphery of the Levočské vrchy Mountains. During the period when the Cave was discovered (November 2004) the cave was sucking air. According the last measuring in May 2005 the temperature in the area of the entrance abyss ranged 5,3 to 5,7 °C, in the back parts of the Cave the temperatures ranged 4,8 – 5,4 °C. The longterm observation of circulation of air is still not completed. There is no water stream in the Cave the extensive humidity is interconnected with the seepage of the surface water and the ability of massive porous sandstones to hind the water. On many places the water is dropping from the ceiling and the walls of the Cave are often covered by thin clay film. In spite of the fact we would not expect dripstones in the Cave there are several groups of around 10 cm long straw stalactites and one rather strange stalactite with the diameter approximately 3 cm at the root and length of 12 cm occurring in the Cave. In the Cave we observed 3 species of chiropteras, separately or in groups (*Myotis myotis, Myotis emarginatus, Rhinolophus hipposideros*). The total amount of the chiropteras was several tens of pieces. On the same places we found skeletons of the small gnawers and the skeleton of the dog that fell into the entrance abyss and died. The occurrence of troglobite fauna was not observed.

The entrance into the Cave is narrow, shaft like, with the depth 12,5 m (see Fig. 2). The total difference in elevation is -28 m. We divided the main corridor of the Cave into the Spišská and Brutovce branch (Spišská a Brutovská vetva) according of the orientation of the direction of the branches from the entrance. After the narrow beginning, about 5 m above the floor, the entrance shaft is conically opened into the spacious passage. On the left side of the main passage, in the height about 2 m above the floor, the small passage that is leading over the rock stage into the Brutovce branch is situated. To the right from the entrance shaft the Spišská branch is beginning and the passage is slightly descending. The walls of the passage are of height up to 8 m the width of the passage is around 3 m. This passage was named the Dining room (Jedáleň). The floor is formed by debris, the walls are straight, created by massive layers of sandstone. In the ceiling the intraclasts of other rocks, armored mud balls, are presented. The typical feature of this cave is flat ceilings in the most passages, occurrence of which can be explained by existing the thin layer of claystone on the edge of ceiling on which the massive layer of sandstone was slipping like on the soap. The bedding of the sandstone layers is not very visible the sandstone appears to be homogeneous compact rock. The slope of layers is often near the horizontal position. Behind the Dining room the passage is slightly ascending and enlarging into the larger dome with the rock step. Named as the Timura‘s dome (Timurov dóm) this is the most spacious passage of the Spišská branch (see Fig. 3). The massive large boulders form the floor of the dome. This huge space of height 6 to 8 m



The Cave under Spišská

Polygonal course length: 624,29 m

Drawing: P. Imrich
Mapping: P. Imrich, F. Majerníčková, G.Majerníčková, V. Timko, J. Vykoupil, M. Hajduk
Exploration and technical support: J.Timura, J. Ducár, P. Hurný, V. Vaník and all above

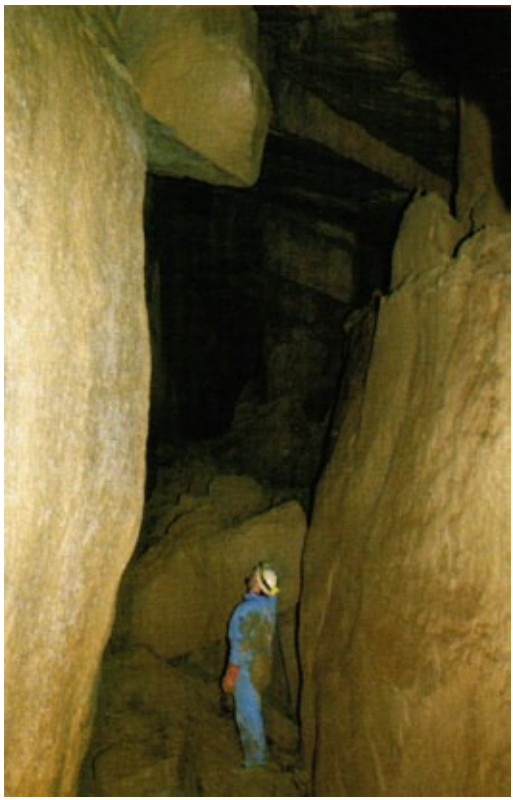


Fig. 3. Timura‘s Dome. Photo: R. Pavlík

and width over 3 m has the typical flat ceiling and almost vertical straight walls. After continuing to the right along the mail passage, and overcoming the several large rock boulders, we reach the other spacious gallery named as the Mummy‘s gallery (Mamčina galéria). This part of the Cave is the bearer of potential danger. On many places the large sandstone plates of weight of several tons are hanging from the ceiling and practically nothing is anchoring them. Reading forward the Cave involves more incrushs and dangerous boulder fields. Just in these places the surface depression that is following the mainstream of the Spišská branch is becoming to be the deeper and rockier. Forwarding ahead the higher occurrence of incrushs and boulder field can be expected but also enlengthening the polygon traction of the Cave as the depression on the surface continues the next several hundreds of meters.

From the upper level of the Spišská branch, closely to the beginning ofthe Mummy‘s gallery, the narrow height straight passage is decreasing – the Pharaoh‘s passage (Faraónova chodba) – see Fig. 4. The man feels like in the pharaoh‘s crypt. The passage of height straight walls and flat smooth ceiling is formed in massive compact sandstone. From here, the passage is decreasing into the Geometrie passage (Geometrická chodba). Geometrically regular narrow passage ends in fall. In any cave hardly can be found so horizontal angular passage; the nature is simply the ultimate architect. To the left from this passage we came on the Crossing (Križovatka). This regular crossing of four passages is missing just traffic lights. Following to the right the passage leads to the zigzag passage named the Breaker (Lomák). This is one of few places in the Cave that make problems when need to be overcome by caveman with the more robust chest. To the left from the Crossing another interesting passage is situated. One of its extensions is named the Slug‘s slippery (Šlimači šlisk). We agreed this is the most appropriate name of passage in the Cave. The long straight passage of height up to 5 m has smooth plane walls of homogeneous sandstone, flat floor covered by sand and clay, and flat ceiling. The narrowing passage is following into the dark nobody found where. Closely under the ceiling the layer of claystone can be observed, weathering of this claystone produces muddy clay film on the walls of the passage. When passing

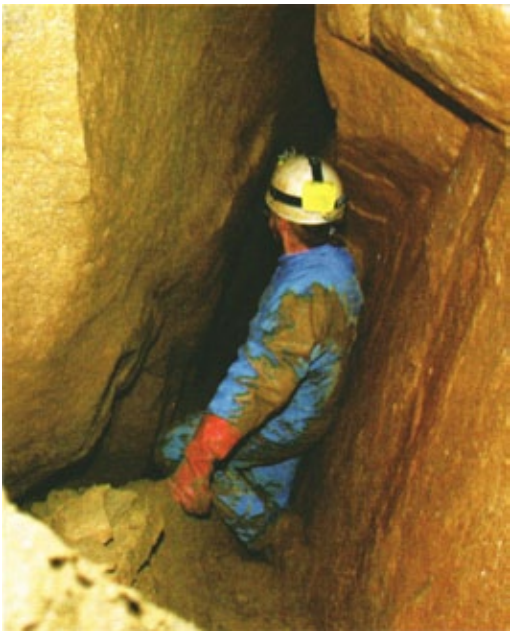


Fig. 4. The entrance into the Pharaoh‘s passage. Photo: R. Pavlík

this narrow passage with muddy clay film on the walls, slipping on the mud, the speleologist quickly forgets the color of his overall. In period of higher seepage of surface water into the Cave this feature occurs more often also on the other passages of the Cave. Approximately to the W from the Crossing the passages are joining the main corridor of the Spišská branch.

The Brutovce branch begins from the entrance shaft by the Boar‘s passage (Diviačia chodba). In this passage the boar skins, the bowels and remains of the animals that fell into the entrance shaft or were dropped down by hunters were found. After overcoming the rock step continuing from the Boar‘s passage we reach the spacious hall that floor is covered by huge rock boulders – the Main passage (Hlavná chodba). This passage is ending by around 4 m height rock step. This step can be avoided through narrow trespassing – the Gabi‘s suffering (Gabikine trápenie), normally passable just in one direction, as it was ascertained by one of cavegirls of the Speleoclub Šariš. Behind the rock step the most humid place in the Cave is situated. The water infiltrates from the surface, the continuous “rain“ is existing here. The place was named the Rain passage (Dižďovica). From here the cave hall that invokes the respect by its dimensions, morphology and geology is opening. Maximum height 10 m, width over 6 m, robust rock boulders on the floor, massive flat sandstone layers hanging from the ceiling, the erosion wash downs on the left side, intraclasts of other rocks in sandstone, the graded bedding of the coursegrained sandstones to conglomerates, carbonized chaff of plants, holes after dropped out intraclasts, with the upper level of the passage these all is creating the monumental labyrinth. The upper level of the passage was named the Valent‘s gallery (Valentova galéria) in memory of discoverer of the Cave. At the end of the passage, nearly before the broken passage, several groups of the straw stalactites of length up to 10 cm are situated on the ceiling of the passage – The Straw passage (Brčková chodba). The final gradual fall in the Lake Passage (Jazierková chodba), in which the extension of the passage can be seen along the flat ceiling, is one of the prospective continuations of the Cave.

Maintenance of the entrance and surrounding of the Cave

The unique cave needs attention. The original fencing of the Cave was corrupted by gradual fall of the soil, rock and clumps. There was necessary to make the technical precautions to secure the entrance of the Cave against the fall. The technical precautions consist in cleaning the entrance from the fallen rock and soil, building the new solid fencing and securing the entrance against unwanted fall of animals and tourists, as the entrance to the Cave is situated near the country road. The excavated material was used for terrain fitting of surrounding of the entrance. The entrance was secured by new fencing with fitting the new solid wood piles. Above the entrance the solid wooden log, on which the rope ladder is mounted, was anchored to secure the safety of entering the Cave. Also the biological waste was necessary to discharge – the boar, deer and other skins, hoofs, and slowly decaying remains of animals (mainly bowels). The scree cone accumulated on the floor of the entrance shaft was plained. By this, the platform with better entering the solid ladder that is continuation of the rope ladder was formed. For better overcoming the rock steps several ladders was installed in the Cave. The building operations will continue by fitting the concrete plate into the entrance of the Cave. By this, the large rock blocks in the area of the entrance will be stabilized and the fixation of the entrance against falling the entrance will be created.

Mapping and exploration of the Cave

The Cave was mapped by hanging mining compass and declinator (with the precision of scale dividing on 1/3 of degree) and steel measuring tape with dividing on cm. The mapping was performed in several stages. The mapping is still not finished; another enlengthening of the polygon course of the Cave is just the matter of time.

Also the exploration of the Cave is far from completeness. There was no time to explore detail the continuation of the main corridors of the Cave. Great expectation lays on continuation of the Spišská branch where the surface depression tracing the mainstream of this branch is forwarding ahead additional several hundreds of meters. After overcoming the final fall it is not unreal the length of the Cave will be doubled. By now the several extensions and narrow cracks were not explored and mapped that gives assumption for several tens, maybe hundreds of meters. So the answer to the question: ”When the first kilometer will be overcome in this cave?“ will not keep waiting long time on yourself.

Conclusion

This biggest discovery in the Levočské vrchy Mountains can be the first milestone on the way to the systematic exploration of this area. With its respectable dimensions the Cave have achieved the matchless first place among Slovakian pseudokarst caves. This discovery raise hopes for similar discoveries in other fields of the Levočské vrchy Mountains. As presented above there are several other caves, of which some can be interconnected with the "mother" Cave when detaily explored, situated in surrounding of the Cave.

Another prospective area for caving can be the sliding area on the southern slopes of Čierna hora (altitude 1090.6 m). The most interesting cave in this area is the Jew's cave (Židova jaskyňa) with mapped length 134.6 m. According the last explorations the length of this cave is at least 250 m. Character of this cave is extremely complicated several-levels labyrinth. In the area more then 10 caves with length from 10 to 80 m is existing. The exploration in these caves like Trojvchodová, Čugaňa, Valentova, and other will continue.

No less interesting field is the area in neighbourhood of the Strieborná hora hill (altitude 949.3 m). Well known in this area, but still not fully explored, is the cave in Opálené – preliminary length around 60 m; and the area of the Adamová Hora hill (altitude 939.9 m) with the cave Paľova jaskyňa (length 30 m) and another caves, according the local information, waiting to be discovered.

The matter of heart for the Speleoclub Šariš is the area of the Zámčisko hill (altitude 1236.4 m), where the four caves of length at least 50 m (Nikova, Ľadového dychu, Vaľova, Veľkého chrobáka) and many small caves with length up to 50 m are situated.

The aim of the Speleoclub Šariš is detailed reconnaissance and documenting of the region of the Levočské vrchy Mountains. During the short existence (Speleoklub Šariš was officially established in April 2004) we succeed to enrich the Slovakian speleology in significant way by many caves just in the pseudokarst region of the Levočské vrchy Mountains. We wish to continue in this job for nature, knowledge, and pleasure of all.

The operations in this pseudokarst region will continue; we are full of expectation how this region can surprise us. Maybe by the first kilometer overcome in Slovakian pseudokarst cave?

Besides the speleological value, these discoveries can influence the detail grasp of geology of this region. For example, it is not possible in this area to study the geology in such wide-spread and untouched environment as just in the Cave under Spišská. This offers possibility of practical using of this cave as an interesting geological attraction for skilled geologists to study the detailed geology or for the geology students to verify in practice the knowledge gained on University.

Goodbye in the pseudokarst paradise! The Speleoclub Šariš looks forward to Your visit.

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How the Map of Čachtice Cave Has Been Created

Martin Sluka, 2005

Introduction

Čachtice karst plateau spreads at West Slovakia (Middle Europe) direction W from the town Nové Mesto nad Váhom, NW from world-wide famous village Čachtice – remember "Vampire from Čachtice castle". The entrance of Čachtice cave is in middle of plateau with GPS coordinates: N48°44.55' E17°47.22'.

The Čachtice cave was discovered in 1956 as a result of activities of a professional team of Turista, state enterprise, led by Ján Majko. The team aimed to find cave areas suitable for making them open for the public. For the first time, in 1960, the cave was mapped out, on request of the above mentioned national enterprise, by Dr. Anton Droppa using miner's compass, clinometer and tape. Dr. Droppa's map showed the length of about 750 m mapped and the additional length of approx. 500 m sketched (Fig. 1). As no suitable areas accessible for tourists had been found, any works to improve cave accessibility were not commenced.

Ing. Marcel Lalkovič et al. carried out additional mapping of the underground areas in 1972–74, again driven by the idea of opening them for the public, say, to fullfill a political order. The team surveyed the areas from the entrance up to the edge of the Rotunda hall, i.e. the approximate length of 330 m in total, by means of a mining theodolite.

In the mid of 70's it appeared clear that there were other large areas in the Čachtice cave that were displayed neither in the map of Dr. Droppa, nor in any other available plan. In 1977 a few members of the Čachtice group of Slovak Speleological Society (SSS) took a part in the summer expedition camp organised in southwest Romania by the Focul Yiu group of Bucharest, whose activities concentrated primarily on the survey and documentation of local caves. Employing experience gained in the camp we decided to employ surveying methods, similar to those in Rornania, for mapping the Čachtice cave. According to our fresh experience we estimated the whole survey would take max. 5 to 10 actions (!!!).

The first mapping action was organised by Jaro Zoldfay and Juro Kouřil before the end of 1977. They started, at the right point, i.e. the most remote place (according to recent knowledge) at the siphon in the Brčková Hall. However, already the following action of January 10th 1978 showed that the survey would not be as easy as we expected. The "Romanian" methodology of drawing the polygon up to the end of even the smallest branch led us reliably to the places, whose existence we had not had any faintest idea about.

Thanks to Ivan Demovič, in August 1978, water was removed from the sump of Brčková Hall (using shopping plastic bags) and the sump was got over.

In the days of "coal holidays" on January 16th 1979 the Perlový (Pearl) Dome was discovered as well as the Sup (Vulture) Chasm four days Jater. For the following two years we were not able to make a step forward from the then "end" of the Čachtice cave. It should be noted that no any systematic digging works were carried out.

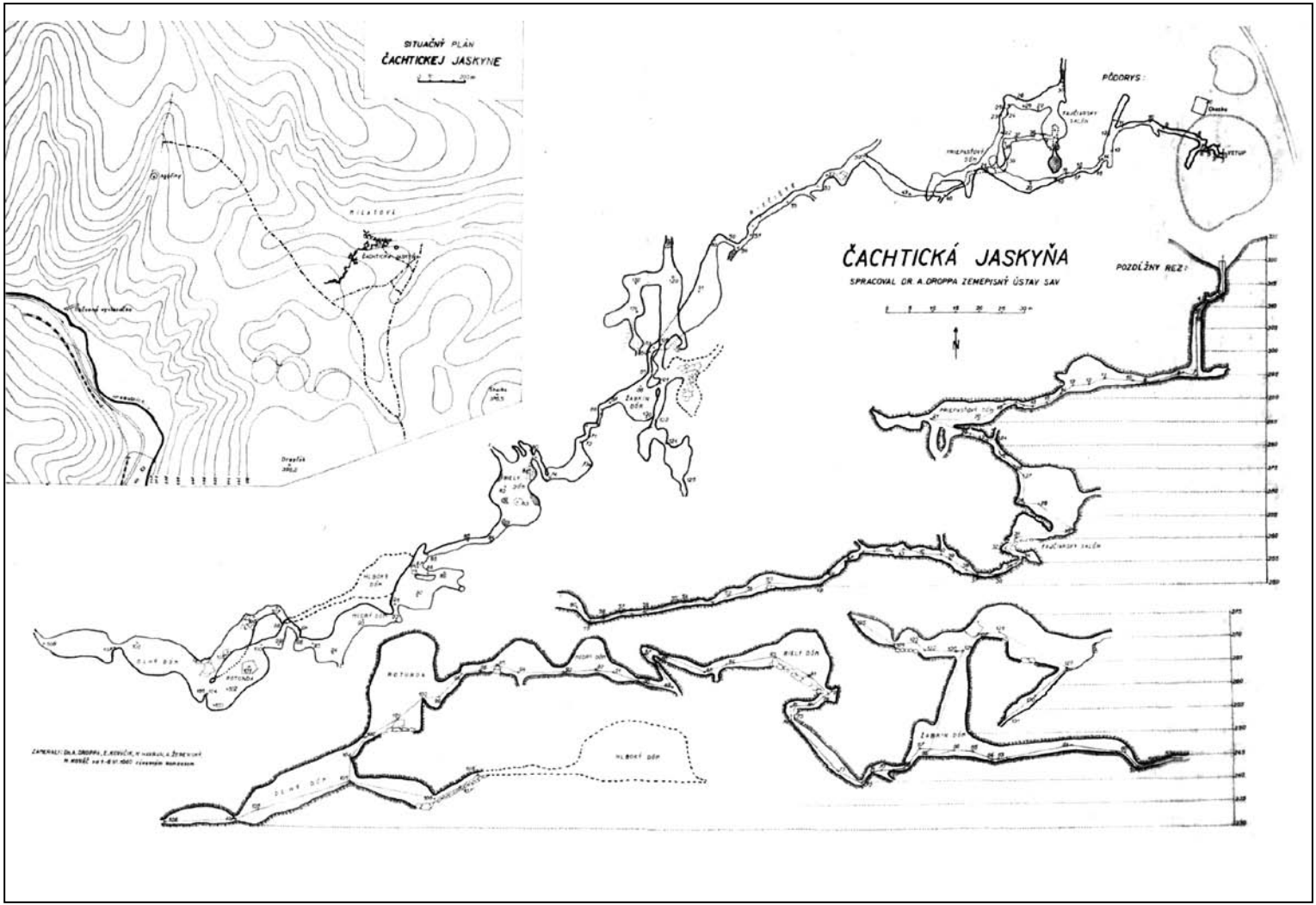
This first stage of mapping lasted up to 1982. Other, very important contribution to the already mapped areas was added by the team grouped around Braňo Šmída in the 2nd half of 1990's.

Employed Methodology

It could be said that, perhaps, any imaginable methodology were employed to map the Čachtice cave – beginning with the theodolite, continuing with the laser measuring system based on Leica Disto, the miner's compass and ending with the "Romanian method".

The largest part of the area was mapped using the simple "Sport" compass and the topofil and elevations were estimated with the accuracy to 0.5 m, in the same way as in Romania. It is worthless to question the accuracy of that method. It worked quickly and effectively and was verified on the dozens of kilometres of Romanian caves. Even in the later processing of the results by computer no essential errors were detected in the supporting materials obtained by the method of concern. On the contrary more problems occurred in relation to the data obtained by more accurate methods, if relevant sketches were missing.

At the beginning of works all the maps were drawn directly in the cave at the scale of 1:200 using graph paper (mostly impregnated by polystyrene), as it had been used in Romania. In fact, it was the only way, how one could make head and tail in the maze of cave galleries and cracks. Fortunately, those original map documents have been


SITUAČNÝ PLÁN
ČACHTICKEJ JASKYNE
ČACHTICKÁ JASKYŇA
SPRACOVAL DR. A. DROPPA ZEMEPISNÝ ÚSTAV SAV
PÔDORYS:
POZDĹŽNY REZ:
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HLBOKÁ DIERA
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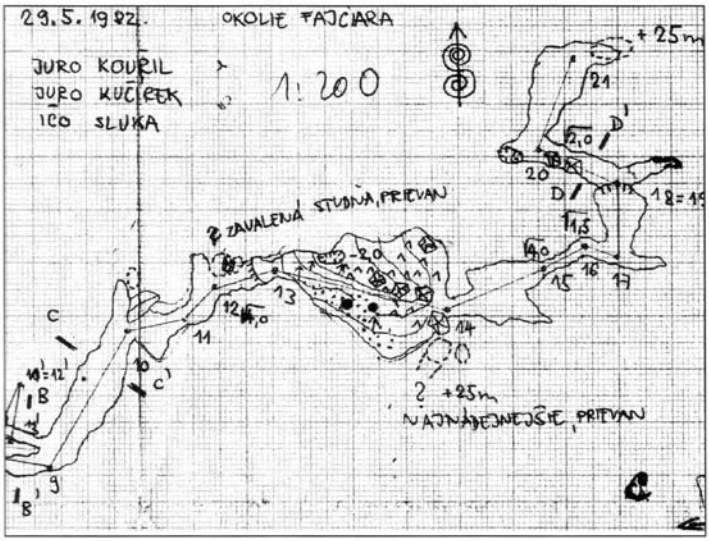


Fig. 2. The map sketched in cave on graph paper.

preserved. Juro Kouřil prepared their substantial part.

Each part of the cave map (of a length of 200 – 300 m) was transferred to the sheet of tracing paper. The sheet copies were forwarded always to the SSS secretariat as supplements to the trip reports. Regrettably, the original sheets have been "lost" as well as their copies in the SSS files – but a few exceptions.

Other substantial part of documentation of variable quality came from Braňo Šmída.

Peter Magdolen provided his detailed documentation on the surveying of the Katedrála (Cathedral).

There has been, and still is, the hand draw general map at the scale of 1:200, event if without any detail. Eyewitnesses certainly saw the large broadsheet stuck together from the sheets of graph paper with the cave outline drawn on. It was, however, the only copy and it has been never transferred on tracing paper to make the preparation of more copies possible (in that period blueprinting was the only available way for us how to make copies.).

In 1983 a manually drawn copy of the map was prepared at the scale of 1:1000. It was then reduced in scale and published in the specialised bulletin ("Spravodaj SSS").

Computer Era

I have never relinquished my dream of a well-done map of the Čachtice cave. An additional attempt was made in the mid of 1990's, when I entered the measured data in the CavePlot software.

Later, "Toporobot" software was employed and provided some contours of sorts (the set of lines connecting transversal sections). More importantly, using Toporobot we succeeded to record other data, namely the dates of particular actions, names of "surveyors" and to generate the first 3D model of the Čachtice cave. I attempted also to employ the data obtained in such a way as the initial one for drawing the map in the Adobe Illustrator software. But I gave it up very soon. It was impossible for me to make head and tail in several layers of space at the scale of 1 :200 with all the details and ceiling and bottom morphology.

Meanwhile I concentrated my mapping activities particularly on the Dead Bats Cave (JMN) (Central

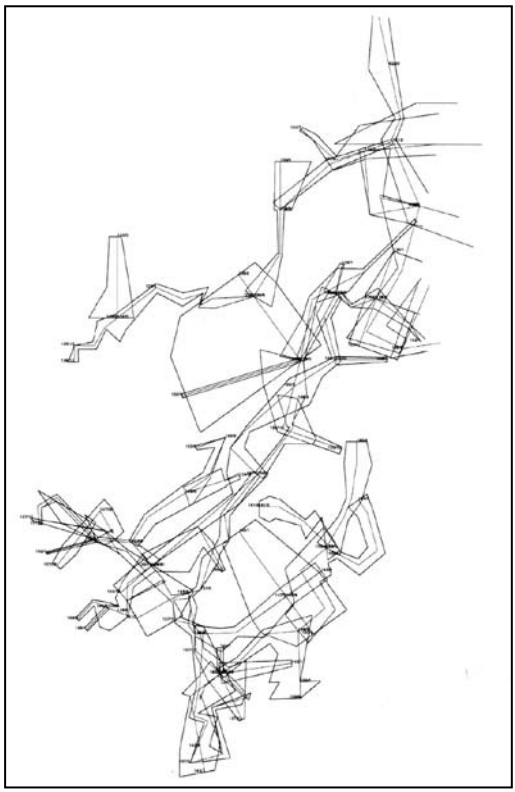


Fig. 3. A detail of the map obtained by means of Toporobot.

Slovakia – Low Tatras), where our habits gained in Romania proved successful again. In this connection I cannot forget the saying of leader of local cavers Milan Štéc, who said before entering the chasm "Thirty": "Now, boys of Prague, there are about 250 meters down there, we have crawled it through, now you can map it out." The exploration and surveying of areas located below the "Thirty" has not been completed up to now.

Before the end of 1990's in the JMN we started to work with Martin Budaj and Stacho Mudrák, cavers from town Banská Bystrica, Slovakia.

They were young and enthusiastic and, fortunately, resisted to the enticement of "making all things properly" and to the temptation to map it again. Instead of it they commenced to gather all the available supporting materials and succeeded to draw, by hand, the JMN atlas of 166 pages at the scale of 1:200. As it is stated in the introduction to the Therionbook, already in the course of drawing the atlas it became clear that its thorough review should follow, as the discovery of new areas had not ceased.

Therion Era

As early as in the mid of 1960's the cavers of the U.S.A. raised the idea to digitize the information on cavem areas. At that time that attempt ended in a complex numerical code assigned to the relevant survey point. The code characterised the space around the point of concem. The results were as inapplicable to map drawing as unintelligible for man.

Similar attempts have been made repeatedly with recurrence to find a solution – for the last one see Compass Points, 2005, no. 34, (BCRA, United Kingdom).

Very interestiting articles wrote David MacKenzie: "Cornputer-Drawn Passage Walls", Association for Mexican Cave Studies Activities Newsletter #11 pp86-89, 1980 and Andrew Waddington: "Computer Drawn Passage Walls", Cambridge Underground 1986-7, pp 13-14. One may read these articles as the "first chapters of Introduction to Therionbook",

In the course of discussions we held in the JMN, and in the Gen. M. R. Štefánik Chalet, with Martin and Stacho we repeatedly encountered that idea and it gradually appeared to us that the idea might be successfully implemented – to get a chance for generating the maps of caves based on their digital description. Then, on Christmas 1999, Martin and Stacho really created the first minimalist version of Therion software.

From the very beginning it was clear if I want to complete the map of Čachtice cave at all, it would be possible by means of the Therion software only.

However, it was not so simple. My repeated attempts to understand the complex methods used for working in Therion always ended with disappointment at my own incompetence. Therion allows for recording any information shown on the maps of caves – try to imagine it. It is the main source of complexity of the software. At that time Martin and Stacho had already almost the whole JMN, the Cold Wind Cave, Harmanec cave and a number of other smaller locations described in Therion (together around 30 km).

Finally, at the beginning of 2004, I made up my mind to scan the first original maps of Čachtice cave to be used as the input data for drawing it in Therion. After numerous consultations by phone and e-mail, evening after evening, I gradually drew out almost all the parts of the syslem that were available to me. It took about one year of work and then I was able to generate the whole ground pian of the Čachtice cave. The most interesting aspect of the whole work was the way, in which the individual pieces ("scraps") of that "jigsaw puzzle" forming the entire map fitted one another. Participants in the Speleomeeting of SSS 2005 got the chance to see the map at the scale of 1:200 (small part shown here).

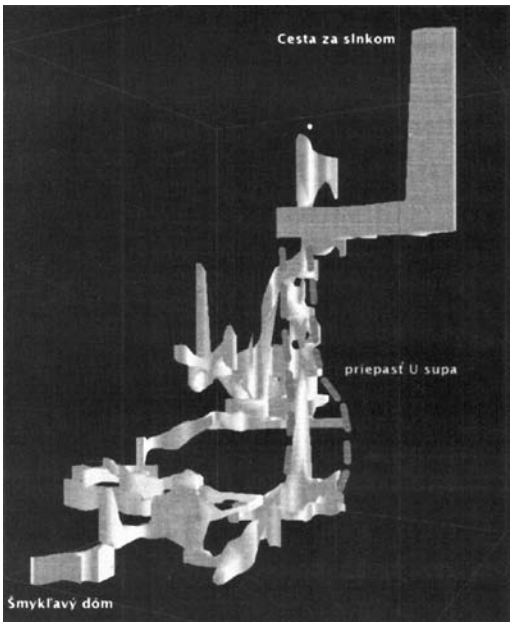


Fig. 4. Around the Sup chasm. Generated by Therion.

The things that have not been made up to now include cross sections, the extended elevation and the complete review of known areas. Those works may be, however, carried out by other interested people, who will need to add any new data to the existing ones, and add certain details and new areas. There are tens of promising points in the Čachtice cave.

Conclusion

On the conclusion I would like to thank very much to Martin and Stacho for their Therion. On the ground of the SSS a tool was developed for documenting cavern areas, which has not find a parallel in the world up to now (http://therion.speleo.sk). The right way consists in the generation of caves documentation, not in drawing the works of art. The software is able to generate the general map or atlas, a 3D visualisation or contours for publication at the scale of 1:2000, statistics or the detailed map of a caves part needed for an exploration using the only set of data stored in the computer. Therion is anything but a simple tool, but it is the only one that is able to manage the challenge.

Participants in the Mapping of Čachtice cave, ordered by surveyed lengths [m]:

Martin Sluka 2935.21; Juraj Kouřil 1846.32; Jaroslav Kouřil 1185.02; Braňo Šmída 890.8; Štefan Sluka 887.64; Juraj Kučírek 766.22; Jaroslav Zoldfay 654; Vladimír Guľa 588.7; Ivan Poláček 550.07; Božena Betušová 542.9; Lubomír Vlkovič 542.9; Jiří Schwarzer 530.89; L. Novotný 477.89; Peter Zámečník st. 469.87; Anton Straka 448.97; Peter Zámečník ml. 387.89; Ján Kunda 367.19; Jozef Blaško 352.54; Michal Dvorský 347.35; Ján Rajčány 335.3; Ivan Demovič 323.4; Ludovít Straka 323.4; Alžbeta Straková 323.4; Peter Hankócy 269; Stanislav Lovič 269; Vladimír Nosko 269; M. Uherčík 240.1; Stanislav Kučírek 237; Peter Jurika 233.5; Libor Vlkovič 233.5; Erik Kapucian 216.91; Jozef Murárik 147.7; Pavol Senecký 140.1; Ľubomír Vince 135.9; S. Gajdošík 128.44; Milka Kouřilová 93.4; J. Drobný 92.4; Peter Magdolen 92.4; D. Moravanský 92.4; T. Šembera 92.4; J. P. Sadloň 89.3; Antonín Jančařík 84.6; A. Černý 69.48; Andrej Holovič 69.48; Ondřej Sluka 69.48; M. Uhlík 69.48; P. Bada 66.11; Karol Kýška 58.4; Iša Pospíšilová 53; Vladimír Kubiš 51.75.

The overall length of centrelines employed in mapping the Čachtice cave is 3865 m.

If I have forgotten to name someone, I would like to apologize to him or her for the omission, but not all the available documentation contains the surveyors' names.

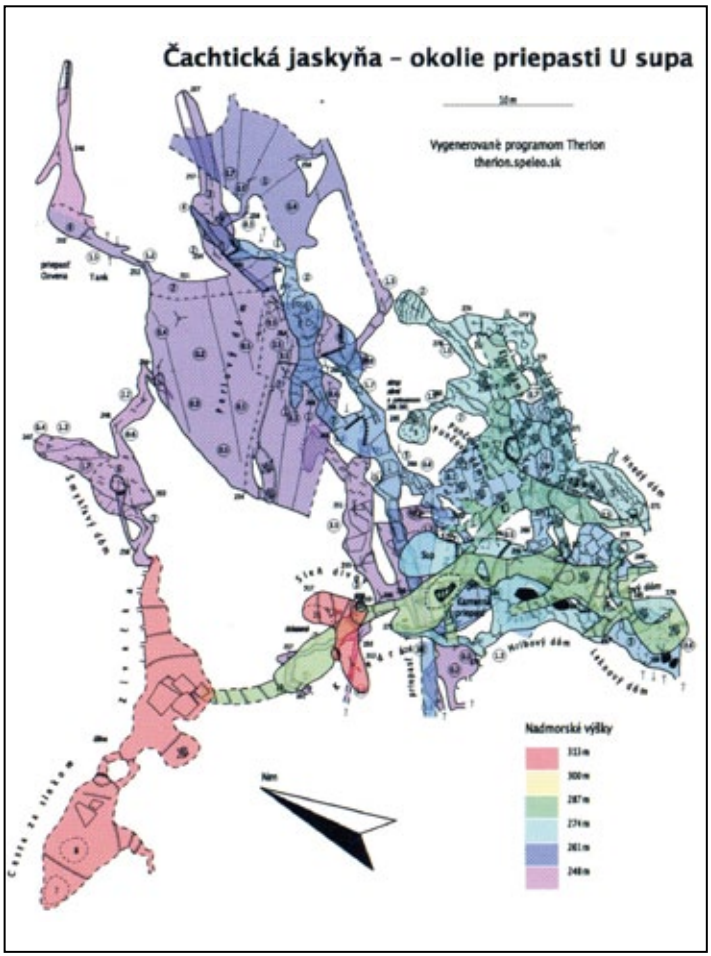


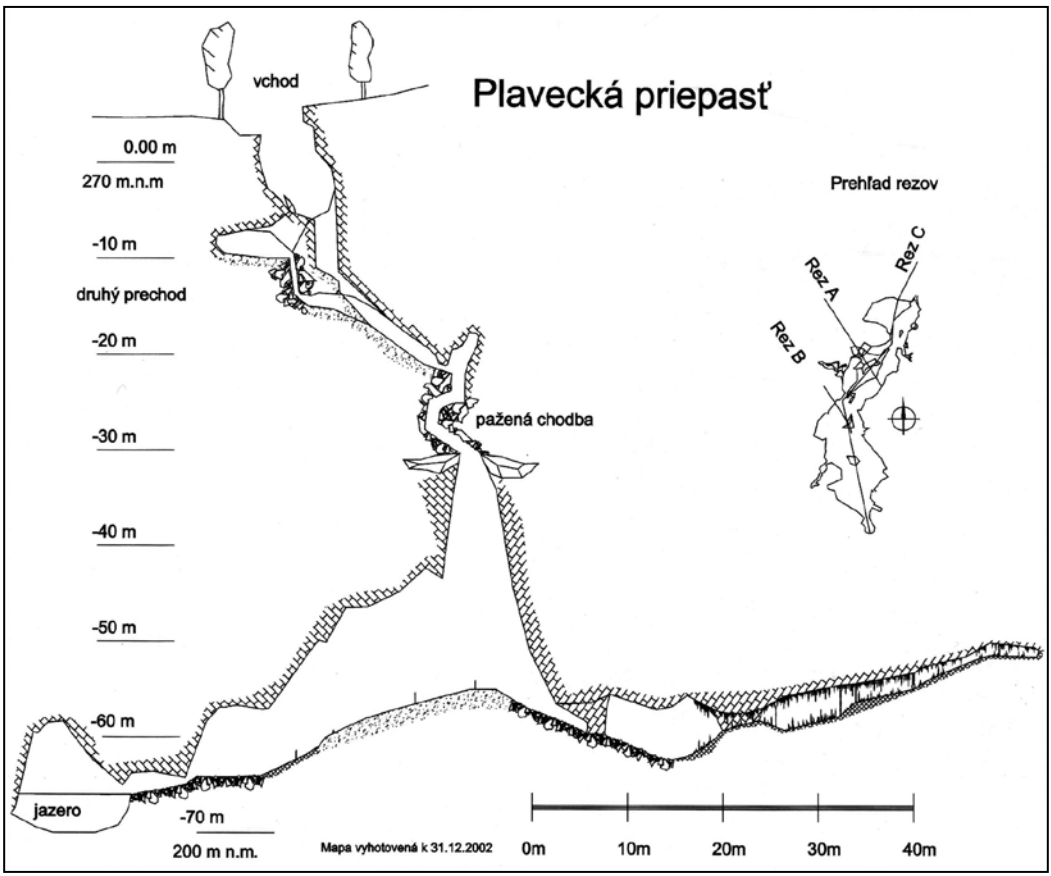
Fig. 5. 3D oj Sup chasm generated by Therion and visualised in Geo3D (http://www.topoi.ch).

PLAVECKÁ ABYSS PP-2

Jaroslav Butaš

In 1996 members of Plavecké Podhradie speleological group and Speleo Bratislava realized new examination of Plavecká abyss PP-2 (before called as a Cable cave, Malé Karpaty Mts.). The result of this examination was a suggestion for new exploratory works. Spade-works on introductory parts of Plavecká abyss took whole following year. During this year we prepared a cableway for exploratory works and we also eliminated dangerous hanging rock-blocks. The exploratory probe has been situated in the south part of an abyss. The material from an upper part of our probe formed a mixture of rock-blocks with sinter crusts and the soil. The thickness of sinter crusts was from 50 to 70 cm. The work in following buried parts of a probe was very complicated, because free rock-blocks were unstable. For any advancement has been necessary to construct reinforcement. Steel pipes with Ø 60 mm have been used as a reinforcing material. The reinforcing cage has a square shape with proportions 1 × 1 m and it has been gradually constructed from up to down parts. The material from the probe has been mined out to top parts and our advancement was cca 1 m for one exploratory action. The free space has been found in a depth of 5 m and our observations confirmed a potential for further 30 m of a free space. For new advancement has been necessary to enlarge a bottom part of the exploratory probe. The enlargement of the bottom part took two exploratory actions and then we are able to descend on the bottom of new parts. The D-day happens 13.7.2002 and the pri vilege of the first descend was attributed to Tomáš Ďurka from Speleo Bratislava.

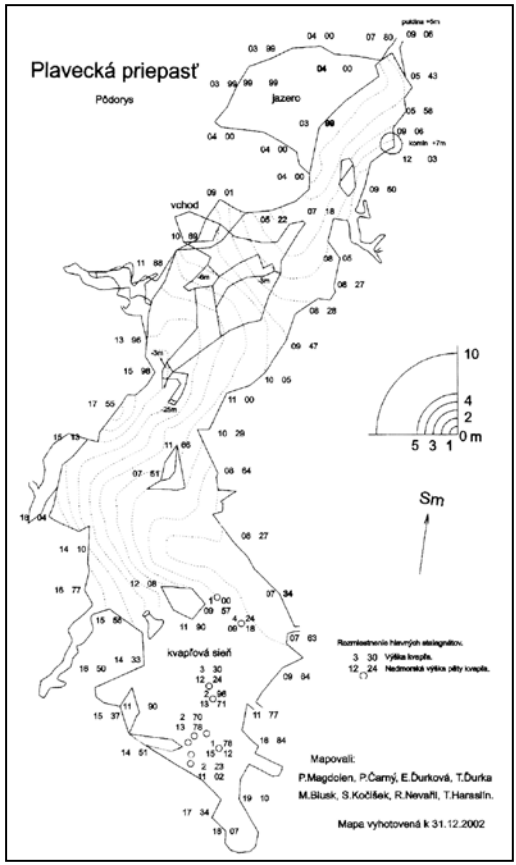
Plavecká abyss PP-2 is situated on the western side of the castle hill near to Plavecké Podhradie village. Surrounding rocks according to geological



map are light Mesozoic limestones (illyr to ladin) which contain layers of dolomites and they belong to Havranica nappe (a part of Choč nappe; Maheľ, 1972). The introductory part has a character of a little abyss with a cross-section 6 × 5 m. Two passages are in the bottom part, the first passage has a south direction and the second has a northern direction. The northern passage pass through a short caved part and then is again connected with a main southern passage. In the present this 10 m long passage is partly caved in and partly filled in with a mined out material. The southern passage opens with a short 6 long vertical part, next parts have a steeply declination and in the depth of 15 m is a bottle-neck which forms a beginning of upper spiral part of Plavecká abyss. The beginning of a main abyss is in depth of 30 m. The main chamber is 15 m width, 50 m long and it is 10 to 30 m high. The shape of a chamber is similar to church with one tower. The descend route is situated in a tower-shaped part. The bottom part bellow a main abyss is formed with a detrital material. This detrital cone has a northern declination.

The lower parts on the left side are beginning with a small passage (2 × 4 m) and later a height is changing from 5 to 12 m. The left side of this passage is covered with clay sediment. There is no another deposition of clay sediments in this cave. We suppose that this type of sediment has been redeposited from upper parts of this cave. The main area of lower parts is formed with a black lake. The depth of this lake is 0.5 to 3 m and a black color is probable caused by re-deposition of a guano into lake. Marks of various water-level on the walls refer to wobbling of water in lake. There is no knowledge about hydrologie regime of a lake, but now we monitor all changes of water-level for further genetic interpretation. We suppose that little springs near to cave are connected with this lake.

The upper parts on the right side are beginning with a passageway between the wall and the large detrital cone. Behind this narrow part is another chamber. The detrital material in this part is often coated with a sinter of variable thickness. The main speleothems of this chamber are staff-shaped stalagmites. Apart from this type of speleothems are also present quill-shaped stalactites, pagodas and sinter coatings or crusts. The longest staff-shaped stalagmite is cca 10 cm width and 4.6 m high. Speleothems have a white or creamy-ochre color. This space is 3 m width, 5 m long and the top of this part is falling from 15 to 5 m in an eastern direction. The unique speleothems are probably



connected with temperature conditions of Plavecká abyss PP-2. The temperature is 11 °C and this is not typical for the region of Malé Karpaty Mts. The humidity of cave is 90 to 95 %. Apart from classical speleothems the thick guano depositions and many bat bones have been found in some parts of both chambers. We suppose that these are remains after a large bat colony that colonized this cave for a long time. In the present time have been observed only three bats. We suppose that temperature conditions are not so good as in neighboring Plavecká cave. Bat bones have been collected and they have been given to SMOPaJ for an osteology research. Speleothems in this cave are unique and they need special protection. For more details see Bulletin of SSS (Butaš, 2003).

References

BUTAŠ, J. (2003): Plavecká abyss PP-2. Bulletin of SSS, vol. 34, no. I, 35-38 (In Slovak).

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List of the longest and deepest caves in Slovakia

By J.Tencer (2005), inovation to date 8.8.2005

The longest caves

1.	Demänovský jaskynný systém, Nízke Tatry, Demänovské vrchy	34952 m
2.	Stratenská jaskyňa – Psie diery, Spišsko-gemerský kras, Slovenský raj	21987 m
3.	Jaskyňa mŕtvych netopierov, Nízke Tatry, Ďumbier	19060 m
4.	Jaskyňa zlomísk, Nízke Tatry, Demänovské vrchy	10445 m
5.	Javorinka, Východné Tatry, Vysoké Tatry	8378 m
6.	Systém Hipmanových jaskýň, Nízke Tatry, Demänovské vrchy	7208 m
7.	Jaskyňa Skalistý potok, Slovenský kras, Jasovská planina	5885 m
8.	Domica – Čertova diera, Slovenský kras, Silická planina	5368 m
9.	Jaskyňa v Záskočí, Nízke Tatry, Demänovské vrchy	5034 m
10.	Mesačný tieň, Východné Tatry, Vysoké Tatry	5000 m
11.	Liskovská jaskyňa – jaskyňa L-2, Podtatranská kotlina, Chočské podhorie	4145 m
12.	Čachtická jaskyňa, Malé Karpaty, Nedze	4058 m
13	Belianska jaskyňa, Východné Tatry, Belianske Tatry	3641 m
14.	Stanišovská jaskyňa, Nízke Tatry, Demänovské vrchy	3138 m
15.	Moldavská jaskyňa, Košická kotlina, Medzevská pahorkatina	3070 m
16.	Bobačka, Spišsko-gemerský kras, Muránska planina	3036 m
17.	Jasovská jaskyňa, Slovenský kras, Jasovská planina	2811 m
18.	Harmanecká jaskyňa, Velká Fatra, Bralná Fatra	2763 m
19.	Čiemohorský jaskynný systém, Východné Tatry,Vysoké Tatry	2360 m
20.	Nová Stanišovská jaskyňa, Nízke Tatry, Demänovskě vrchy	2334 m
21.	Javorová priepasť, Nízke Tatry, Demänovské vrchy	2249 m
22.	Jaskyňa studeného vetra, Nízke Tatry, Ďumbier	1766 m
23.	Systém Suchej a Mokrej diery, Vysoké Tatry, Východné Tatry	1764 m
24.	Zápoľná priepasť, Kozie chrbty,Važecký chrbát	1721 m
25	Stratený potok, Spišsko-gemerský kras, Muránska planina	1642 m
26.	Bystrianska jaskyňa, Horehronské podolie, Bystrianske podolie	1600 m
27	Podbanište – jaskyňa nad Kadlubom, Revúcka vrchovina, Železnícke predhorie	1570 m
28.	Suchá jaskyňa,Velká Fatra, Hôľna Fatra	1541 m
29.	Gombasecká jaskyňa, Slovenský kras, Silická planina	1525 m
30.	Štefanová č.1, Nízke Tatry, Demänovské vrchy	1521 m
31.	Ardovská jaskyňa, Slovenský kras, Silická planina	1492 m
32.	Dobšinská ľadová jaskyňa, Spišsko-gemerský kras, Slovenský raj	1491 m
33.	Sokolová jaskyňa, Nízke Tatry, Demänovské vrchy	1460 m
34.	Brestovská jaskyňa, Západné Tatry, Roháče	1450 m
35.	Medvedia jaskyňa, Nízke Tatry, Demänovské vrchy	1420 m
36.	Demanovská medvedia jaskyňa, Nízke Tatry, Demänovské vrchy	1390 m
37.	Krásnohorská jaskyňa, Slovenský kras, Silická planina	1355 m
38.	Drienovská jaskyňa, Slovenský kras, Jasovská planina	1348 m
39.	Jaskyňa v ponore Jašteričieho jazera, Slovenský kras, Silická planina	1189 m
40.	Silická ľadnica, Slovenský kras, Silická planina	1100 m
41.	Jaskyňa v Homoli, Spišsko-gemerský kras, Muránska planina	1058 m
42.	Velké Prepadlé, Malé Karpaty, Homoľské karpaty	1045 m
43.	Jaskyňa na Kečovských lúkach, Slovenský kras, Silická planina	1010 m
44.	Četníkova svadba, Strážovská pahorkatina, Strážov	1000 m
45.	Okno, Nízke Tatry, Demänovské vrchy	930 m
46.	Ladzianskeho jaskyňa, Spišsko-gemerský kras, Muránska planina	909 m
47.	Jaskyňa verných, Východné Tatry,Vysoké Tatry	870 m
48.	Bystriansky závrt, Horehronské podolie, Bystrianske podhorie	843 m
49.	Nová Kresanica, Západné Tatry, Červené vrchy,	820 m
50.	Kunia priepasť, Slovenský kras, Jasovská planina	813 m

The deepest caves

1.	Systém Hipmanových jaskýň, Nízke Tatry, Demänovské vrchy	495 m
2.	Mesačný tieň, Východné Tatry, Vysoké Tatry	385 m
3.	Javorinka,Východné Tatry, Vysoké Tatry	360 m
4.	Jaskyňa mŕtvych netopierov, Nízke Tatry, Ďumbier	320 m
5.	Jaskyňa Skalistý potok, Slovenský kras, Jasovská planina	317 m
6.	Javorová priepasť, Nízke Tatry, Demänovské vrchy	313 m
7.	Jaskyňa v Záskočí – Na Predných, Nízke Tatry, Demänovské vrchy	284 m
8.	Systém Čiernohorských jaskýň, Východné Tatry, Vysoké Tatry	232 m
9.	Kunia priepasť, Slovenský kras, Jasovská planina	203 m
10.	Tristarská priepasť, Východné Tatry, Belianske Tatry	201 m
11.	Demänovský jaskynný systém, Nízke Tatry, Demänovské vrchy	201 m
12.	Stratenská jaskyňa – Psie diery, Spišsko-gemerský kras, Slovenský raj	194 m
13.	Havran, Nízke Tatry, Demänovské vrchy	187 m
14.	Čertova priepasť, Slovenský kras, Horný vrch	186 m
15.	Nová Kresanica, Západné Tatry, Červené vrchy	183 m
16.	Brázda, Slovenský kras, Silická planina	181 m
17.	Bystriansky závrt, Horehronské podolie, Bystrianske podolie	174.5 m
18.	Zadný úplaz, Západné Tatry, Červené vrchy	165 m
19.	Belianska jaskyňa, Východné Tatry, Belianske Tatry	160 m
20.	Jaskyňa zlomísk, Nízke Tatry, Demänovské vrchy	147 m
21.	Bobačka, Spišsko-gemerský kras, Muránsky kras	142 m
22.	Malá Železná priepasť, Slovenský kras, Silická planina	141 m
23.	Velká Buková priepasť, Slovenský kras, Silická planina	140 m
24.	Ponorná priepasť, Slovenský kras, Silická planina	135 m
25.	Jaskyňa studeného vetra, Nízke Tatry, Ďumbier	129 m
26.	Ľadová priepasť, Nízke Tatry, Demänovské vrchy	125 m
27.	Diviačia priepasť, Slovenský kras, Plešivecká planina	123 m
28.	Nová Éra, Východné Tatry, Belianske Tatry	121 m
29.	Bezodná priepasť, Západné Tatry, Osobitá	120 m
30.	Veterná priepasť, Slovenský kras, Horný vrch	120 m
31.	Jaskyňa Slnečného lúča, Nízke Tatry, Demänovské vrchy	113 m
32.	Dobšinská ľadová jaskyňa, Spišsko-gemerský kras, Slovenský raj	112 m
33.	Natrhnutá priepasť, Slovenský kras, Dolný vrch	112 m
34.	Silická ľadnica, Slovenský kras, Silická planina	110 m
35.	Hlinoš, Slovenský kras, Dolný vrch	110 m
36	Čachtická jaskyňa, Malé Karpaty, Nedze	110 m
37.	Attilova priepasť, Slovenský kras, Silická planina	108.5 m
38.	Priepasť v Okolíku, Západné Tatry, Osobitá	106 m
39.	Michňová, Spišsko-gemerský kras. Muránska planina	105 m
40.	Mojtínska priepastná jaskyňa, Strážovské vrchy, Mojtín	104 m
41.	Zvonivá jama, Slovenský kras, Plešivecká planina	101 m
42.	Obrovská priepasť, Slovenský kras, Dolný vrch	100 m
43.	Kosienky, Nízke Tatry, Demänovské vrchy	97 m
44.	Jaskyňa pod Úplazom, Východné Tatry, Vysoké Tatry	97 m
45.	Priepasť na Sivom vrchu, Západné Tatry, Sivý vrch	93 m
46.	Bystrianska jaskyňa, Horehronské podolie, Bystrianske podolie	92 m
47.	Jaskyňa na Rúbani, Strážovské vrchy, Strážov	92 m
48.	Štefanová 1, Nízke Tatry, Demänovské vrchy	91 m
49.	Jaskyňa za Bukovicou, Nízke Tatry, Demänovské vrchy	91 m
50.	Nová Muflonia priepasť, Slovenský kras, Plešivecká planina	88 m