Caves Formed in the Volcanic Rocks of Hungary
Part I: Caves formed in Rhyolite, Rhyolite Tuff, Rhyodacite Tuff, Dacite, Andesite, Andesite Agglomerate and Andesite Tuff

István Eszterhás[1] & George Szentes[2]

[1]Köztársaság út 157. H-8045 Isztimér, Hungary
[2]Alte Frankfurter Str. 22 b, D-61118 Bad Vilbel, Germany. szentes@aol.com

Abstract

Organised research into the non-karst caves of Hungary, relating to the study of caves formed in volcanic rocks, began in 1983 with the launch of the Volcanspeleological Collective. Their comprehensive activities are still ongoing. The organisation, led by István Eszterhás, consists of a nucleus of 15 persons, who are occasionally joined by several more cavers. They have listed 894 non-karstic caves, and surveyed 741 of them. In 40 caves they have dug and discovered nearly 1000 m of new cave passages. They have studied the development of the non-karstic caves, and have determined new types of cave development (consequence caves, holes formed by alkaline solution, fumarole cavities). They have identified and described speleothems previously unknown in Hungary, such as silica stalactites and isingerite discs. They have solved the problem of ice development in low elevation basalt caves. They have classified 200 species of animals and 18 species of fungi (some of them are unusual) which are to be found in the caves. The results have been summarized in 7 separate volumes and in 160 articles mainly in Hungarian, but occasionally in German or in English. The majority of the non-karst caves in Hungary, numbering 669 caves, developed in volcanic rocks. The study reviews, in two parts, the most important achievements resulting from research on these caves. The first part presents the caves formed in rhyolite, rhyolite tuff, rhyodacite tuff, dacite, andesite, andesite agglomerate and in andesite tuff.

1. Introduction

In Hungary as well as 2800 karst caves, 894 non-karst caves are listed (Bertalan 1958, Eszterhás 2005, Eszterhás & Szentes 2004-2009, Ozoray 1952). Among the non-karst caves, 669 have developed in volcanic rocks. The first part of this study summarizes the 531 non-karst caves, which have formed in rhyolite, rhyolite tuff, rhyodacite tuff, dacite, andesite, andesite agglomerate and in andesite tuff. The majority of the caves are between 2 and 10 m long, but some are more extensive and have developed in an atypical manner. The longest non-karst cave in Hungary, the 428 m long Csörgő Hole in the Mátra Mountains, has developed in rhyodacite tuff. Detailed information on the caves in rhyolite, rhyolite tuff, rhyodacite tuff, dacite, andesite, andesite agglomerate and in andesite tuff can be viewed on the website http://geogr.elte.hu/non-karstic using either Netscape or Mozilla browsers. The list is updated every year (Eszterhás & Szentes 2004-2009).

2. Geological locations of the rhyolite, dacite and andesite formations

The main landscape of Hungary consists of the Great Hungarian Plain, the Small Plain, the North Hungarian Mountains, the Transdanubian Central Mountains, the Transdanubian Hills and Island Mountains and the pre-Alps. In the present study we discuss only those landscapes where caves are to be found in the volcanic formations. The Devonian, Permian, Jurassic and Cretaceous quartz porphyry, diabase and dolerite occurrences in the Bakony, Mecsek and in the Mátra Mountains are negligible as regards cave development.

Significant andesitic volcanism took place in the Middle and Upper Eocene, which resulted in the formation of amphibole andesite, andesite agglomerate and tuff in the Velencei and in the Mátra Mountains. The caves of the Pázmándi Cliffs in the north-eastern part of the Velencei Mountains formed in andesite agglomerate. Volcanic activity in the Miocene produced extensive rhyolite, dacite, andesite masses and their tuffaceous formations in the Visegrádi-, Börzsöny-, Mátra- and in Eperjes–Tokaji Mountains. The majority of the caves are to be found in these sequences. Part of the Cserhát Mountains and the Bükk Region are also composed of similar sequences (Fig. 1).

The key horizon in the North Hungarian Mountains is the Lower Miocene Ottnangian light grey pumiceous rhyolite tuff referred to as Lower Rhyolite Tuff in geological literature. In the Carpathian and Badenian Stages significant andesite volcanic activity and tuff deposition occurred. The rhyodacite tuff, referred to as Middle Rhyolite Tuff divides the Lower and the Middle Andesite Formations. The final stage of andesite volcanism is characterised by dark grey piroxene andesite. Andesite volcanism was accompanied by rhyolite intrusions in the Mátra and Eperjes-Tokaji Mountains. Little Miocene dacite occurs in the Börzsöny and Mátra Mountains.

The Visegrádi Mountains have formed from a Miocene

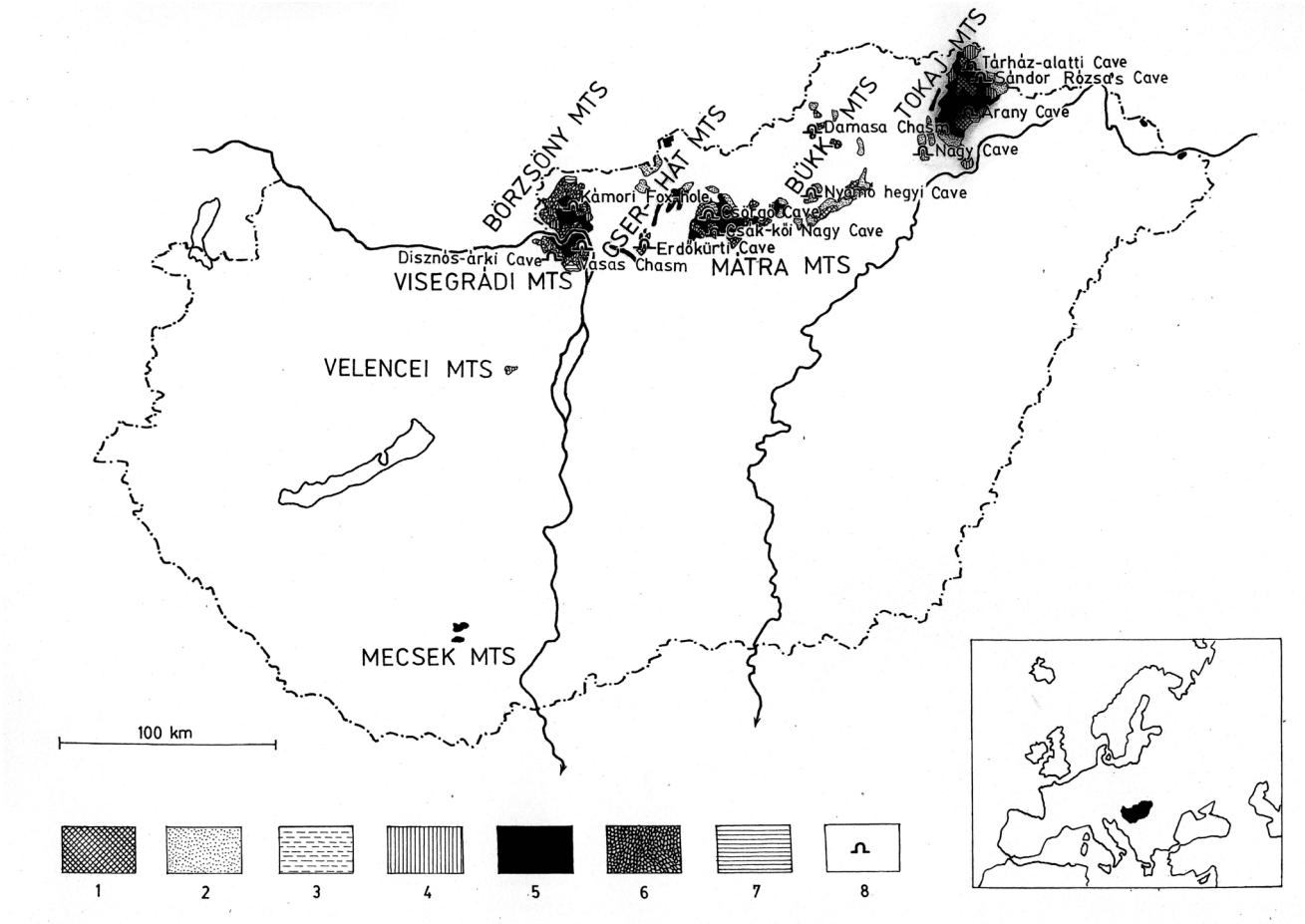

Fig. 1. Caves formed in rhyolite, dacite, andesite and in their tuffs in Hungary, showing the most remarkable caves in the formations. 1. rhyolite, 2. rhyolite tuff, 3. rhyodacite tuff, 4. dacite, 5. andesite, 6. andesite agglomerate, 7. andesite tuff, 8. remarkable cave

stratovolcano which has been strongly denuded and dissected along fault lines. It is composed of andesite agglomerate, andesite tuff and subordinately compacted andesite. The Börzsöny Mountains are mainly made up of the denuded residual of a Miocene stratovolcanic blanket. In the middle section a collapsed caldera can be proved. The major part of the landscape consists of low hills formed of sediments. In the middle and eastern areas of the mountains andesite rift volcanoes, andesite agglomerate and andesite tuff appear. The base of the Medves-Ajnácskői Mountains is composed of a denuded Miocene sedimentary formation. The mountains have witnessed a great deal of basalt volcanic activity, though this activity began with two andesite laccolith intrusions. The Mátra Mountains comprises of a stratovolcanic group with several eruption centres. The eruptions happened in the Miocene and have resulted in various formations of lava rocks and pyroclastics. Volcanic tuff deposition has covered large areas in northern Hungary. Thick tuff and the andesite agglomerate layers have accumulated in the margins of the karstic Bükk Mountains, and it is here that several non-karst cave caves have developed. The andesite agglomerate also outcrops also on the rim of the Sajó Basin. Intense volcanic activity took place in the Eperjes-Tokaji throughout the Miocene. The oldest sequence is composed of andesite, andesite agglomerate and tuff, while the younger formation is of rhyolite, rhyolite tuff and subordinate dacite and dacite tuff (Juhész 1987, Fig. 1.).

3. The most significant caves and their genotypes which have formed in rhyolite, dacite, rhyolite tuff and rhyodacite tuff

Three caves have formed in rhyolite in the Mátra Mountains, one small crevice cave, one small pseudo cave and the Csák-kői Big Cave. The Csák-kői Big Cave can be found in a former millstone quarry near the village of Gyöngyössolymos. It consists of a large cavity in hyolite, caused by breakdown and thus is a consequence cave (Fig. 2; Fig. 3). There are two distinct parts to this cave. The southern part is the original quarried chamber and consequently this is an artificial cavity. On the other hand the northern part, a long labyrinth, has resulted from natural breakdown and has developed as a natural cave. There are six entrances to the artificial cavity and to the natural cave. The length of both parts is 113 m.

Thirty one caves between 2 m and 40 m long have formed in rhyolite and perlite in the Eperjes-Tokaji

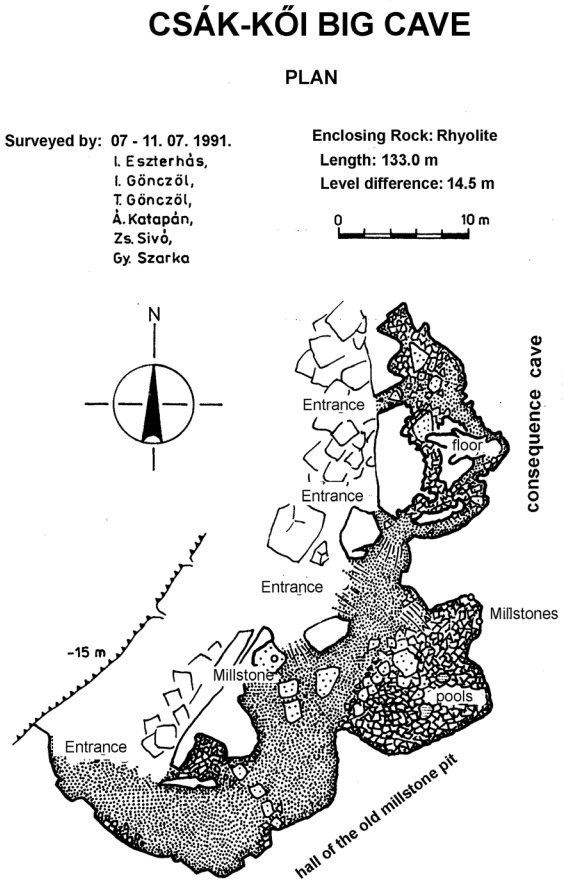

Fig. 2. Survey of the Csák-kői Big Cave in rhyolite Mátra Mountains.

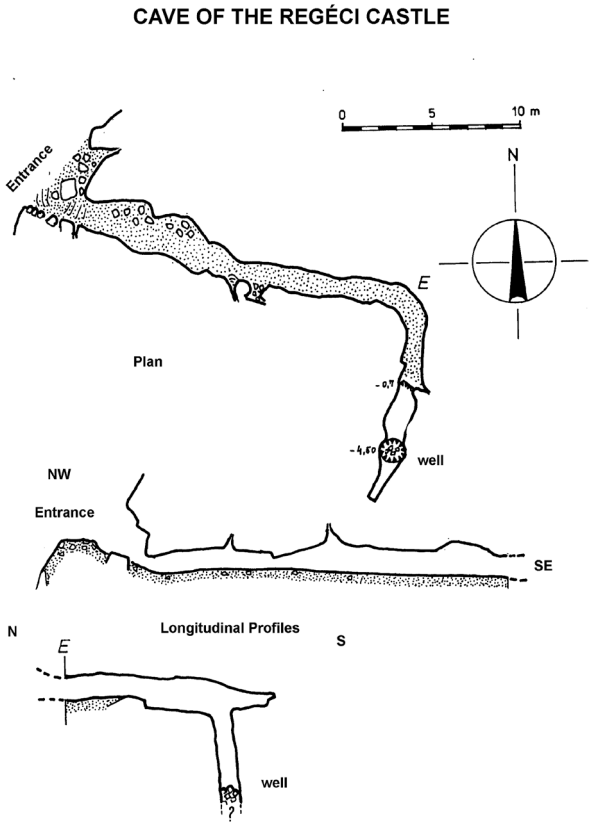

Fig. 4. Survey of the Cave of the Regéci Castle, Eperjes-Tokaji Mountains.

Fig. 3. Csák-Kői Big Cave in rhyolite, Mátra Mountains

Fig. 5. Cave of the Regéci Castle in dacite, Eperjes-Tokaji Mountains

Mountains. The 13 m long Cave Beneath the Garnet near the village of Füzér developed along fault lines as a result of movement. The 29 m long Iván Cave to the north of Erdőbénye village has formed as a result of extension, which was caused by the termination of lateral pressure in the rock masses. Small rock shelters developed as a result of lateral erosion, for instance the 2-3 m deep Rock Shelter below the Castle of Kőkapu.

Only in the Eperjes-Tokaji Mountains have caves formed in dacite. There are 28 caves between 2 m and 40 m in length. The longest cave in dacite is the 40 m long Regéci Castle Cave (Fig. 4, Fig. 5). Only the first 20 m is natural cave passage, formed as a result of weathering along the fault line. The rest of the cave has been artificially widened and a well has been dug at the end. The 11 m long through cave, Desem Cave was formed by rock extension (Eszterhás 1993).

In northern Hungary, 38 caves have formed in rhyolite tuff and rhyodacite tuff. The petrographic difference between rhyolite tuff and rhyodacite tuff is minimal, therefore we present collectively those caves which have formed in these rocks. In the Mátra Mountains one small cave has developed in rhyolite tuff and 6 caves have formed in rhyodacite tuff. The rhyodacite tuff, referred to as Middle Rhyolite Tuff, is speleologically important because the longest non-karstic cave in Hungary, the 428 m long Csörgő Hole has formed in rhyodacite tuff (Eszterhás 2003a). The Csörgő Hole is an atectonic labyrinth (Fig. 6).

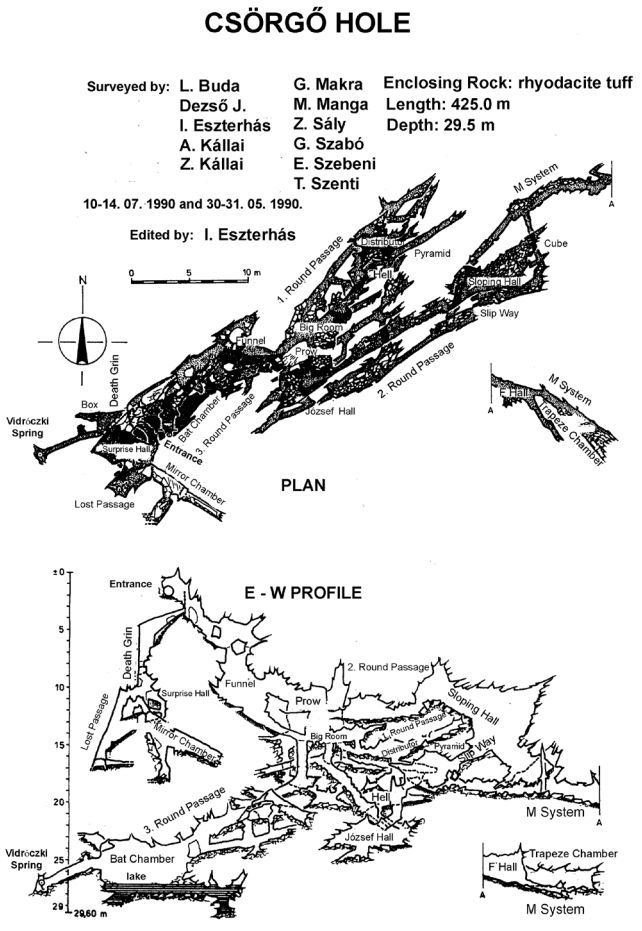

Fig. 6. Survey of the Csörgő Hole, the longest non-karst cave in Hungary, Mátra Mountains.

The development of the cave can be traced back to the continuous sliding of the rhyodacite tuff and the consequent aggradation. The boulders have slid south-eastwards on a 20° slope, therefore between the accumulated boulders passages have formed following a NE - SW strike. Because of the continuous sliding of the boulders, the size and form of the cavities are still subject to frequent change. This cave consists of a complicated labyrinth with several chambers, passages of varying lengths, and shafts (Fig. 7).

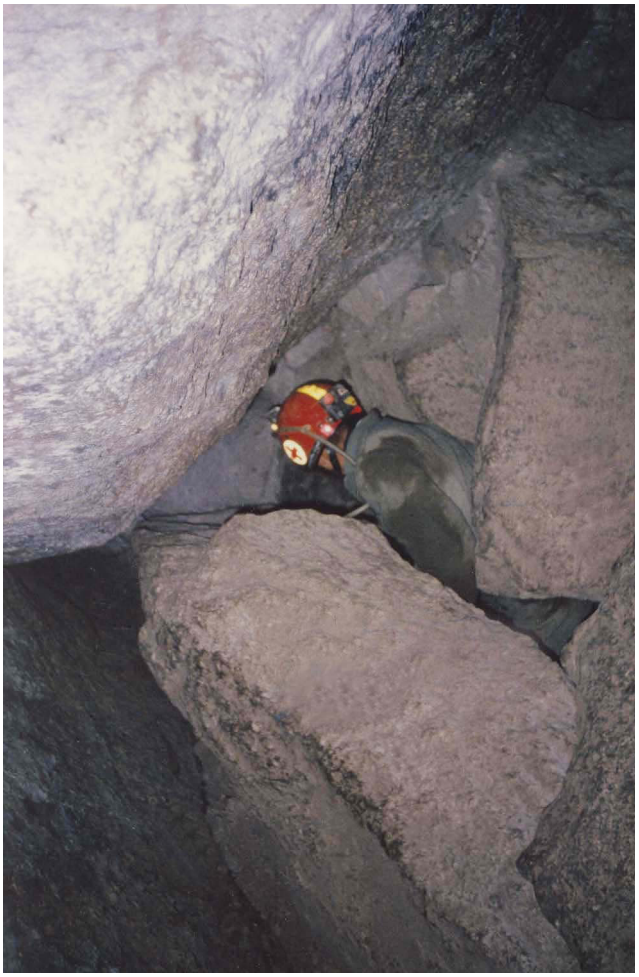

Fig. 7. Csörgő Hole in rhyodacite tuff, Mátra Mountains.

The 15 m long Macska Cave can be found in the Gorge of the Macska Valley. The cave was developed by rock extension in rhyodacite tuff. After the deepening of the gorge, its steep, backward sloping side lost its lateral support and thus tension occurred in the rock mass. Later the rock cracked and the blocks separated from one another, forming a cave-sized fissure. The Macska Rock Shelter is a cavity the Macska Valley. The rock shelter was shaped by erosion in rhyodacite tuff below a waterfall.

Nearly one thousand artificial caves, mainly former cave-dwellings and cellars, have been excavated in rhyolite tuff in the Bükk Region. Ten small natural caves have been formed in rhyolite tuff. The biggest is the 16 m x 18 m Nyomó-hegyi Cave (Fig. 8), which has formed as the result of fragmentation of rhyolite tuff . There are also tectonic caves such as the 13 m long Haramia Pit.

Twenty two caves have formed in rhyolite tuff in the Eperjes-Tokaji Mountains. The most spectacular

Fig. 8. Nyomó-hegyi Cave in rhyolite tuff, Bükk Region.

is the 50 m long Arany Cave (Fig. 9; Fig. 10) near the village of Tállya. The entrance to this partly collapsed horizontal cave has developed in a complex manner. Originally it was formed along a fissure by an underground stream. The natural passage was widened to accommodate a mining tunnel in the 17th century when ore prospecting was in progress. Later, the first part of the tunnel collapsed but was subsequently re-opened in 1993. There is a slow running, knee deep, stream in the cave. The roof is nicely decorated with a large number of 20-40 cm long silicate stalactites.

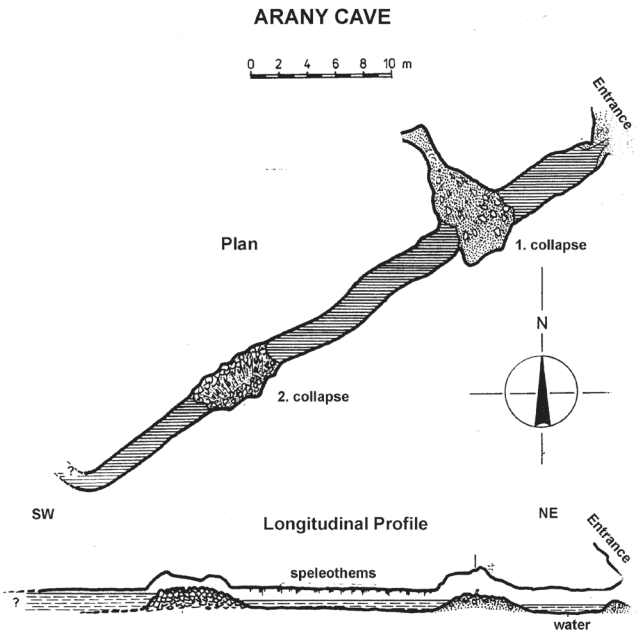

Fig. 9. Survey of the Arany Cave, Eperjes-Tokaji Mountains.

Alkaline solution has been responsible for the formation of ten caves in the Miocene rhyolite tuff of Mount Fuló near the village of Legyesbénye. There the 25 m long Big Cave, and the 13 m long Small Cave are the most spacious. The seeping alkaline hot spring

Fig. 10. Arany Cave in rhyolite tuff, Eperjes-Tokaji Mountains.

water has resulted in siliceous precipitation in the rhyolite tuff. After the pH of the water exceeded 9 the process was reversed, and the precipitated silica was dissolved. As a result of this, natural holes developed in the tuff. The Somosi Hole, near the village of Golop, despite being a cellar, can be considered as a natural cave in the rhyolite tuff, because the break down of the cavity displays the initial phase of consequence cave formation.

4. The most significant caves and their genotypes which have formed in andesite, andesite agglomerate and andesite tuff

Four hundred and thirty-one caves in Hungary have formed in andesite, andesite agglomerate and andesite tuff.

Two caves have developed in compact andesite in the Visegrádi Mountains. The 13 m long Dömörkapui Cave is a consequence cave, which is a result of the break down of a mining tunnel. The 4 m x 8 m wide Csódi-hegyi Cave is believed to be a syngenetic cave. Five smaller caves have developed in andesite in the Börzsöny Mountains. The most significant is the 10 m long Andesite Cavity in the Rózsa Mine. The cave is a syngenetic crystal cave, which was opened by ore mining operations to a depth of 92 m. Five caves are to be found in andesite in the Cserhát Mountains. As a consequence of intense Miocene volcanic activity, the syngenetic caves of Függő-kői Cave, Double Hole and

the Sámsonházi Bubble Cave are syngenetic caves, which were formed by steam explosion (Szentes 1971). The Sárkányfürdő Cave was developed in andesite by the lateral erosion of the Cserkúti Creek.

Twenty-one caves open in compact andesite in the Mátra Mountains (Eszterhás 1996). There are two different types of syngenetic holes. In the abandoned and flooded Gyöngyösoroszi Mine, four crystal caves were found at a depth of several hundred metres. The caves were formed on the edge of an ore dyke and the tracyandesite as a result of the influence of the ascending hot solutions. The cave walls were covered with spectacular crystals, mainly of amethyst. Unfortunately after their discovery the crystal caves were looted and filled with debris. Gas bubble cavities, the Gyula Cave, the Kis Gyula Cave and the Vidróczki Cave are to be found in andesite near the villages of Mátrakeresztes and Mátraszentimre. The Gyula Cave has archaeological significance. The other caves in andesite are 2–5 m long crevices or rock shelters (Eszterhás 2003b).

One hundred and ninety-eight caves have formed in andesite in the Eperjes-Tokaji Mountains. The majority of these caves are between 2 m and 5 m long. Three andesite caves are longer than 20 metres. The longest is the 45.6 m long Rózsa Sándor Cave. The cave was developed by rock extension. The 31.5 m long Difficult Through Cave is a combined fissure which developed along several vertical crevices near the village of Háromhuta. The smaller caves exhibit some interesting characteristics regarding their formation and subsequent development.. Only one syngenetic cave, the Upper Cave, is to be found in this locality, and this is in Sárospatak town. This cave is a fumarole shaft. The 14 m long Bárány-hegyi Cave near the village of Boldogkőváralja has developed as a the result of rock fragmentation. Several caves have been formed as a consequence of loosening of the rock, along the bedding planes. These caves include Lőállás Cave near the village of Mogyoróska and Holyca Cave in the Tekeres Creek Valley. There are also some pseudocaves, such as Boldogkővári Hole and Labyrinth Cave near the village of Középhuta.

Many caves have formed in andesite agglomerate in the andesitic mountains, but in the Börzsöny and Visegradi Mountains only a few caves are to be found in andesite tuff.

Six caves have been found in the Eocene andesite agglomerate of the Velencei Mountains. The 7 m long Szedres Cave and Crevice Cave are tectonic caves near the village of Pázmánd. The 7 m x 6 m wide Maléza Cave and three other small caves are pseudocaves which were formed amongst the boulders at the above-mentioned location.

Sixty two caves have formed in andesite agglomerate in the Visegrádi Mountains. The longest cave is the 60 m long Disznós-árki Cave near the village of Pilisszentkereszt, which formed as a result of the sliding of broken rock layers and the consequent aggradation (Fig. 11). Nine other caves are longer than 10 metres. There are also syngenetic fumarole tubes, such as the Maria Cave, Ablakos Cave and the Csikóvári Tube Cave.

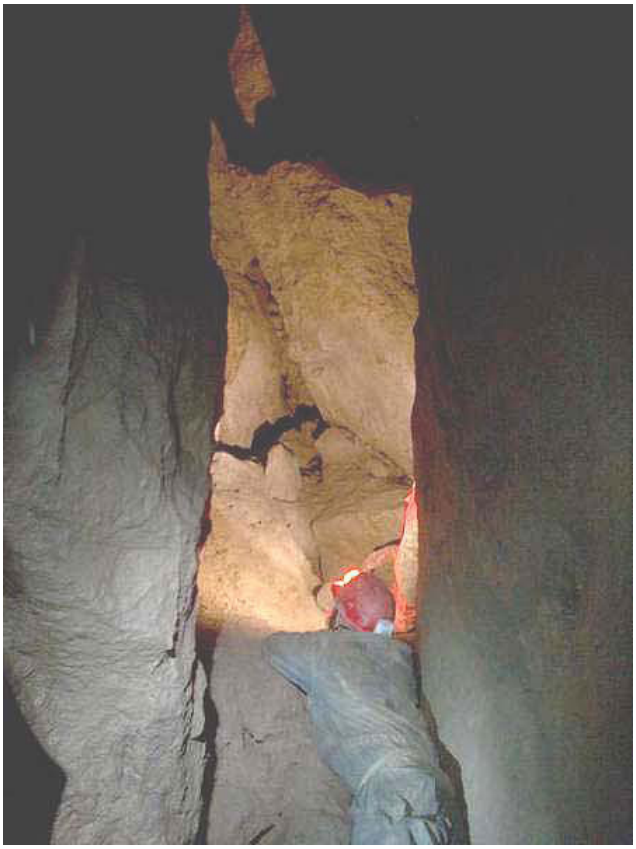

Fig. 11. Disznós-árki Cave in andesite agglomerate, Visegrádi Mountains.

Many different types of postgenetic caves have been identified. These include four caves between 25 m and 50 m long in the Vasas Chasm (Fig. 12; Fig. 13), whilst at Mount Kő, near the settlement of Dobogókő, the Egres Cave and the Bubia Cave have formed as a result of tectonic movement. The Őz Cave is a pseudocave located in the agglomerate boulders. The Rock Shelters of the Rám Chasm are typical erosional caves. Ten caves occur in andesite tuff. Sas-kövi Cave near the town of Szentendre is 63 m long, but the origin of the cave is in dispute as some say it is an artificial hole. The 16 m long Domini Cave is a pseudocave located in the andesite tuff boulders. The Karolina-árok Caves are lateral erosional caves.

Seventy-five caves have formed in the andesite agglomerate of the Börzsöny Mountains. These caves are generally small cavities, their average length being 4 m. Only 4 caves are longer than 10 metres. The thirty metre long Hermit Cave above the

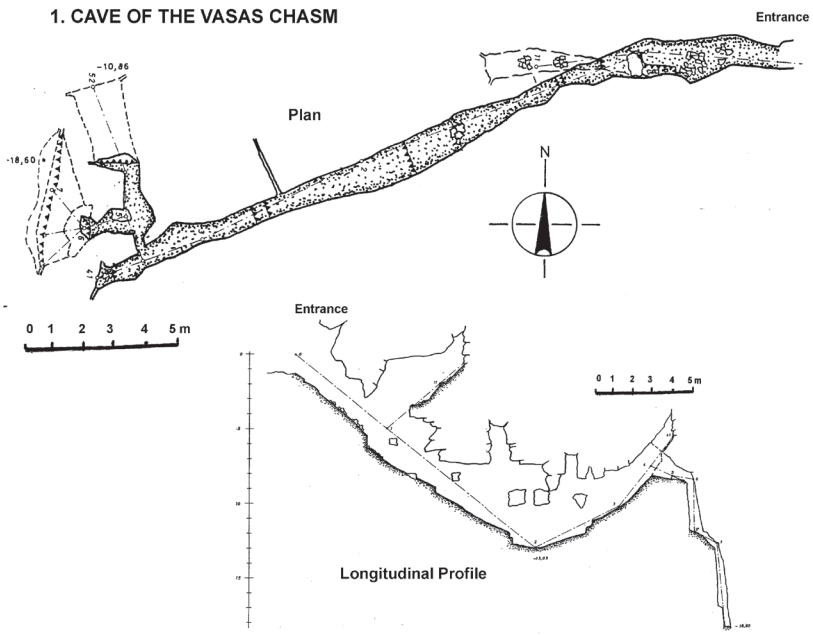

Fig. 12. Survey of Cave No. 1 of Vasas Chasm, Visegrádi Mountains

Fig. 13. Cave No. 1 of the Vasas Chasm in andesite agglomerate,Visegrádi Mountains.

village of Nagymaros has been artificially widened. The eighteen metre long Holló-kői-lámpás Cave is a pseudocave, formed amongst large boulders. The syngenetic Kámori Fox Hole was formed by the expansion and dissolving effect of ascending hot solutions in the semi-plastic lava rock. It is a 11.5 m long tube forming a horizontal cavity. The only 2 m long fumarole tube, Jókofág Cave, has a similar origin. Most of the caves in the Börzsöny Mountains are postgenetic. They were formed in andesite agglomerate by tectonic movement (Alsó-Rab Hole, Jancsi-hegyi Cave), either as a result of collapses along the bedding planes (Pléska Fissure Cave) or by the lateral erosion of a creek (Rakottyás-patak Cave, Pogány-völgyi Rock Shelter). Five caves occur in andesite. These are rock shelters, which were formed by lateral erosion, as instance the Itató-vízesési Rock Shelter.

One cave is known in andesite agglomerate in the Cserhát Mountains. The 21 m long Erdőkürti Andesite Cave opens in a quarry (Fig. 14; Fig. 15). It appears to be a syngenetic cave. On the swampy moorland falling hot volcanic gravel heated up the swamp water, pressure of the steam which was generated as a result of this caused a hollow to form in the andesitic gravel.

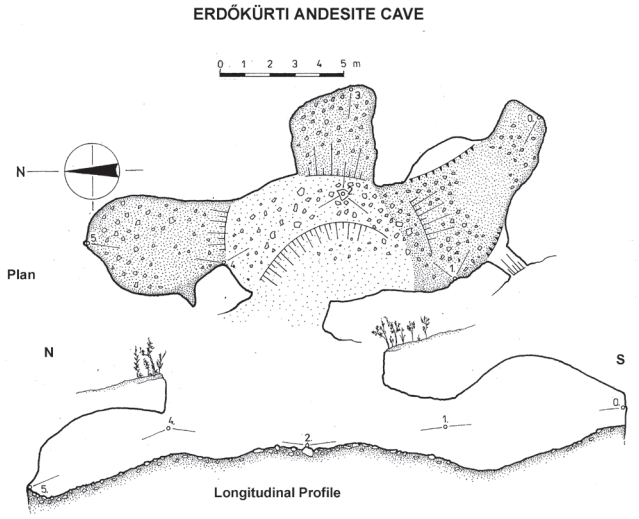

Fig. 14. Survey of the Erdőkürti Andesite Cave, Cserhát Mountains.

Fig. 15. Erdőkürti Andesite cave in andesite agglomerate, Cserhát Mountains.

Twenty-five caves open in andesite agglomerate in the Mátra Mountains. The caves are small, less than four metres long fissures or rock shelters. The Tekeres-kői Rock Shelter near the village of Abasár and the 5 m long Holló-kői Fissure Cave should be noted.

The tuffaceous sequence of the Bükk Region partly consists of significant andesite agglomerate accumulation. The eleven caves of Damsa Chasm are atectonic caves, for example the 56 m long Táncterem-Lepkés-ág Cave, the 24 m long Hollow Fissure and the 21 m long Deep Fissure, where the formation is the result of a landslide in the andesite agglomerate near Bánhorváti village. The length of the other eight caves are between 3 metres and 13 metres.

One cave is known in the Sajó Basin, in the hill country to the north of the Sajó River, the Nagy-kő Hole. It opens in the northern hills 1 km from the village of Sajókaza. The 2.9 m long and 1 m high cave has developed as a result of tectonic movement in an andesite agglomerate cliff, which rises from its tuffaceous environment.

No caves were found in either andesite agglomerate or in andesite tuff in the Eperjes-Tokaji Mountains.

5. Mineralogical, Hydrological, Climatological, Biological and Archaeological Observations

Generally the non-karst caves in Hungary are poor in mineral content, but in some caves formed in volcanic rocks various mineral formations occur. The andesite cavities from the influence of the ascending hot solutions in the Mátra and Börzsöny Mountains were found during mining operations. Their walls were covered with large brilliant individual quartz, amethyst, baryte and celestite crystals and disseminated pyrite. Unfortunately, immediately after their discovery, the caves were looted.

In the Upper Cave near the town of Sárospatak, in the Hermit Cave near the town of Gyöngyös and in the Ablakos Cave near the village of Dömös, silicate encrustation (albite, anorthite, kaolinite) occurs. Many spectacular 5 cm -10 cm in diameter and 20 cm – 40 cm long, tridymite containing silicate stalactites are to be found in the Arany Cave in the Eperjes-Tokaji Mountains. In twenty andesite caves (e.g. Galériás Cave, Függő-kői Cave, Smirgli Cave and Alsó-Rab Hole) 3 mm -5 mm long butt-shaped grey silicate pisolites can be observed, composed of quartz, feldspar and mica.

Lateral erosion of the creeks has formed the Macska Rock Shelter in rhyodacite tuff, the Sárkányfürdő Cave in andesite and the Görgeteges Rock Shelter in andesite agglomerate. The Arany Cave has developed in rhyolite. From the cave a slowly flowing stream emerges. The water is acidic due to the decay of the pyrite. In the longest non-karst cave in Hungary, the Csörgő Hole. Several hydrological observations have been carried out. At a depth of 27 m the Vidróczki Spring emerges. The water shortly disappears between the blocks. The spring water was dyed with fluorescein and it appeared after 7 hours in the Vándor Spring on the surface, which lies 8 m deeper and 180 m away. When the Vidróczky Spring has a larger discharge it feeds a small lake in the Bat Chamber. The lake completely disappears at times when there is a low discharge from the spring. In the Surprise Chamber it is possible to hear the sound of a stream, but unfortunately it has not been possible to find the origin of this phenomenon.

The climatic conditions in the relatively small non-karst caves in Hungary do not show significant deviation from the surface climate. In the bigger caves the temperature is more or less constanct throughout the year, relative to the annual average surface temperature. The exceptions are those caves that have developed in porous or detritic rock formations. Here evaporation on the large rock surface causes such a significant heat extraction that the surroundings are cooled below freezing point. The Csörgő Hole has formed in porous tuff blocks, therefore the average temperature in the lower part of the cave is +4ºC. The Cold Hole near the village of Pusztafalu has an average temperature +6.5ºC, because the cave has formed in porous dacite blocks. One of the five small ice caves which are to be found in Hungary is the Ice Pit in the Damsa Chasm. The cavity has developed in porous andesite agglomerate and the floor and the walls are covered with thick layers of ice. The Ice Tunnel near the village of Telkibánya is an artificial hole in rhyodacite gravel, but the conditions which have resulted in the formation of the ice are similar to those found in natural caves.

The fauna and the flora in non-karst caves do not show significant differences from those found in karst-caves, although variations in proportions found can be observed. For instance the proportions of the penicillin flora and the Lepidoptera fauna are higher than in the karst-caves. In almost every cave springtails (Collembola) occur, as do rove beetles (Staphylinidae), humpbacked flies (Phoridae), spiders (Araneidae), mosquitoes (Nematocera), small carrion beetles (Catopitae), butterflies and moths (Lepidoptera) and bats (Chiroptera). Troglophile butterflies – the herald moth *(Scoliopteryx libatrix),* the tissue *(Triphosa dubitata)* and the European Peacock *(Inachis io)* - use many non-karst caves as resting places in the daytime, as well as allowing the imago to overwinter

in the caves. Those caves, which are dens of foxes, badgers and woodland dormice, are infested with fleas (Siphonaptera). In the andesite caves, which open near water (e.g. Sárkányfürdő Cave, Pogány-völgyi Rock Shelter), the larvas of Caddisflies (Trichoptera) are abundant.

Palaeontological excavations have been carried out in only a few volcanic caves. The remains of 33 molluscs and 54 vertebrates were discovered in from the Függő-kői Cave in the Cserhát Mountains.

Archaeological remains occurred in 12 non-karst caves, which were formed in rhyolite, dacite and andesite. The oldest findings, Neolithic potsherds and lithic tools (flint obsidian), were excavated from the Big Cave near the village of Legyesbénye between 1910 and 1932. From the Big Cave artefacts from the metal ages were also discovered, as well as from the ancient times and from the Middle Ages. From the Gyula Cave in the Mátra Mountains 53 potsherds from the Bronze Age and from the 12th to the 15th century were excavated. In the Cave Beneath the Garnet at the Castle of Füzér many Middle Age potsherds originating from the castle and dating from the Middle Ages were unearthed. Neolithic potsherds and stone and metal tools were found in the Függő-kői Cave. From the Király Cave near the village of Szomolya 36 potsherds were unearthed, dating from the 12th to 13th centuries. Some caves on higher ground were modified into small fortifications or shooting boxes such as the three caves near the village of Arka in the Eperjes-Tokaji Mountains and the Lőállás Cave (Eszterhás 2003b).

6. References

Bertalan, K. 1958 Magyarország nem karsztos barlangjai. *Karszt-és Barlangkutatási Tájékoztató (jan-jún.), Budapest* pp. 13-21

Eszterhás. I. 1993 Genotypes of caves in volcanic rocks in Hungary. *Conference on the karst and research activites of educational and research institutions in Hungary, Jósvafő* pp. 81-86

Eszterhás, I. 1996 Höhlen des Mátras. *Proceedings of the 6th International Symposium on Pseudokarst, Galyatető* pp. 166-173

Eszterhás, I. 2003a Csörgő-lyuk. [in] Székely, K. *Magyarország fokozottan védett barlangjai – Mezőgazda Kiadó, Budapest* pp. 229-231

Eszterhás, I. 2003b A nemkarsztos barlangok kutatottsága Magyarországon. *Karsztfejlődés* (VIII. kötet), Szombathely pp. 347-361

Eszterhás, I. 2005 Magyarország nemkarsztos barlangjai – kézirat a Vulkánszpeleológiai Kollektíva Évkönyvében az MKBT és a BI adattárában, Budapest pp. 162-200

Eszterhás, I. & Szentes, Gy. 2004-2009 Magyarország nemkarsztos barlangjainak katasztere – http//: geogr.elte.hu/nonkarstic

Juhász, Á. 1987 Évmilliók emlékei. *Gondolat Kiadó,* Budapest pp. 1-562

Ozoray, Gy. 1952 The genesis of non-karstic natural cavites as elucidated by Hungarian examples. *Karszt- és Barlangkutatás* (II. kötet), Budapest pp. 127-136

Szentes, Gy. 1971 Caves formed in the volcanic rocks of Hungary. *Karszt-és Barlangkutatás* (VI. kötet), Budapest pp. 117-129