SYNGENETIC VOLCANIC CAVES IN THE WESTERN CARPATHIANS

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Summary

The Northern and Western part of the Carpathians arch, known as the Western Carpathians, extends in the territories of Slovakia, southern Poland, Northern Hungary and the eastern part of Czech Republic. That is a result of the Alpine orogenic cycle. In the termination of Alpine orogeny, volcanic activities in Tertiary and Quaternary resulted from the subduction in the back part of the Carpathians arch. During the Middle Miocene some large stratovolcanoes of acide and intermedial alcali-calcareous volcanic rocks were formed. Later, in Pliocene and Pleistocene the volcanism had a basic character with alcali basalts in Southern (rarely in Middle) Slovakia and Northern Hungary.

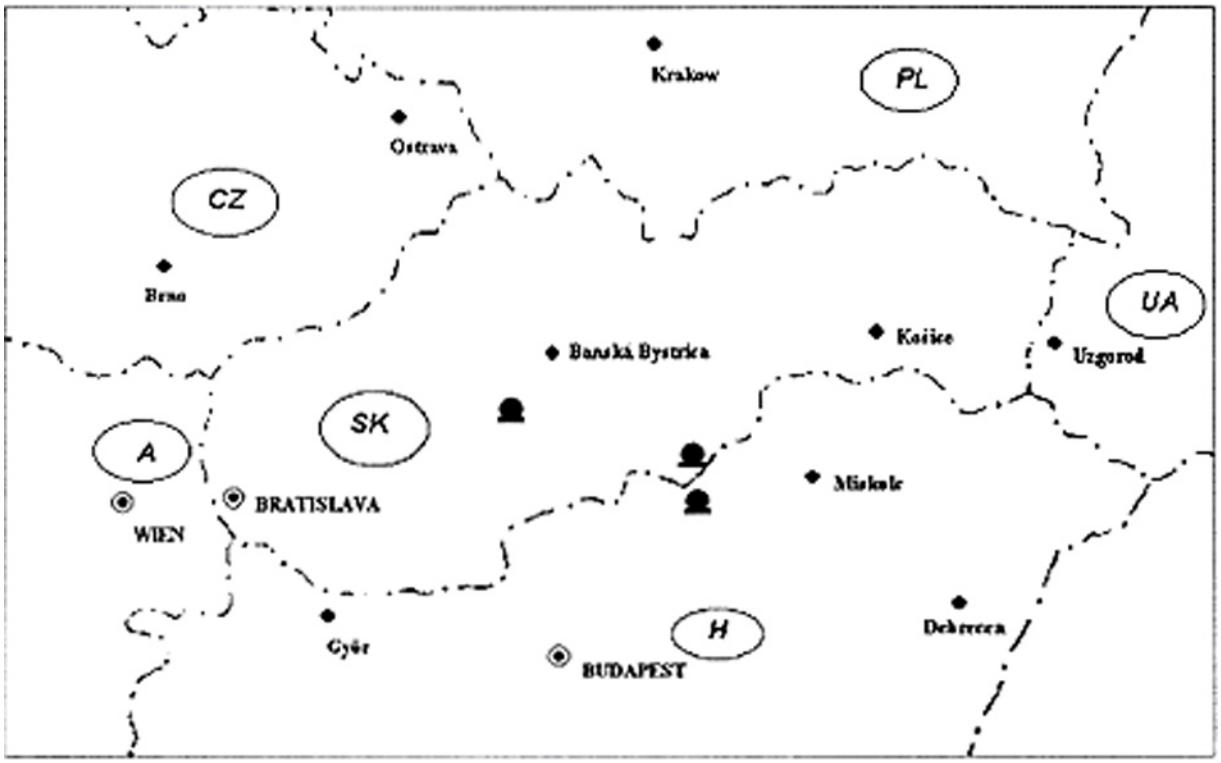

Fig. 1. Situation of the volcanic caves in the Western Carpathians.

Although the syngenetic volcanic caves also in andesite are mentioned, its syngenetic origin is not proven explicitly, because its primary features are wiped out by weathering processes.

On the other hand, the young volcanic structures of Pliocene-Quaternary basalts preserve sufficiently enough syngenetic volcanic caves with their microforms. These caves in following places are known: Ragác hill in Cerova vrchovina mountains (Southern Slovakia), Putikov vršok in the Štiavnické vrchy (Middle Slovakia) and Kis-ko hill in Northern Hungary.

There are 3 small gas cave known in scoria-cone of Ragác (Ebeczkého jaskyna with the length of 17 m, Ragácsky komín - 6,2 m and Ragácska studna with the depth of 9,3 m). Putikov vršok is the youngest volcanic structure in Slovakia (0,53 +- 0,16 Ma). The gas cave named Sezam with the length of 26,4 m is known in basalt agglomerates of this scoria-cone.

Kis-koi-bazaltbarlang with the total length of 30 m and the depth of 15,6 m is a vertical volcanic cave into eruptive fissure. The residues of lava coatings and lava stalactites occurs in the wall of the conduit.

The Northern and Western parts of the Carpathians belt, known as the Western Carpathians, extend in the territories of Slovakia, Southern Poland, Northern Hungary and the Eastern part of the Czech Republic. The mountain range is a result of the Alpine orogenic cycle. Therefore the sediments of Tethys realm are its main building elements (mainly Mesozoic and Tertiary shales, sandstones, limestones, dolomites). The older (Paleozoic perhaps Proterozoic), mainly crystallic and magmatic rocks at smaller places in core mountains and as denudation relics in older (Hercynian and Caledonian) structures are situated. In the termination of Alpine orogeny, volcanic activities in Tertiary and Quaternary were a result of subduction and the collision of the Carpathian belt with the margin of the European plate in Neogene (LEXA et al. 1993). During the Middle Miocene some large stratovolcanoes were formed in Middle and Eastern Slovakia and Northern Hungary. They are composed of acide and intermedial alcali-calcareous volcanic rocks (andesites, rhyolites, diorites, dacites). Later, in Pliocene and Pleistocene the volcanism had a basic character with alkali basalts in Southern (rarely in Middle) Slovakia and Northern Hungary.

In Miocene andesites in Northern Hungary some little caves were researched by ESZTERHÁS, which may have been origin of a volcanic explosion or exhalation (for example *Csódi-hegyi-barlang* in Visegrádi Mountains, *Kámori-rókalyuk* and *Rózsabánya andezitürege* in Börzsöny Mts, *Vidróczki-barlang* in Mátra and *Felso-barlang* in Tokaj Mts. - see ESZTERHÁS - GAÁL - TULUCAN, 1996). In the summer of 1999 I visited *Vidróczki-barlang* with the length of 5,1 m and *Függo-koi-barlang* (3,5 m) in Mátra Mountains. Both horizontal undergroud cavities in compact andesites are situated near the volcanic center, therefore we do not elimine their syngenetic origin. However, absence of its primary features (wiping out by weathering processes) do not allow us to make explicit conclusions.

On the other hand syngenetic volcanic caves with their microforms are evidently preserved in the young volcanic structures of Pliocene-Quaternary basalts. From this volcanism some small scoria-cones with lava flows, diatremas, necks and residues of maars remains. The caves only in 3 localities occur: Ragác Hill in Cerova vrchovina Mountain (Southern Slovakia), Putikov vršok Hill in Štiavnické vrchy (Middle Slovakia) and in Kis-ko Hill in Northern Hungary.

Ragác

Ragác is a small scoria-cone with the height of 250 m (536 m altitude) near village of the Hajnácka in Cerová vrchovina Mountain. At present there are remains of only NE part of the original volcanic cone with the diameter of about 1 km. The crater is not preserved. The summit region is formed by agglomerates, agglutinates and lapilli tuffs with 3 dikes of basalt. In the southern part of the Ragác is a 2,5 km long lava flow extends, which originated from the lower part of this scoria-cone. The age of the alcali nefelinite basanit of the lava flow is 1,39 +- 0,12 Ma (determined by K/Ar method, BALOGH - MIHALIKOVÁ - VASS 1981). The lava flow has a arch-like shape, because it flowed around the eastern part of older maar structure. In limnic tuffits of the crater lake of this maar Upper Pliocene mammals were found (mainly tapires, rhinoceroses, mastodontes - KUBINYI 1863, KORMOS 1934, FEJFAR 1958 and others).

The volcanism in the Ragác had a highly explosive character. In volcanoclastic rocks of the summit numerous small explosive cavities occur with the diameter of some cm to 1 m. In this part 3 gas caves are known. They were formed by fumarola processes - exhalations of volcanic gases and vapours in basalt volcanoclastics (agglomerates, agglutinates) during volcanic eruptions or shortly after them. Fumarolas were probably of high temperature (100-900 °C). Various minerals sometimes sublimated from ascending vapours. The morphological shapes of these chimnies are not regular, often with small hollows and cavities.

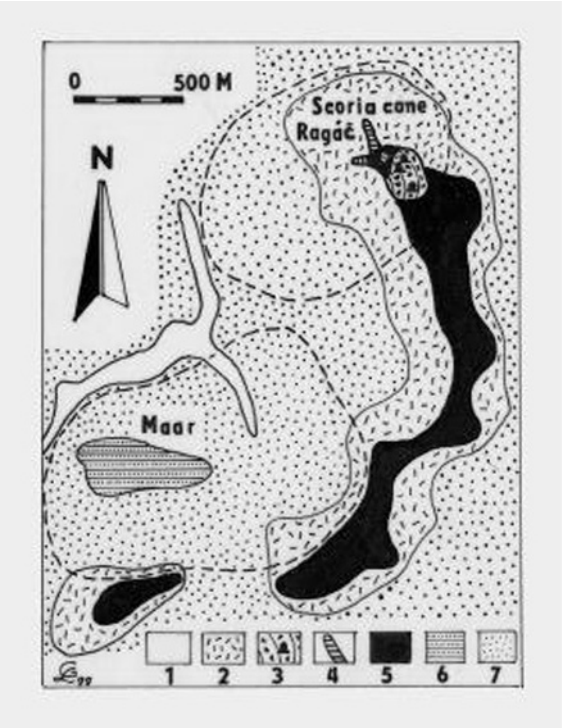

Fig. 2. Geological situation of the Ragác hill. After D. Vass - V. Konecný, 1992, modified by L. Gaál. The supposed original volcanic structures are marked by disturbe lines. Explanations: 1. Alluvium of the streams, 2. Slope sediments with the fragments of basalt (Quaternary), 3. Agglomerates and agglutinates of basalt with occurance of the gas caves, 4. Basalt dikes, 5. Lava flow (3-5 Pleistocene), 6. Tuffs and lapilli tuffs of maar (Upper Pliocene), 7. Sandstone (Lower Miocene).

Ebeczkého jaskyna (Ebeczky´s cave) is a typical gas cave on the southern slope of Ragác Hill, at an altitude of 495 m. The horizontal underground corridor is accessible with a horizontal and a vertical entrance. The total length of the cave is 17 m, the width is 1-3 m, the height of top is 1-2 m. Some sidelong prominences and hollows stick out from underground corridor. In the back part of the cave in 1990 a vertical chimney was discovered, its origin was proved by explosion of ascending gases (GAÁL - ESZTERHÁS 1990). The origin by gases of this cave was mentioned by JUGOVICS (1944), but PILOUS (1982) considered it as a weathering cave. Some thin crusts of mixture of calcite and gypsum are between the dark volcanic bombs in many places of the cave walls (by X RD analysis made by Geological Institute of the Slovak Academy of Sciences, Banská Bystrica), from which small pisolites secondarily originated. The gases probably exploded near the surface of the volcanic cone as a consequence of a sudden decrease of hydrostatical tension. There are several small explosion cavities around the cave with a diameter about 1 m.

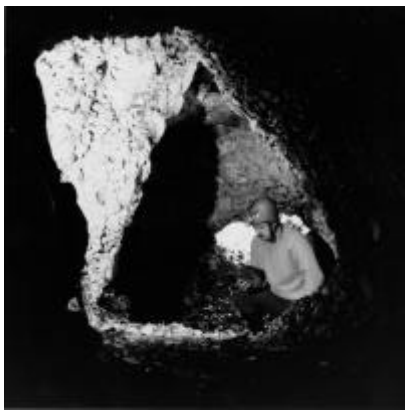

Fig. 3. The gas cave „Ebeczkého jaskyna“. Photo by Jozef Gaál.

Ragácska studna is situated under the summit cliff of the scoria-cone of Ragác Hill. It is a vertical conduit with a diameter of 1,5 m, formed in agglomerates of vesicular basalt bombs and lapilles. Its depth was 3,8 m, but during our new research it was deepened to 9,3 m in 1999 (in older literature mentioned also 15 m - JUGOVICS 1944). In the past, its origin was explained differently: by volcanic exhalations (JUGOVICS 1944), as a volcanic crater (KLINDA 1977), as an artificial shaft (PILOUS 1982, VÍTEK 1983) and again as a volcanic exhalation chimney (GAÁL - ESZTERHÁS 1990). Its origin by fumarola processes support several features, mainly its irregular course in the lower part of the chimney (discovered during research in 1999). According to morphological shape of surrounding cliffs we can deduce a existence of explosive cavity above the present entrance of conduit. Therefore the conduit could represent a rest of intake channel of gases.

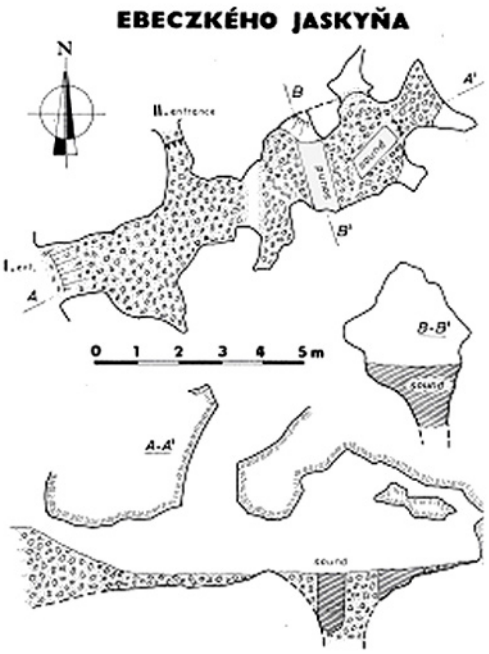

Fig. 4

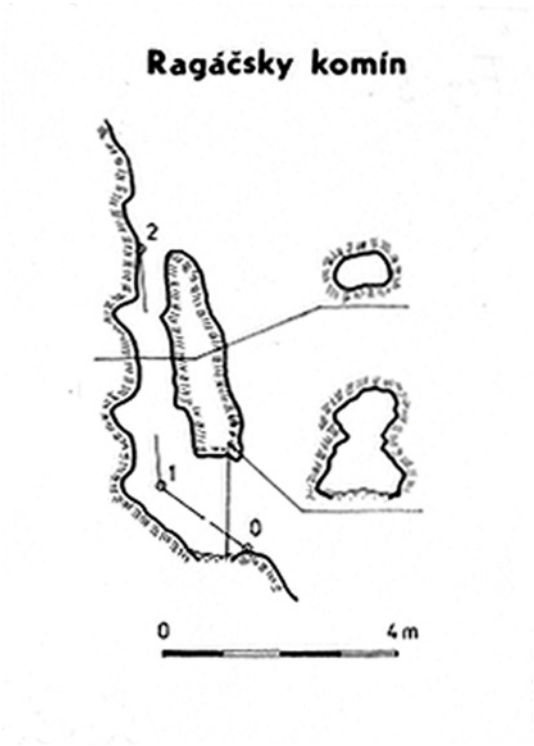

Fig. 5

Ragácsky komín is a small open volcanic conduit, described by GAÁL - ESZTERHÁS (1990) under the north-eastern wall of the summit cliff of Ragác. It has two entrances: the lower is larger (1,8 x 1,4 m) and oriented horizontally, the upper one is vertical (0,5 x 0,4 m). The lenght of the conduit is 6,2 m. It originates in agglomerates and agglutinates of vesiculare basalt bombs. There are some other small hollows and cavities around this conduit, what proves highly explosive character of the volcanism.

Putikov vršok

It is a small scoria-cone with the lava flow of nepheline basanites in the SW part of the large Miocene andesite-rhyolite stratovolcanic stucture named Štiavnica in Štiavnické vrchy mountains (Central Slovakia). The age of basanite from lava flow near Nová Bana is 0,53 +- 0,16 Ma (KANTOR - WIEGEROVÁ 1981) and it represents the youngest volcanic structure in Slovakia. The lava flow the Pleistocene terrase of Mindel-Riss age particularly covers.

Sezam is a similar gas cave as Ebeczkého jaskyna. Its entrance is relatively large (1,9 x 1,7 m) in altitude of 450 m. Its total lenght is 26,4 m, depth 14,6 m (GALVÁNEK - GAÁL, 1995, GAÁL 1996). From the horizontal corridor a vertical conduit extends with a depth of 10 m. It has irregular course with many small sidelong hollows and cavities. The cave originates in agglomerates of brown-red volcanic bombs, breccias and lava coatings, which formed the filling of the crater wall.

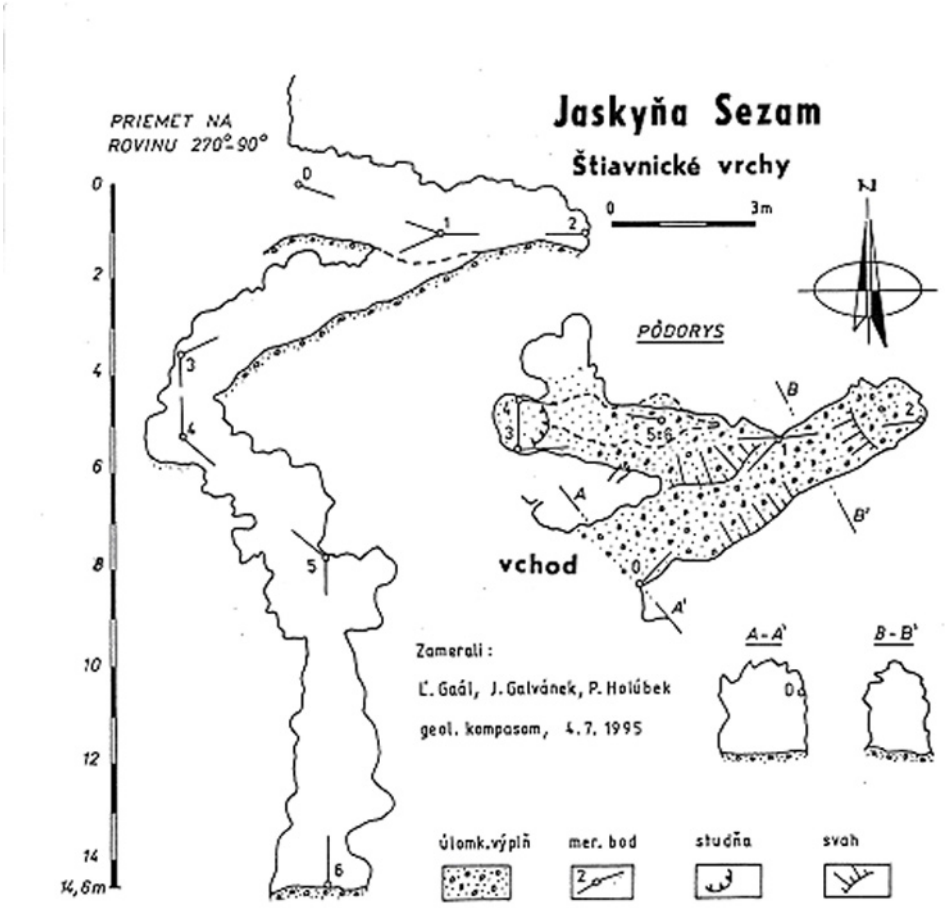

Fig. 6

Kis-ko

Kis-ko is a small hill with a basalt cliff near village Szilaspogony, 12 km east of the town of Salgótarján in Northern Hungary. The cliff represents a residue of diatrema with the height of 30 m at the altitude of 381 m. The diatrema consists of agglomerate and agglutinate of basalt with some basalt dikes. In the middle of diatrema, there is a uniquely preserved open vertikal volcanic conduit named Kis-koi-bazaltbarlang.

Kis-koi-bazaltbarlang was described by JUGOVICS (1942), OZORAY (1960), SZENTES (1971) and was mapped by ESZTERHÁS with the total lenght of 30 m and the depth 15,6 m (GAÁL - ESZTERHÁS, 1990). The vertical conduit has a crack shape in direction NNW-SSE (335°-155°) with the length of 11,5 m. The entrance is small and narrow, but the dimension of the conduit widens with its depth. The bottom part is 4,5 x 6 m wide. This space is accessible through an artificial tunnel mined in 1910. There are several stacked cavities and separated narrow and short intermediate passages in the conduit. The traces of lava flows, residues of lava coatings and lava stalactites occurs in the wall of the conduit.
According to the shape of the conduit and its typical volcanic features we can deduce its origin as a vertical cave within eruptive fissure. The lava penetrated into the eruptive fissure in finish of eruptions, had low energy, therefore is not effuse on the surface. It was quickly cooled by the contact with the surrounding damp sandstones, but it´s inner hot part flows down into the innermost part of the fissure. The similar forms was described for example from Etna (LEOTTA - LIUZZO 1998). The solid linings of the lava in the conduit wall was preserved to present and conserved the fissure before collapse.

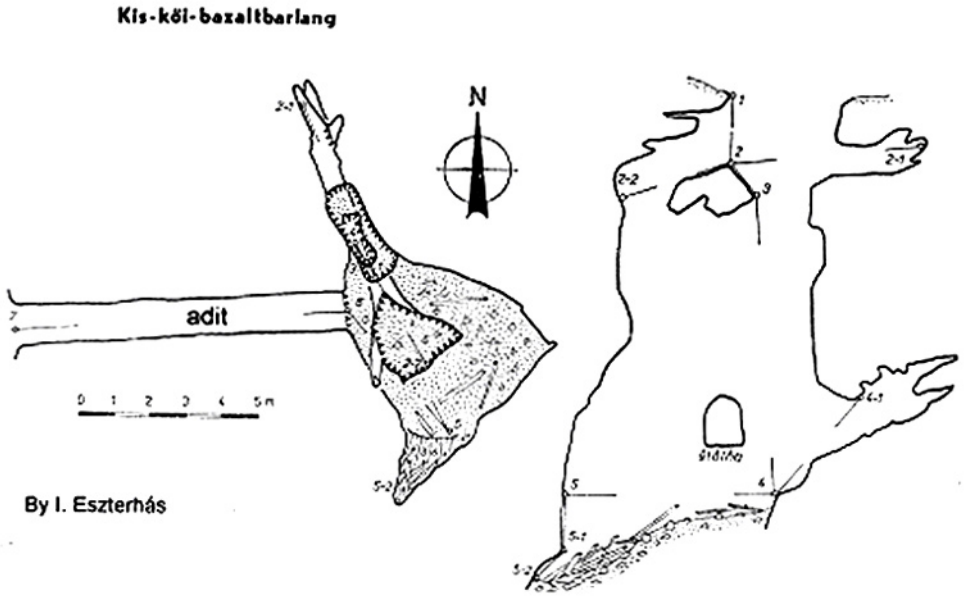

Fig. 7

About 400 caves (about 100 in Slovakia and 300 in Hungary) are known in young volcanic rocks (andesite, dacite, rhyolite, basalt and its volcanoclastics) in Western Carpathians, but the most of them are originated by slope movement (fissure caves, boulders caves) and by weathering or by other postgenetic processes. The syngenetic volcanic caves are very rare in this area, therefore they are of a great morphological, geological and mineralogical importance. They demand adequate protection and management.

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