Geogr. Fis. Dinam. Quat.
21 (1998), 5-8, 2 figg., 1 tab.

KÁROLY BARTA (*) & TAMÁS TARNAI (*)

GEOMORPHOLOGICAL INVESTIGATION OF CAVE EXPLORATION OPPORTUNITIES IN THE MECSEK MOUNTAINS, S-HUNGARY

ABSTRACT: BARTA K. & TARNAI T., *Geomorphological investigation of cave exploration opportunities in the Mecsek Mountains, S-Hungary*. (IT ISSN 0391-9838, 1998).

For two years a research has been conducted to confirm the existence of a cave system several kilometers long beyond the most abundant spring of the karst of the W-Mecsek, the Vízfö Spring. Attempts have been made to find the optimal site for opening an entrance to the cave.

This article describes the methods and achievements of preliminary geomorphological and hydrological field surveys, which were preceded by a thorough study of literature, clearing the entrance to the cave. Observations of karst processes and features were also made. The impacts of recent tectonic movements on the extension and links of the catchment area, the communication between surface and underground water-courses and cave formation are presented. The research is to be continued with exploration of the Szuadó Cave (145 m present-day length).

KEY WORDS: Allogenic karst, Speleology, Hungary.

RIASSUNTO: BARTA K. & TARNAI T., *Ricerche geomorfologiche sulle possibilità di esplorazione delle cavità carsiche nelle Montagne di Mecsek, Ungheria meridionale*. (IT ISSN 0391-9838, 1998).

È stata condotta una campagna di ricerche per confermare l'esistenza del sistema carsico ipogeo, lungo molti chilometri, collegato con la maggiore sorgente della regione occidentale di Mecsek, la sorgente Vizfö. Sono stati fatti dei saggi per individuare o ricavare un'entrata alle cavità.

L'articolo descrive i metodi e le prove preliminari per i rilevamenti geomorfologici e idrologici, preceduti da un completo esame della letteratura. Sono state fatte osservazioni sui processi e le morfologie carsiche. Vengono illustrati gli impatti dei movimenti tettonici recenti sull'estensione e la continuità dell'area, i rapporti fra le acque superficiali e sotterranee e la genesi delle cavità. Si ritiene che la ricerca debba continuare nella Cavità Szuadò.

TERMINI CHIAVE: Carsismo allogenico, Speleologia, Ungheria.

INTRODUCTION

In the W part of the Mecsek Mountains there are Triassic karstic rocks on the surface. The karst area of the W-Mecsek extends over 38 km^2 and is situated on the N part of the Jakabhegy Anticline. The Permian and Triassic strata of sandstones, mudstones and limestones folded into anticline on the Cretaceous/Eocene boundary (Rónaki, 1961). The central, highest part of the anticline has been exposed by erosion (fig. 1).

The karst of the W-Mecsek is similar to that at Aggtelek and Bükk Mountains (N-Hungary) (Szabó, 1953) but its morphological features are more mixed: there are numerous individual and rows dolines, sunkholes and dry valleys (Hevesi 1991). The biggest spring in the karst region is found near the village Orfü (F_1). The spring's cave is explored in 170 m lenght but a more than 20 m deep sump does not allow the further exploration (Rónaki, 1962). Because of its size and its water output (4 m^3 per minute) the existence of a bigger cave system is supposed beneath the karst area (Rónaki, 1970). Our research has been focused on collecting further evidence on the existence of this cave system and finding answer to some morphological and genetic problems, determining the optimal sites for exploration and estimating the size and the lenght of the system.

KARST VALLEY SYSTEM

The catchment area of the Vízfö Spring is 16 km^2, including a non-karstic surface of over 5 km^2 (the upper part of the Körtvélyes and Szuadó valleys and the vicinity of Büdöskút Spring, fig. 1). It is a typical allogenic karst, the streams from the non-karstic area disappear in sinkholes (F_{1-7}) then they flow under the surface and issue in the Vízfö Spring (Rónaki, 1962, 1970). Dry valleys are detected as continuations of non-karstic valleys, remnants of the valley network formed prior to the young tectonic movements, on the karst surface. Quaternary uplift was more than 100 m and the karstwater table sunk, therefore the valleys became dry. Doline formation processes started on the floors of valleys without a non-karstic catchment area.

(*) *Department of Physical Geography, József Attila University, Egyetem u. 2-6, H-6725 Szeged, Hungary.*

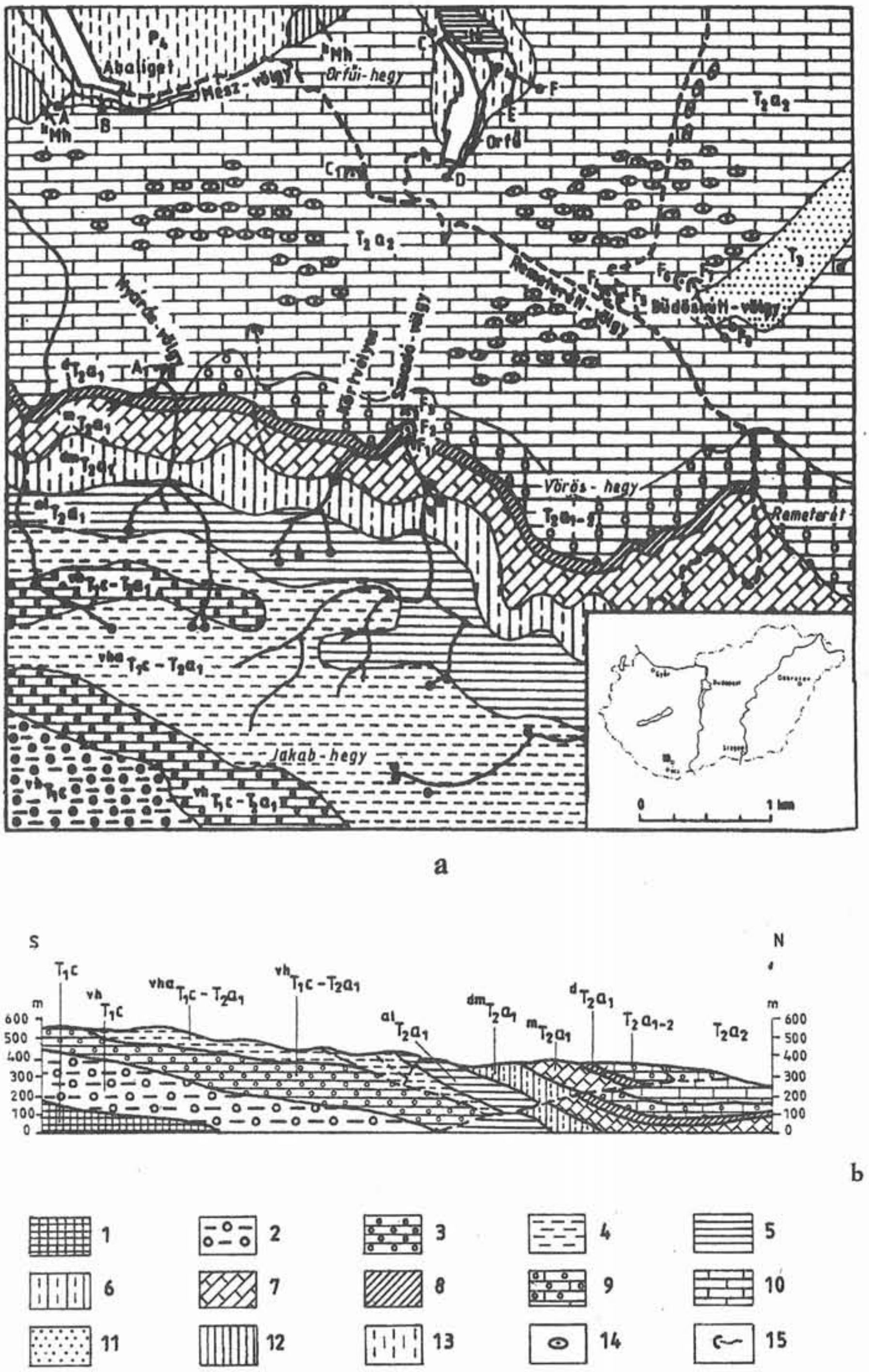

FIG. 1 - Geological map (a) and profile between the Jakab Hill and the Mész Valley (b) of the Western Mecsek with the sinkholes and springs (after the geological map series of the Máfi, 1965-1970). 1) green and grey sandstone (T_1c); 2) red sandstone underlying conglomerate (T_1c); 3) conglomerate and red sandstone (T_1c-T_2a_1); 4) red sandstone and aleurolit (T_1c-T_2a_1); 5) red and green sandstone, mudstone and aleurolit (T_2a_1); 6) grey dolomite marl with anhydrite and gypsum (T_2a_1); 7) grey bituminous limestone with marl (T_2a_1); 8) red and grey dolomite (T_2a_1); 9) limestone with dolomite in thin layers (T_2a_{1-2}); 10) grey limestone with dolomite lens and thin layered limestone (T_2a_2); 11) grey sandstone, aleurolit and mudstone (T_3); 12) conglomerate, clay and rhyolite tuff (Mh); 13) various loess (p_4); 14) dolines; 15) sinkhole. A) Abaliget Cave; A_1) Viganvár Sinkhole; B) Kispaplika; C) Mészégetö Cave; C_1) Gubacsos Sinkhole; D) Sárkány Spring; E) Spring of Pécs's Cavers; F) Vizfö Spring; F_1) Szuadó Sinkhole; F_2) Gilisztás Sinkhele; F_3) Trió Sinkhole; F_{4-5}) Szárazkút Sinkholes; F_6) Spirál Sirkhole; F_7) Palermo Sinkholes; F_8) Büdöskút Spring.

Valleys with partly non-karstic catchment incised onward until their bathycapture (Jakucs, 1971). Now these valleys are only shaped during floods. There is an interesting exception: the Remeterét Valley (fig. 2). This valley has poorly developed dolines, but well developed sinkholes indicating a former sizable stream. At present the whole catchment area is karstic.

There are two specific features in valley alignment. First, there is no head valley. Valley profiles are generally hyperbolic but in the case of the Remeterét Valley the initial steeper-sided stage is not found. Instead, there is a well-developed valley immediately from the divide with a uniform gradient. This is explained by recent tectonic movements.

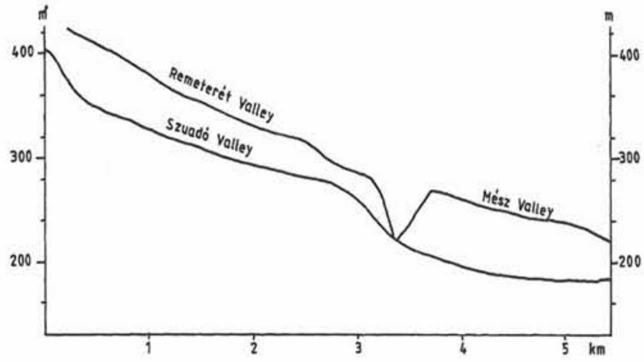

FIG. 2 - Profile of the Remeterét and neighbouring valleys.

VALLEY EVOLUTION

The mountains are bordered by sharp faults (fig. 1, in the north the spring line (A-F) shows them, in the southeast out of map). Along them there has been intense erosion, valleys retreat and can reach the valleys beyond the watershed. Presumably this happened to the first part of the Remeterét Valley. From its size it is supposed that the valley had 4-5 km^2 nonkarstic catchment area, with developed sinkholes and poorly developed dolines. More evidence would be gained if sandstone gravels were found in the sinkholes (Barta & Tarnai, 1995).

The other feature has a similar cause. Comparing the lower part of the Remeterét Valley with that of the Szuadó Valley, their steeper sections are found to indicate recent uplift. The Mész Valley is a direct continuation of the Remeterét Valley (fig. 2). Before the uplift they constituted a continuous valley running from Remeterét to Abaliget and the Szuadó Valley was a side valley. During the uplift a small gully retreated until reaching the junction of the two valleys. This gully formed along the faults which control the direction of the Szuadó Valley because their direction is the same. After this capture the Mész Valley became dry and the stream of the Szuadó Valley turned northward (Szabó, 1955).

It would be difficult to date these two events but they can be correlated. If the Remeterét Valley had become dry earlier than the Mész Valley, the stream from the Szuadó Valley would have eroded on its continuation the Mész Valley. In an opposite case the Remeterét Valley wonld have cut deeper while dolines would have formed in the dry Mész Valley. In the first case the Mész Valley would grow deeper and develop more rapidly, in the second case it would happen with the Remeterét Valley. But actually they are in the same level, so it is estimated that the two events have approximately the same age.

EXPLORATION OPPORTUNITIES THROUGH SINKHOLES

In our opinion it is possible to approach the cave from the spring or from the sinkholes. Because of the swamp near the spring the only chance is the exploration of the sinkholes. As it has been mentioned, the catchment area has three non-karstic partial catchments. The smallest of them is the Büdöskút Valley catchment (0.35 km^2), of sandstone. This valley has some minor sinkholes near the boundary of karstic and non-karstic rocks but large sinkholes are found downstream its junction with the Remeterét Valley (F_{4-5}). The small catchment area and a small stream may not have formed these large sinkholes. Perhaps the former non-karstic catchment of the Remeterét Valley is responsible for their formation. The Körtvélyes has a non-karstic catchment of 0.65 km^2 area but there are no sinkholes, the stream seeps to the fissures of the limestone along 1 km. It may be explained by the lack of sandstones in the catchment. The nearby non-karstic catchment of the Szuadó Valley is 3.4 km^2, consisting of sandstone and mudstone with three sinkholes. After comparing their size and development with those of the Remeterét Valley, it is supposed the above mentioned 4-5 km^2 belongs to the Remeterét Valley catchment area. The more developed sinkholes of the latter are inactive, filled by clay alluvium.

In conclusion it is claimed that the Szuadó Valley sinkholes seem to be the most suitable for further investigation of exploration opportunities. Of the three sinkholes only the uppermest one (F_1) is active. During floods the stream flows on the surface and it disappears in the third sinkhole (F_3). The Trió Sinkhole is better developed than the Szuadó Sinkhole and it is able to swallow 5-6 m^3 water per minute. It was explored 4-5 m long but owing to a danger of collapse the works were interrupted. On the other hand it is very difficult to divert the skeam, so decision fell on the Szuadó Sinkhole.

In order to estimate size of the cave system, the parameters of the Vízfö catchment area were compared with those of the neighbouring Abaliget Cave and Spring (A), known to be 1 km long (Kordos, 1984). If it is supposed that the two caves have formed under the same conditions (geological features, parent rocks and climate), their size only depends on the extension of their non-karstic catchment area because the rates of their streams with hard sandstone-gravel bed determine the rate of erosion (tab. 1). The Abaliget Cave also has only one active sinkhole (A_1) (Lovász, 1971). The following table shows some parameters about the sinkholes.

TABLE 1 - Parameters of the sikhole catchments

sinkhole	non-karstic catchment area (km^2)	infiltration rate (l/min; November, 1994)	sinkhole/spring distance (m)
Szuadó	3.4	100-120	2800
Viganvár	2.5	5-10	1800

Based on these data and taking into acccunt the size of the explored cave sections it is expected that the Vízfö Spring cave system is at least twice as large as the Abaliget Spring system. Explorations of the Szuadó Sinkhole started in November 1994. Now the known length of the cave is 145 m long and it is 46 m deep. Hopefully this means that the entrance to the Vízfö System has been found.

REFERENCES

BARTA K. & TARNAI T. (1995) - *Barlangkutatás a Nyugat-Mecsek karsztterületén* (Cave exploration in the karst region of the W-Mecsek Mountains). Unpublished manuscript, Szeged.

HEVESI, A. (1991) - *Magyarország karsztvidékeinek kialakulása és formakincse II* (Development and landforms of the karst regions of Hungary). Földr. Közl. 115, 3-4, 99-120.

JAKUCS L. (1977) - *Morphogenetics of karsts*. Akadémiai Kiadó, Budapest.

KORDOS L. (1984) - *Magyarország barlangjai* (Caves of Hungary). Akadémiai Kiadó, Budapest, 242-249, 260-262.

LOVÁSZ GY (1971) - *Adatok az Abaligeti-karszt geomorfológiai és hidrológiai jellemzéséhez* (Contributions to the geomorphological and hydrological description of the Abaliget Karst). Földr. Ert., 20 (3), 283 295.

RÓNAKI L. (1961) - *A Mecsek és a Villányi-hegység barlangjai* (Caves in the Mecsek and Villány Mountains). Karszt és Barlang, 1, 3-19.

RÓNAKI L. (1962) - *Az orfüi Vízföforrás-barlang feltárt szakaszának földtani viszonyai* (Geological conditions ot the explored section of the Vizfö Spring Cave at Orfü). Karszt és Barlang, 2, 51-55.

RÓNAKI L. (1970) - *Vízfö-forrás és barlangjának kutatása* (The Vízfö Spring and the exploration of its cave). Karszt és Barlang, 1, 25-30.

SZABÓ P.Z. (1953) - *Két mecseki karsztforrás vizsgálata Komló és Pécs vízellátása szempontjából* (Investigation of two karst springs in the Mecsek from the viewpoint of water supply of Komló and Pécs). Földr. Közl., 77 (3-4), 161-189.

SZABÓ P.Z. (1955) - *A fiatal kéregmozgások geomorfológiai és népgazdasági jelentösége Dél-Dunántúlon* (Geomorphological and economic significance of recent tectonic movements in South-Transdanubia). Dunántúli Tudományos Gyüjtemény, Pécs, 4, 3-30.