Endokarst Morphology in the Rarău Massif

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Abstract. The Rarău Massif holds a series of morphologically diverse, genetic types of landforms, among which the petrographic landforms developed on limestone and dolomite are the most notable. As regards the typology and distribution of carbonate deposits, the Rarău Massif is not known for its endokarstic landforms. The most famous of its caves – Peştera Liliecilor, is not remarkable through karst formations, but through the colonies of bats it has sheltered over the years. Limestone klippes currently display a greater diversity of underground caverns. These caverns most often correspond to gravitational cracks present in the rock or are the result of chaotic position of scree aggregates detached by physical processes from the main rock. The only signs of karstification processes manifested in some cavities are represented by *montmilch* on the walls and also small corrosion shapes. A few potholes have been reported in the cracks present within the klippes. Corrosion is a process with weak manifestation in the caves mapped around the Pietrele Doamnei area. Our approach aims to improve the picture of the relatively poorly developed karst in our study area, with the more complex diversity specific of this genetic type of petrographic landforms. We can assert that our research is developing, our expectations being stimulated by identification of certain underground caverns.

Key – words: Rarău Massif, karst, cavities, karst morphology, cracks, endokarst

1. Introduction

Karst topography in Romania is associated with a variety of karstifiable rocks, among which limestones and dolomites are the most representative as regards covered area and form variety. Apuseni, Banat, Cerna, Southern Retezat, Căpățânii and Vâlcanului Mountains, as well as Mehedinți Plateau and South Dobrogea Plateau are just a few examples in this regard. Located on the crystalline axis in the northern part of the Eastern Romanian Carpathians, the Rarău Massif holds a series of morphologically diverse, genetic types of landforms, among which the petrographic landforms developed on limestone and dolomite are the most notable. Such features favor the development of karst processes in the Rarău Massif, despite that the forms identified and mapped so far cannot be compared in what concerns size and number with the landforms of other classic karst areas. Karst morphology, particularly the exokarst, contributes to the shaping of an emblematic image of Rarău, through the presence of the group of large residual rocks known as Pietrele Doamnei (the Lady's Rocks).

Research on the study area can be found since the end of the 19th century, *i.e.* the monography of K. Paul - 1876 (after Rusu, 2002). Research expanded in the twentieth century with Uhlig - the first to speak of the Rarău Mesozoic marginal basin, followed by Atanasiu, Băncila who develop the hypothesis of normal geological structures and Preda, Elias, Popescu-Voiteşti who consider that the geological structure of the area is represented by overthrust nappes. In the second half of the current century, important geological contributions of paleontological, mineralogical and tectonic - structural nature are provided by Mutihac (1965, 1968) and Turculeț (1963, 1964, 1966, 1971).

Geomorphological characteristics of the massif are approached by Sârcu *et al.* (1971), Popescu Argeşel (1972), Iosep (1972) and Rusu (1997, 2002). Karst topography is addressed in general studies by Bleahu (1972) and in particular by Valenciuc (1964), Bojo *et al.*, (1975), Rusu in the works already mentioned, Done *et al.*, (2011). Notable is also the mapping fieldwork conducted by Cristea (1954), Bleahu, Bucovina Speleology Club (1980, 1991, 1992, 1994 Club GEISS Iași), and more recently by Bouaru (2005, 2012) and our team (2013-2014).

1.1 Study area

Located at the northern end of the central group of the Eastern Romanian Carpathians, the Rarău Massif has a maximum altitude of only 1651 m. The massif neighbors two major valleys towards the north and south, which are also physical and geographical boundaries, *i.e.* the Bistrița River and the Moldova River valleys. The Rarău Massif is bordered by a series of mountain units - Giumalău

Mountains to the west, Bukovina Mountains towards the north, Stânişoarei Mountains to the east and south and Bistrița Mountains to the south (Fig. 1). The eastern and western boundaries are less clearly delimited. Within these limits, questionable only as regards the transition towards the Stânişoarei Mountains, the Rodna Massif covers an area of 160 km².

1.2 Methods

The research of karst landforms in the Rarău Massif involves a series of classical methodological stages: bibliographic information, analysis of cartographic material resulted from previous research, geomorphological mapping of karst areas, documentation and mapping of underground caverns, construction of genetic hypotheses. Geomorphological surface mapping was based on the 1/25000 cartographic maps published by the Military Topographic Directorate between 1980 and 1986.

2. Results and discussions

2.1. Geological characteristics

The Rarău Massif shows a typical syncline structure, with layers arranged chronologically in a tectonic basin (Fig. 2). The metamorphites have a basal position, whereas the Mesozoic strata consisting of dolomites, sandstones and conglomerates, jasps, wildflisch and massive limestone appear towards the surface. At the top of the mountain, many allogenic limestone blocks of various sizes were identified, known under the name of klippes. They are of Triassic (Piatra Şoimului, Piatra Zimbrului, Popchii Rarăului) and Cretaceous (Pietrele Doamnei, Rarău and Hăghimişul Peaks) age, some of them originating from coral reefs that were "placed" in the wildflisch by complex tectonic overthrust (Mutihac *et al.*, 1968).

The limestones and dolomites of the **klippes** appear massive and the presence of corals indicates coral reefs as a likely origin (Turculeț, 1971). Generally, there is no evident stratification of these rocks, except for the Rarau and Hăghimiş peaks. In the first case, the layers are placed in vertical position.

2.2. Geomorphological controls of the karst development in Rarău

The characteristics and position of karstifiable rocks in the Rarău Massif are somewhat atypical compared to the important karst areas in Romania, where they appear as compact and thick horizons (*e.g.* ca. 600 m thickness in the Apuseni Mountains). In terms of karst morphology, two main important units can be defined in our study area:

i) Triassic deposits (Campilian - Anisian) consisting of a thick blanket (50-150 m) of dolomites and dolomitic limestone which are positioned over the crystalline schists, with outcrops only on the syncline flanks;

ii) Triassic and Cretaceous limestone klippes of the Transylvanian Nappe, buried in the Cretaceous deposits of the *Wildflisch Unit***.**

The area covered by this type of rocks in the Rarău Massif is over 35 km², based on the Geological Map 1:200.000, Rădăuți sheet. In relation to typology and covered area, karst development occurs differently. Fossilization of the Campilian - Anisian dolomitic limestone horizon makes the development of Exokarst morphologies almost impossible. However, the synclinal position of the strata may suggest favorable underground drainage, which may contribute to the development of endokarstic landforms. No underground holes associated with this horizon have been reported so far, but their formation is hypothetically possible.

The klippes cover relatively small areas from the total karstifiable area. Their position at the surface makes them susceptible to corrosion exerted by rain or snow melt water. Moreover, periglacial morphological conditions have left obvious traces in their current geomorphology.

Apart of the physical and chemical properties of limestone and dolomites, intense tectonization of the olistholits generated a network of cracks that may have a fossil origin, resulted either during rock consolidation or burial in the wildflisch.

Cracking may depend in some situations on the general lines of geological strata – as in the case of Rarău – Hăghimiş, or on the relation between the klippes and slope lines, *i.e.* Pietrele Doamnei Rocks. The emergence, evolution of gravitational cracks and development of underground holes, such as Peştera Liliecilor (the Bats Cave), are explained by Bleahu (1974), who cites theories developed by Gajac (1963) and Renault (1967, 1969).

Deepening of the river network and generation of slope systems, along with the malleable substrate can favor gravitational sliding of the blocks, which results in creation of new gravity crack lines or development of the existing cracks. This instability is also influenced by depth of valleys that determine different base levels for each slope. Consequently, the blocks will be subjected at the base to

gravitational compensation which tends to keep the klippe in a stable equilibrium. There is also a direct relation between the slope and the decompression forces acting on the extremities of the klippes. Cracking may progress to the phase of full separation from the main block, the detached part being subjected to fragmentation through collapse or sometimes involved in delapsive movement (Fig. 3 D).

Depending on the degree of development, cracks can be open or closed. The latter retain in their top part a heavily fissured rock mass. On the background of the crack system development, fragments of various sizes collapse from the ceiling, some of which being trapped in the narrower middle or bottom part of the crack.

Meanwhile, individualization of blocks on the cracking lines favors their movement on the Wildflisch clay substrate, with a rotational/ delapsive motion. The hypothetical development we refer to is supported geomorphologically by the presence on the south – eastern side of the Pietrele Doamnei Rocks of a lineout of large blocks which preserve the result of such movements through their position.

Basically, the klippe morphology highlights karst cavities which can be classified into several categories and stages of development: cavities in the disaggregated blocks, caves related to the tectonic litho- morphological fissures and tectonic-corrosive caves (Oprea *et al.*, 2011).

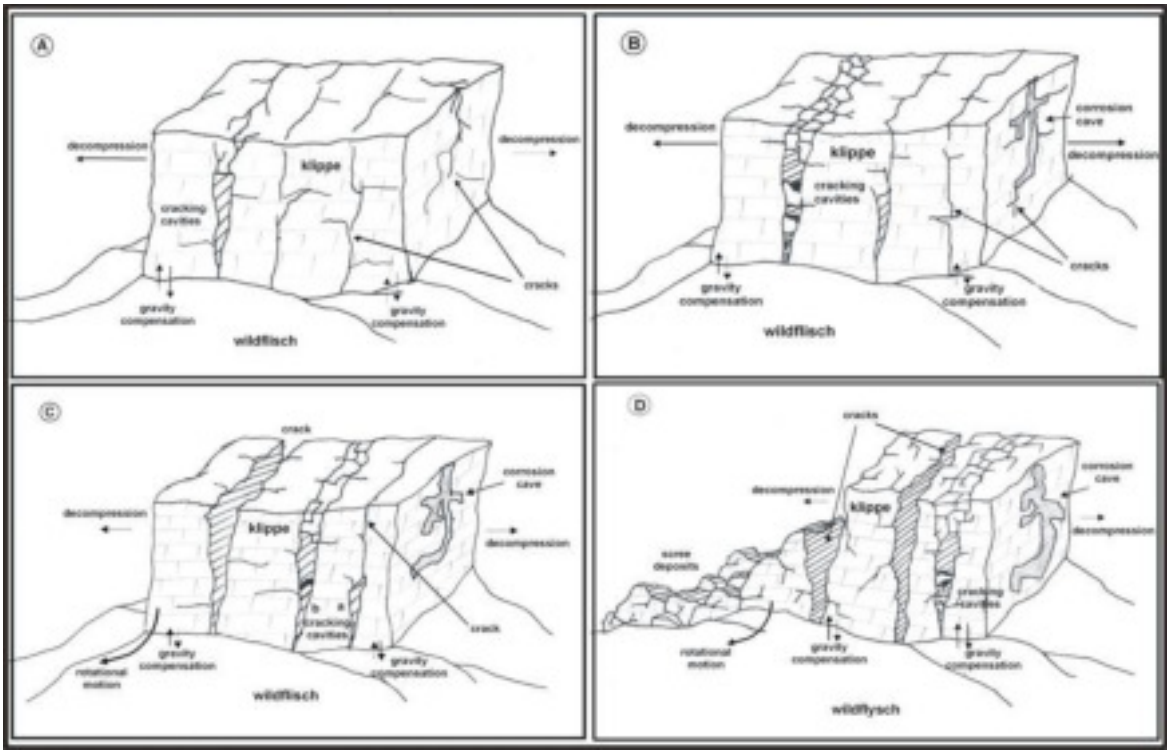

Fig. 3. **Stages of the morphological evolution of the klippes and endokarst typology in the Rarău Massif**

3. Karst morphology in the Rarău Massif

Karst morphology is the result of chemical and mineralogical properties of karstifiable rocks; the generated landforms have peculiar characteristics in land geomorphology. Development of karst topography is the direct consequence of a single dominant morphological process, namely dissolution. The others are somewhat secondary compared to the development of other genetic types of landforms, where geomorphological processes have a rather balanced importance. Weathering, erosion and sediment transport generate distinct types grouped into types of erosion and accumulation, both at the surface, *i.e.* the exokarst, and below the ground, *i.e.* the endokarst.

3.1. The exokarst

The typical exokarst – the surface karst in the Rarău Massif, covers a rather small area compared to the total area of the massif. There is no published literature exclusively focused on the study of the Rarău exokarst. Moreover, its landforms are relatively few and poorly shaped, *i.e.* polished surfaces, karrens, dolines, gorges.

Landforms resulted from the "polishing" of klippes and carbonate blocks by sheet or rill runoff

are most representative for this area (Sîrcu *et al.*, 1971). The areas with the most typical such landforms are the slopes of Piatra Şoimului, Pietrele Doamnei, Piatra Zimbrului rocks and the northern slope of the Rarău Peak.

Photo 1. **Karrens**

Karrens are micro-landforms which appear as elongated, rectilinear rills, but also with sinuous directions (sometimes tubular, developed vertically in the rock mass), centimeters deep (photo 1). They appear frequently on the steep slopes of klippes, but also on smaller blocks. They develop especially on steep slopes, where they can reach lengths of 10-15 m. We identified such landforms on the side towers of Pietrele Doamnei area, but also on the north side of the Rarău Peak.

Sinkholes (dolines) are relatively small karst hollows, usually developed on flat or low declivity areas, funnel or plate shaped. In Rarău their diameters do not exceed 40-50 m. Although classical sinkholes are the result of karst processes, in our study area many of them are likely caused by suffusion processes occurred in the scree. The most evident sinkholes are located near Cabana Speo (the Speological Cottage), on the access plateau to Pestera Liliecilor (the Bats Cave), on the plateau region of the northern side of Popchii Rarăului (Bojo *et al.*, 1975). They are buried in the weathered rock layer or in the soil horizon. No active sinkholes with steep slopes have been identified. A few negative landforms are noted, with amphitheater shaped morphology, open towards the slope line, which resemble collapse sinkholes. They were identified at the edge of the plateau between Popchii Rarăului and Stâncile Popchii rocks, on the route linking the Plateau from the Moara Dracului gorge. The author above mentioned also marks more advanced landforms on the geomorphological map of the Rarău karst, such as sinkhole valleys – around Popchii Rarăului rocks, and even a 'sohodol' (*i.e.* dry valley)**,** which is located between the Pastoral and Speo cabans.

Gorges represent narrow valley sectors bounded by steep slopes, which basically could have developed antecedently (old valley that develops on the same path despite lifting tectonic movements), but also on the background of underground drainage (caves). Narrowing sectors or gorges were identified on the rivers that drain the NE areas, tributaries of Moldova, *i.e.* Izvorul Alb (the Piatra Buhei sector) and Valea Caselor (Moara Dracului gorges, currently a natural reserve). Rusu (1997) mentions a similar sector on the Pârâul lui Ion brook, a tributary of the upper Slătioara River.

Slopes constitute a distinct morphological feature, often associated to calcareous or dolomitic klippes. Representative in this regard are the northern slope of the Rarău Peak with a length of ca. 2 km and wall heights up to 200 m, as well as the slopes of Piatra Zimbrului, Pietrele Doamnei and Piatra Şoimului.

3.2. The endokarst

As regards the typology and distribution of carbonate deposits, the Rarău Massif is not known for its endokarstic landforms. The most famous of its caves – Peştera Liliecilor, is not remarkable through karst formations, but through the colonies of bats it has sheltered over the years.

Lithological and structural differences in the limestone*, i.e.* the sedimentary rocks laid over the crystalline of the Syncline and the klippes trapped in wildflisch, allow us to consider both genetic and morphological differences between the potential karsts landforms of such rocks. Unfortunately, for the Campanian - Anisian dolomites no caves have been reported so far, but their thickness and synclinal position support our assumption that caves may still be present. Our reasoning is based on the position of these dolomites at the base of the Syncline and on the fact that the shape of the Syncline favors the concentration of groundwater (karst morphogenetic factor) towards the middle.

Limestone klippes currently display a greater diversity of underground caverns. These caverns most often correspond to gravitational cracks present in the rock or are the result of chaotic position of scree aggregates detached by physical processes from the main rock. The only signs of karstification processes manifested in some cavities are represented by *montmilch* on the walls and also small corrosion shapes. A few potholes have been reported in the cracks present within the klippes.

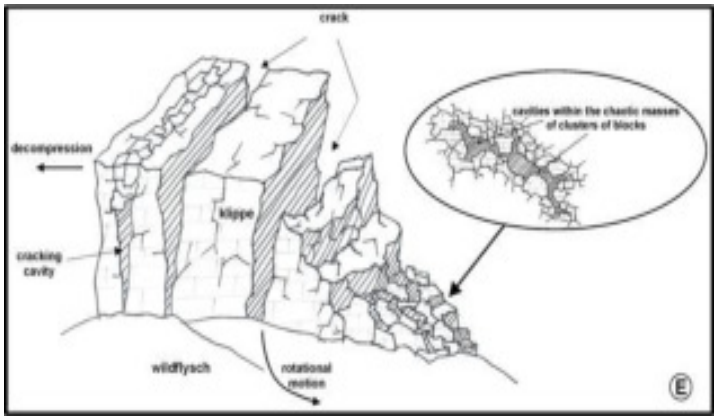

Fig 4. **The position of underground cavities in the scree mass -** ***talus cave***

Corrosion is a process with weak manifestation in the caves mapped around the Pietrele Doamnei area. Despite that the Rarău plateau does not offer great variety in terms of karst landforms, two new caves have been discovered on the northern steep slope of the Rarău peak: i) Pestera Fisurii, with the longest inner gallery of all known local caves; ii) Pestera cu Cot, the first endokarst landform that retains clear traces of corrosion.

Based on morphology, we can classify the underground holes in our study area in three categories:

1. cavities in the chaotic clusters of blocks - ***talus cave***, are the most numerous among the mapped underground holes near Pietrele Doamnei rocks;
2. caves associated to litho-tectonic-morphological cracks;
3. caves with mixed origin, *i.e.* tectonic-corrosive.

3.2.1. Cavities in the chaotic clusters of blocks

They are underground holes preserved in large areas covered by periglacial scree that fossilizes and buries the base of steep slopes or of limestone-dolomite klippes.

The cavities within gravitational clusters may occur in hard rock massifs, not necessarily of limestone, but compact and affected by fragmentation and gravitational collapse processes. They occur most often on the edge of steep walls from which large rock fragments can detach over time and fall towards the base of the slopes. By clustering, such large rock fragments create large or small cavities that can be connected through narrow passages, hence the relatively large spatial extent of some cavities. The team established within the Speo Club Bucovina and led by Adrian Done mapped a number of 25 such caves in the debris that fossilize the basis of Pietrele Doamnei rocks, five of which being considered potholes. Part of these cavities were mapped and recorded in the Cadastre of Caves.

From the genetic point of view, the cavities cannot be considered endokarst, because corrosion marks are absent, but holes in the scree mass (Fig. 4). Only if karst processes caused by properties of dolomites and limestone were identified, such a classification would be justified. Their higher mobility determines a permanent reconfiguration of component hollows, and under these circumstances the access through such cavities involves high risks. Pestera Liliecilor is the most representative of such cavities. It is located in the western part of Hăghimiş Mountain, on a gently sloping morphological plateau about 1 km northward of Pietrele Doamnei Rocks. Genetically, it cannot be distinguished from the cavities located around Pietrele Doamnei. The cave has a mixed development, *i.e.* on fracture lines, but also in the scree mass resulting from weathering of the klippes belonging to the allochthonous Transylvania Nappe.

The cave does not show signs of dissolution or water flow. It rather reveals a cluster of large limestone blocks following a fracture line whose flanks were distanced. It consists of a series of cavities (rooms) – *Luminată, Liliecilor, Dreptunghiulară, Conică, Ramificată, Ascunsă şi a Ceaiului*), which can be seen as hollow spaces formed during gravitational clustering of the rock fragments. These component cavities are linked through narrow passages and thresholds, developed on diaclases within an impressive mass of scree. They show a deep fracture of the olistholit which contains the cave. The fracture is not observable on the outside, with the exception of the final part. The last mapping of Pestera Liliecilor cave reveals cavities of about 340 m length (Club Speo Bucovina and Club GEIS Iaşi, 1994 Fig. 5) arranged on a slope with over 80 m elevation differences and an extension (plan length) of about 100 m. It has no

concretion formations of stalactites and stalagmites type, but only montmilch flow. Screes mobility resulting either from their own mass, or from seismic and gravity movements permanently contributes to the reconfiguration of contained cavities.

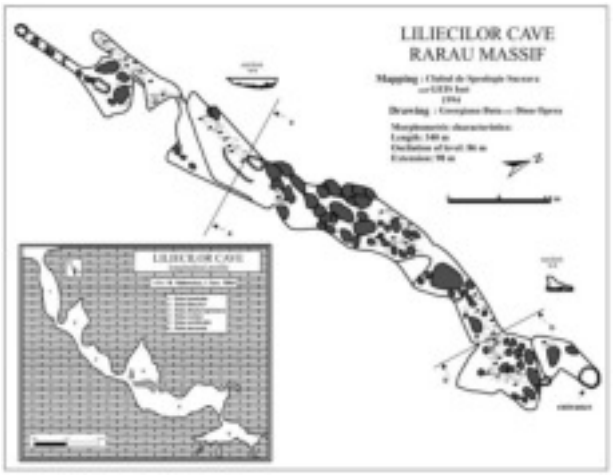

Fig. 5. **Pestera Liliecilor cave - profile and plan view**

In the Pietrele Doamnei Rocks area another cave was identified, namely Peştera Lungă cu Gheaţă (The Long Cave with Ice). With over 80 m length, the cavity has an elevation difference of about 20 m. It can be accessed through a wide pothole, after which the access gallery descends in a tilt spiral through the limestone blocks.

Moreover, it can be noted that secondary side cavities have also developed, but not very important as regards size. The basal part of the main gallery, in cavities with triangular sections resulted from the clustering of large blocks with flat walls, preserves ice throughout the year (Photo 2). Ice presence has prompted us to initiate the thermal monitoring of the gallery and ice volume of by placing thermal sensors and marks. Karst morphology is represented by weak corrosion marks observed on the walls of the blocks, resulting from rainwater or snowmelt leaching.

3.2.2 Caves associated to litho-tectonic-morphological cracks

One of the lithological characteristics of carbonate rocks is their plasticity and brittleness. Cracking occurs in different directions, which are dependent on the structural characteristics, compression or distension forces, sliding movements etc. Basically, the network of cracks appears rectangular, developed both vertically and horizontally, but can also follow insequent directions.

Photo 2. **Peştera Lungă cu Gheaţă (The Long Cave with Ice) – perennial ice**
(D. Oprea-Gancevici)

During mapping performed in the Pietrele Doamnei Rocks area a number of 8 cracks have been observed in the main block of rocks. Their general NNE - SSW orientation is defined by the 180-220 ° azimuth gap. The cracks have widths ranging between 30-40 cm and 2-3 m, as well as lengths of meters or tens of meters. Vertical development is difficult to assess, but we suspect that they cross the entire thickness of the klippe. Overall we consider cracking a result of gravitational decompression occurred in the block parallel to the slope line. Cracks can be seen both on the northwestern and on the southeastern flanks.

Similar cracks are present in the klippe limestone block where Pestera Liliecilor cave is located. In the plateau preserving the cave's entrance there is a rectangular network of cracks, the main being oriented NE-SW, similar to the cracks occurring in Pietrele Doamnei Rocks.

Their formation is related to morphological and structural relationships of the klippes with the clayey wildflisch substrate. Basically, they are produced as a result of increasing depths of valleys, a gravitational imbalance by sliding of blocks \ olistholits, which are subjected to external forces of gravitational pull which "break" the limestone-dolomite rock mass on the low resistance or lithological contact lines (usually diaclases). Cracking occurs most frequently on the mentioned directions by klippe "slicing".

Peştera Fisurii cave is representative of this category of underground cavities. It is located on the northern slope of the Rarău Massif, and was discovered relatively recently (Vasile Bouaru). Its name clearly expresses geomorphologically its appearance, given that its longitudinal profile resembles to some extent a symmetrical V (Fig. 6). Cave formation was a result of a conjoined

influence of geomorphological processes and structural-petrographic characteristics of the klippe. Stratigraphically, the block layers are verticalized. Their structural position is very likely preserved from the moment of collapse and burial in the clay matrix of the wildflisch. The general orientation of the diaclase is given by the 230-240° azimuth gap, and it is coincident with the azimuth of the cracks observed in the Pietrele Doamnei Rocks area.

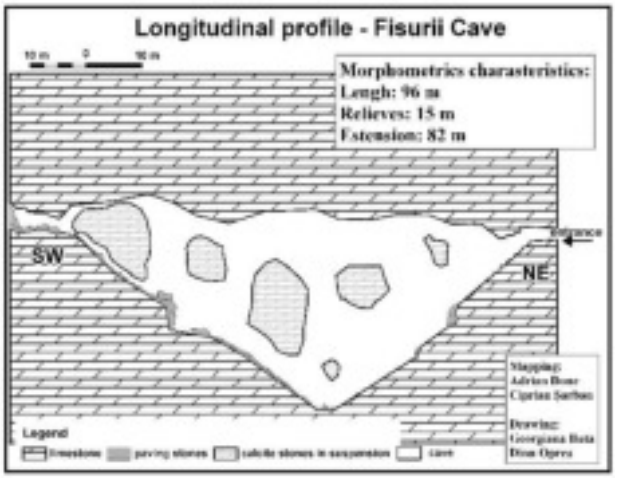

Fig. 6. **Peştera Fisurii cave (The Crack Cave) – longitudinal profile**

Provided that in the case of the latter cracking occurred on low resistance lines, Peştera Fisurii cave was formed on a lithologic contact line; it is entirely centered on a calcite diaclase with thickness between 50 and 100 cm (Photo 3). The length of the cave is about 100 m and the width about 80 m. The opening widens inward to about 1 to 1.5 m. However, the cavity displays a significant vertical development. In the middle, the gallery has a maximum height of about 15 m.

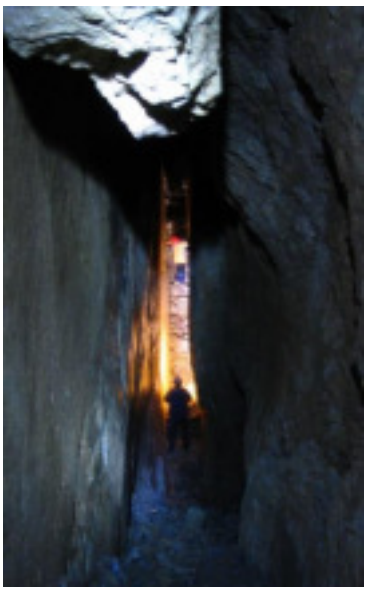

Photo 3. **Peştera Fisurii cave** (D. Oprea-Gancevici)

The next sector requires a descent on a 25 ° to 35° tilted floor, lined with numerous blocks of different sizes, jagged and very unstable, mostly composed of calcite. The blocks originate from the top part of the crack and resulted from physical fracturing. Moreover, the vertical extension of the crack contains stranded boulders of varying sizes whose width is greater than the crack size. Along the descent, there are two thresholds with heights ranging between 1.5 and 2 m, generated by large size blocks, collapsed from the top of the crack. The cave length, from the entrance to its lowest part, is about 50 m. Access on the crack line involves climbing large blocks, on an elevation difference similar to the difference calculated for the descent in the cave, which gives the cave a shape of symmetrical "V" in the longitudinal profile. The presence of blocks, stuck in the crack walls and on the floor, suggests intense fragmentation and collapse activity. The cave does not preserve important features of karst morphology. Small concretions present on the walls are caused by laminar flow of rain or snow melt water. There is a constant flow of water on the walls. The humidity varies between 94-96%, somewhat constant, and the recorded temperature from 2.3 to 2.6 °. Peştera Fisurii cave is the underground cavity with the longest and most unitary gallery identified among the other cavities mapped so far.

3.3.3 Tectonic-corrosive caves

Karst corrosion in the Rarău Massif was seldom reported, as most mapped cavities may be included in the first two categories approached in our paper. Genesis of cavities formed through karst erosion is based on cracks and diaclases which allow water flow, given that the klippes in Rarău have abundant such forms.

The corrosion morphogenetic endokarst in the Rarău Massif could be theoretically identified in the Campilian - Anisian limestone outcrops appearing on the Syncline flanks, under the clayey wildflisch and over the crystalline schists. Water can penetrate gravitationally to the limestone substrate, where it contributes to the degradation of rocks through specific processes. However, the synclinal position of the calcareous layer makes water outflow more difficult. The springs emerging from the dolomite layer flanks of the Bukovina Nappe could signal the presence of underground cavities. Presently we do not have any information in this regard. We note only the local mentioning of two such cavities which could not be located in the field, namely in the Moara Dracului (Devil's Mill) and Piatra

Şoimului (Hawk's Stone) gorges, with lengths of 7-9 m (Vasilie, 2001, http://adone.geonet.ro/speologie/comunicari /bucuresti2001/rarau/rarau.html).

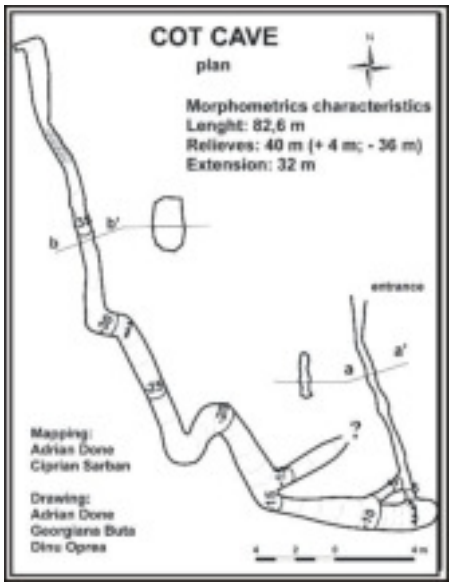

Fig. 7. **Peştera cu Cot Cave – plan view**

The only cavity of this type, mapped in the area of the klippes, is the Peştera cu Cot cave, also located on the northern slope of Rarău, and also reported by Vasile Bouaru. The cave develops on crack lines independent of the klippe stratigraphy, although the entrance and some small sectors appear to correspond to the stratigraphy. The 83 m length, 40 m elevation differences and 32 m extension, the corrosion morphology, karst microforms of coralite type distinguish this cave as the most developed endokarst landform identified so far in the Rarăului Massif.

Photo 4. **Peştera cu Cot Cave – downward gallery (C. Sarban)**

The downward gallery follows a spiral path after the first 10 m from the entrance. The floor slope frequently varies between 30 and 45 °, but there are also threshold-shaped sectors. The final part of the gallery appears horizontal, with a length of about 5-6 m. High slope is reflected in the gallery morphology, *i.e.* circular - ellipsoidal (Photo 4). At the top there is even a diffluence (bifurcation) of the gallery of over 4-5 m length. Two secondary cavities can be separated from the main gallery, with lengths of 3-4 m. Punctually, centimeter-sized circular galleries can be identified in the cave ceiling, which function as water drains. Water flow has generated evorsion processes on crack lines, and the walls preserve the result of turbionary flow under the shape of lateral marmites. The temperature recorded expeditionally (June 2014) reveals values between 5-6 ° C, whereas humidity amounts to 96%.

Peştera cu Cot cave is presently a unique case in the Rarău Massif karst morphology. It preserves clear traces of karst shaping through corrosion, *i.e.* concretion microforms known as coralites, but also small corrosion holes, spoons, evorsion marks, pillars, floor ditches etc. Research of these microforms will continue both from the geomorphological perspective and for assessing environmental conditions and mostly the topoclimate of underground caves. For the latter research direction, the caves are subjected to constant monitoring by thermal sensors that record hourly temperature. The duration of observations will include an annual cycle.

Conclusions

No typical endokarstic landforms have yet been mapped in Rarău. Most existing cavities were generated by the plasticity of rocks and tectonic impacts, by the structural arrangement of limestone - dolomite olistholits, scree masses and large size of blocks detached and gravitationally accumulated at the base of steep slopes.

The majority of underground cavities found in the Rarău Massif have a tectonic and geomorphological genesis. They were formed by deposition or sliding and decompression of limestone blocks on the wildflisch layer. Thus significant accumulation of scree and formation of longitudinal cracks generally oriented towards NE - SW occurred in the area. The rock fragments move, leaving behind cracks that permanently resize over time. Along these cracks sliding and collapse of blocks may occur on the clayey substrate, which by clustering at the base of the slope can preserve open spaces between them, thus creating caverns and tectonic caves – litho – morphologic caves.

Our approach aims to improve the picture of the relatively poorly developed karst in our study area, with the more complex diversity specific of this genetic type of petrographic landforms. We can assert that our research is developing, our expectations being stimulated by identification of certain underground caverns which show, for the first time in the Rarău Massif, clear marks of corrosion, *i.e.* Pestera cu Cot cave. Furthermore, identification of fossils ice in the Peştera Lungă cu Gheață cave, as well as of the bats colony in the Peştera Fisurii cave open new research directions and perspectives, Endokarst evolution of the Rarău Massif, together with other geomorphological elements, gives a distinctive note to this mountainous area. As regards information level, karst research opportunities acquire new levels through identification of new underground caverns, which will be rendered valuable through further investigations.

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