

NYMPHAEA Folia naturae Bihariae	XLVIII	19 - 44	Oradea, 2021
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Morphology and hydrogeology of the karst area of Lumea Pierdută and Vârtopaşul-lezere (Bihor Mountains, Romania)

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Abstract. Here we describe the karst area situated in the hydrographic basin Izvorul Ursului - Pârâul Sec, which includes the Căput Cave, the Lumea Pierdută System (= The Lost World System), the Peştera Mare de la Izvorul Rece (= The Great Cave at the Cold Spring), and the lezere Cave that lies in the karst plateau lezere - Vârtopaşul, above Pârâul Sec. The latter is situated at the limit of three great hydrographic basins: Galbena, Valea Ponoraş and Gârda Seacă. Besides the endokarst the area is extremely rich in attractive exokarst elements.

Introduction

The hydrographic basin Izvorul Ursului - Pârâul Sec is a nearly unique karst zone, not only in Romania but also in Europe. On a reduced surface of only 6.4 km² there are 34 caves, out of which the two great systems detach clearly, Lumea Pierdută System (3,322 m total length) and Căput Cave (1,950 m total length) (Fig. 1). But, not only the endokarst is interesting but also the exokarst: stremsinks, ponors, resurgences, dolines, limestone pavements, pocket valleys, canyons, etc.

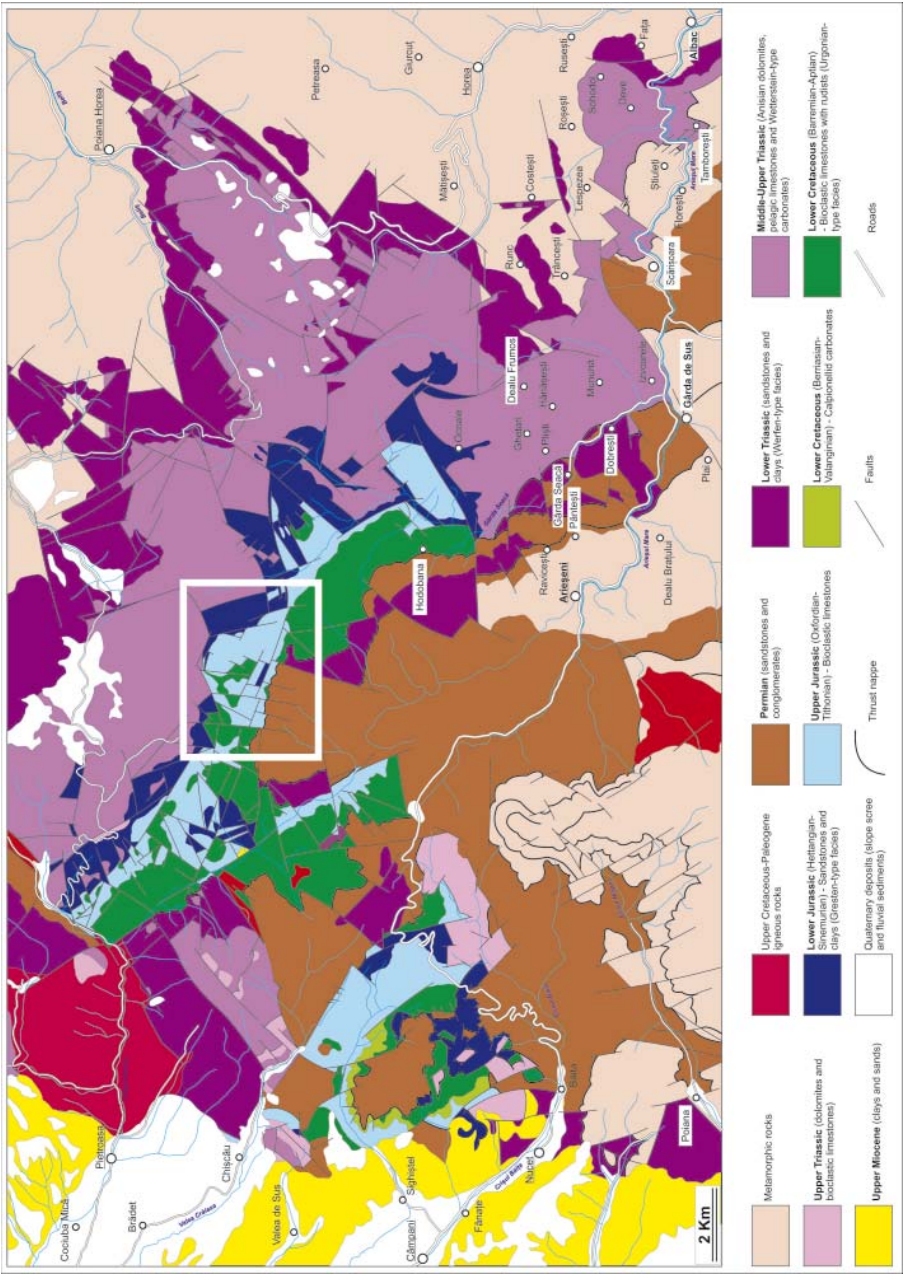


Figure 1. Lumea Pierdută-Vârtopașul-lezere karst area (in white framework) within the geological map of the central part of the Bihor Mountains. Modified by George Pleș after geological maps 1: 50000, sheets 56a (Pietroasa; Bleahu et al., 1985), 56b (Poiana Horea; Bleahu et al., 1980), 56c (Biharea; Bordea et al., 1988) and 56d (Avram Iancu; Dimitrescu et al., 1977)

Peștera de la Căput (=Căput Cave)

Peștera de la Căput, situated at 1050 m altitude (the main entrance) represents the final drainage point of the closed basins: Izvorul Ursului-Pârâul Sec and also a subterranean drain for the small closed basin Cetățeaua (Fig. 2, 4, 5). The cavity is in fact, a maze-like network formed epiphreatically with a total length of 1,950 m and an vertical range (VR) of -91 m. At present, the cave is subjected to a slow clogging evolution, especially due to large accumulations of logs. This last aspect demonstrates once again the total negative impact on nature as a result of the massive and uncontrolled deforestations after 1989.

Explorations history

In 1861, the great Austrian geographer Adolf Schmidl discovered the entrance to Căput Cave. After about a century, in 1952 Mihai Șerban, Iosif Viehmann and Marcian Bleahu had their first exploration of the cave and they reach the -65 m depth. In 1955 Dan Coman, Marcian Bleahu, Iosif Viehmann and Liviu Mînzăraru they got to the terminal sump (it seems they got to the terminal sump- we do not have precise data) at -91 m (-71 m reported to the main entrance). A schematic map was made for 550 m of galleries, that is, the main gallery exclusively. The map was published for the first time in 1976 when it was already totally outdated. Between 1976 and 1983 the Speleological Club „Z” (Liviu Vălenaș, Gizella Kajtor, Tibor Varrö and Iuliana Kövári) sustained explorations of the Căput Cave, that time the side network being explored, the total length of the cave reaching 1,950 m. The explorations în 1976 were made în common with the Speleological Club „Speodava” (Petru Brijan and Viorel Conete) from Ștei. After 1989, massive clogging did no longer allow any speleologist to get to terminal sump. Since 1994, the upper sector of the cave was used as „school land” by the național speleological schools that were developing în the adjacent area.

Lithology, morphology and genesis

The cave has developed in Jurassic limestone (J3), strongly diacized and faulted and developed in a wide homocline. The main faults lines are SE-NW and SW-NE. Practically all galleries in Căput Cave develop on these tectonic lines which can be recognized at the surface, too. The transition from one faulting system to another has created underground false meanders of the main gallery. Morphologically and hidrogeologically, Căput Cave belongs to a vast system with a final unloading point în Izbucul Galbenei (815 m altitude). This important resurgence is also joined by Cetățile Ponorului Cave, Groapa de la Barsa (with the adjacent

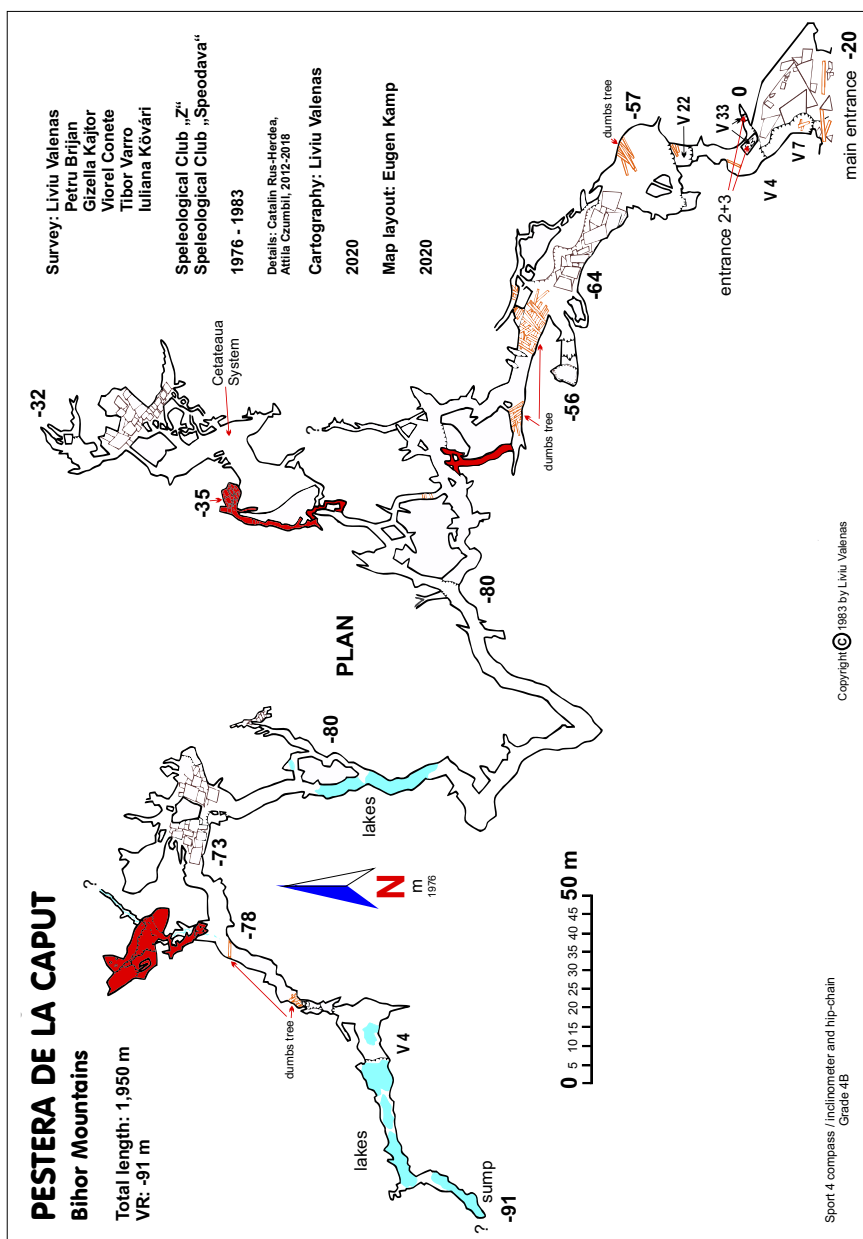


Figure 2. Căput Cave, plan view, cartography by Liviu Vălenaş, 2020.

basins Poiana Zăpodie and Ştevia Lupii), Poiana Ponor and the two small basins Molhaşul Ponorului and Cetăţea. A total number of galleries of 50-70 km (for this great system) is but a minimum at the moment. The main gallery of Căput

Cave with a length of 575 m can be morphologically considered a first order drain. Towards this main drain, two second order secondary drains, Cetățeaua network and the small tributary from -78 m get along. The ratio between the total surveyed length (1,950 m) and the aerial extension (331 m) characterises a relatively maze-like cave, the branching coefficient being of 5.9. The maze-like character stands out significantly especially at the side network Cetățeaua.

Hydrogeology

During the dry season, the cave has no flow except the small tributary at the -78 m depth. Normally, the waters of the valleys Izbucl Ursului and Pârâul Sec get lost in the bedding of the valley at 40-100 m from the main entry. It is obvious that a groundwater flow is organized under Căput Cave with a final unloading point in the still unexplored sector between the terminal sump in Căput Cave and the last sump in the active tributary gallery in Cetățile Ponorului Cave heading towards Căput Cave. During the flooding season, the last 180 m in the main gallery make practically one sump. Cetățeaua Network and the tributary at the -78 m drains the small closed basin Cetățeaua, more precisely the two permanent small pocket walleyes leaks developed at the lithologic J1-J3 contact. Mentioning that the first leak organizes at present underground, too, following under the galleries of Cetățeaua Network, a vadose flowing existing probably only at great floods. Iancu Orășeanu (Orășeanu, 2020) supposed the drainage at least, partly of the plateau (more of a closed basin) Paragina, too, through Căput Cave. The hypothesis is wrong: in Căput Cave, there is no tributary coming from Paragina. But we do not exclude, at a lower level, phreatic evidently, to exist such a confluence.

Description

At point of -20 m (in relation to the secondary entrances) is the main entrance, an imposing sloping portal, 21 m wide and 5 m high. Above the portal on a major fault line several pits open, out of which two grouped appear at the marking +20 m from the main entrance. The two pits unite after a few meters and they have a pit of 33 m. The main portal continues with a gallery resembling a canyon fragmented by three pit of 7, 4 and 22 m respectively. The last pit opens into a large hall of 23/15 m immediately followed by another hall full of blocks, 36 m long and 11 m high, point of -64 m. From this depth the cave presents a phreatic gallery with a beautiful profile of equilibrium with elliptical sections on average 6/3 m. At a distance of 232 m from the entrance, an important bifurcation appears. Towards North-East a maze-like complex develops, partially storeyed consisting of clay galleries - Cetățeaua Network. The sector (with a cumulated length of 611 m) presents two

more large halls of 24.3 × 18.6 m and 31.4m × 7.4m respectively. At the end, a hall (22.8 × 17.1 m), chaotic, full of blocks and pillars and on the left, an ascending gallery. From here, up to the first ponor from the closed basin Cetățeaua there are only 30 m în straight line. The main gallery continues meandering presenting (în the dry season) at 339 m from the entrance a first lake, 23 m long, then a second 9 m long. From the last lake (-81m) the gallery still continues meandering having several slides în living rock, either descending or ascending. At 575 m from the entrance, the explorations have been stopped by a deep overflowing sump (-91 m). From here up to the main gallery in Cetățile Ponorului Cave there is an aerial extension of 300 m. We still have to mention a small tributary at the -78 m running on 50 m up to 60 m în a squeeze line from the second pocket valley in Cetățeaua. Căput Cave also contains large accumulations of logs which endanger any exploration or just a visit.

Mineralogy

Căput Cave is very poor în speleothems. There are some in a hall superior to the tributary starting from -78 m marking.

Possibilities of advance

The main serious possibility of advance is the junction with Cetățile Ponorului Cave forcing the terminal sumps in Căput Cave and in the tributary gallery from Cetățile Ponorului Cave. Maybe in the future, it would be more productive that the diving attempts be done from Căput Cave to Cetățile Ponorului Cave. But to be able to dive into the terminal sump in Căput Cave, the clogging of logs and river deposits must be deblocked from -78 m which was formed after 1990. This operation needs great logistics, which is not impossible. Only a few tens of meters part this sump in Căput Cave from the last sump in the tributary gallery in Cetățile Ponorului Cave. Only theoretically it is possible to advance 100 m more on the last tributary towards the closed basin Cetățeaua but only if the continuous squeezes in this sector are forced.

The Lumea Pierdută System (= The Lost World System)

The Lumea Pierdută System represents the undergrounding of the plateau with the same name, a plateau situated between 1200 and 1220 m (Fig. 3). Concretely, it is about a drain of about 2.5 km (considering also the theoretical meanderings in the segments not known yet) and the diffuse sinking stream of Pârâul Sec (the Dry Creek) and the resurgence from Izvorul Rece (The Cold Spring), 1085 m alt. If

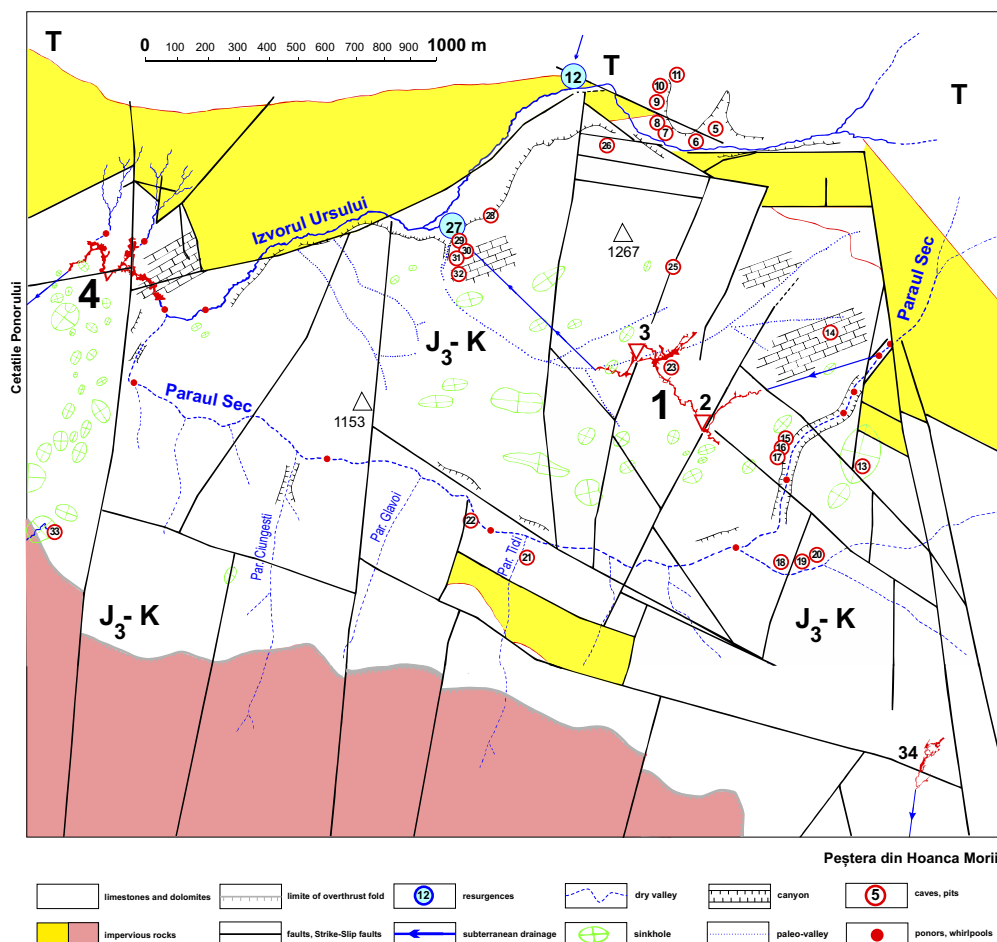
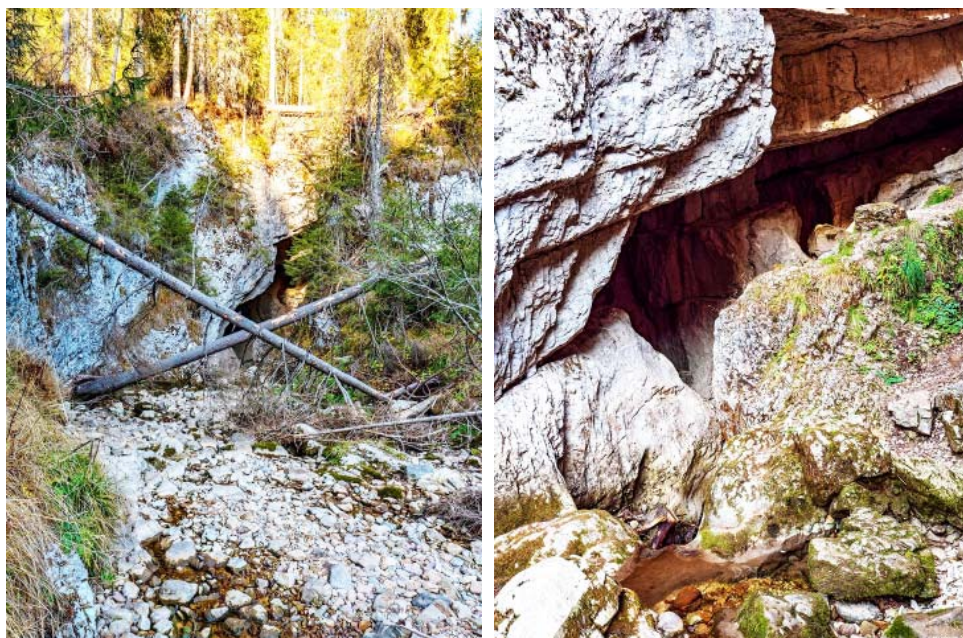


Figure 3. The karst zone Izvorul Ursului and Pârâul Sec. The endocast: 1 – Rețeaua Lumea Pierdută, 2 – Avenul Negru, 3 – Avenul Gemănata, 4 - Peștera de la Căput, 5 - Peștera I din Chicerile Ursului, 6 - Peștera II din Chicerile Ursului, 7 - Peștera Suspendată din Chicerile Ursului, 8 - Peștera III din Chicerile Ursului, 9 - Peștera cu Hornuleț din Chicerile Ursului, 10 - Peștera cu Pod Natural din Chicerile Ursului, 11 - Peștera Mică din Chicerile Ursului, 12 - Izbulul Ursului, 13 – Ponorul-Sală de la Izvoarele Pârâului Sec, 14 - Avenul Înfundat, 15 – Peștera cu Viezuri din Pârâul Sec, 16 - Peștera cu Două Intrări din Pârâul Sec, 17 - Peștera Mică din Pârâul Sec, 18 - Peștera Scundă cu Perle din Pârâul Sec, 19 - Peștera II din Pârâul Sec, 20 - Peștera cu Două Intrări din Pârâul Sec, 21 - Peștera cu Două Intrări din Valea Seacă (Pârâul Sec), 22 - Ponorul cu Sifon din Valea Seacă (Pârâul Sec), 23 - Peștera Mică de la Avenul Gemănata, 24 - Avenul Pionierilor, 25 - Avenul Acoperit, 26 - Peștera Mică de la Nord de Avenul Acoperit, 27 - Izvorul Rece, 28 - Peștera I de la Izvorul Rece, 29 - Peștera Mare de la Izvorul Rece, 30 - Peștera III de la Izvorul Rece, 31 - Peștera IV de la Izvorul Rece, 32 - Avenul cu Două Intrări de la Izvorul Rece, 33 - Ponorul din Barsa Cohanului, 34 - Peștera de la lezere. (Cartography by Liviu Vălenaș, 2020).



Figs. 4 and 5. The main entrance to Căput Cave, photo by Dan Moldovan, 2019.



Figure 6. The 22 m pit in Căput Cave, photo by Attila Czumbil, 2018. **Figure 7.** The first exploration in Căput Cave, 1952, down-right: Marcian Bleahu (who ensures) on the rope ladder: Mihai Șerban, photo by Iosif Viehmann (reproduced from volume „Höhle von Rumänien“, Meridiane Publishing House, Bucharest, 1961).



Figure 8. The hall at the base of the 22 m pit in Căput Cave, photo - Attila Czumbil, 2018.

the resurgence and the diffuse sinking stream of Pârâul Sec are impenetrable, the underground access was possible due to two important pits: the Avenul Gemănata (The Twin Pits) - Gemănata Pit and Avenul Negru - (Black Pit), 81 and 82 m respectively, deep. The Lumea Pierdută System focused on an main course 1.1 km long and on a secondary course, 188 m long, plus a branch occupied by a stagnant lake, 90 m long (Fig. 9). The total length is of 3,322 m, VR -137 m.

Explorations history

In 1952 Mihai Șerban, Iosif Viehmann, Marcian Bleahu and Tibor Jurcsák descended the 81 m well from Gemănata Pit and explored nearly 700 m of galleries. In 1956, another team, led by Marcian Bleahu (Dan Coman, Gheorghe Mantea, Sever Bordea, Josefina Bordea, Corneliu Pleșa and Liviu Munthiu) descended for the first time the 82 m vertical from Negru Pit and made the junction with Gemănata Pit surveying about 1 km of galleries. The map was published only in 1976 when it was no longer relevant. Marcian Bleahu, who undoubtedly was the engine of the explorations in this great network, baptized the limestone plateau with these two pits „Lumea Pierdută“ (The Lost World) after Arthur Conan Doyle's

novel, „Professor Challenger“. The name, totally unknown to the natives, became known and gradually it remained to be used till now. In 1976 the Speleological Clubs „Z“ (Liviu Vălenaş, Gizella Kajtor and József Dezsö) and „Speodava“ (Petru Brijan and Ovidiu Cuc) perfected a collaboration and surveyed minutely the network. The most important advance was achieved on the Secondary Course, the surveyed length (for the whole system) being 2,437 m. Upstream of Negru Pit nothing could be explored, the pit hole being found blocked with snow and ice that year. In 1980 Mircea Sfâşie, together with a group of schoolchildren from Halmeu, all under 15 years (!?), with a rudimentary equipment, descended again in the Negru Pit exceeding the snow blockage and explored a small part upstream, with deep lakes, up to a sump (Sfâşie, 1982). Marcian Bleahu, in 1956 appreciated the vertical of Negru Pit to be 108 m (with this figure, a national record for 14 years), Mircea Sfâşie even to 109 m (Sfâşie, 1982), both values being much exaggerated. The measurements in 1982 reduced the figure to „only“ 82 m. In August 1982 Liviu Vălenaş and Gheorghe Popescu succeeded in widening a squeeze where a strong air current used to blow a little upstream Negru Pit and advanced nearly 1 km, first on a fossil gallery and then on the main course up to a 4 m waterfall. It was exceeded in 1983 by Liviu Vălenaş and Nicolae Sasu, terminus being an open sump with the ceiling at only three centimetres from the mirror of the water. After a few months, the same year, the two passed this sump, too, being stopped by a fissure, extremely narrow, out of which the active appeared through a 2.5 m waterfall, at the -58 m depth. This point could no longer be exceeded till now. In the terminal sump downstream, Liviu Vălenaş dived in 1982 but he abandoned it after only 4.5 m because of the improper equipment. The total surveyed in 1976-1983 was 3,322 m (which is still at present). Unfortunately, Negru Pit has become relatively well-known to the public at large lately through two deadly accidents of some tourists who, being negligent, slipped into the 82 m well.

Lithology, morphology and genesis

The system develops in Jurassic (J3) and cretaceous (K) limestone, strongly diacized and faulted, developed into a large homocline (Fig. 10). The main fault lines are SE-NW and SW -NE. Practically, all galleries develop on these tectonic lines which can be recognized at the surface, too. But the subterranean course appears through a 2.5 m high waterfall directly from the nonkarstifiable stack belonging to the inferior Jurassic (quartzite sandstones and Hettangian quartzites and less frequently Toarcian marls). It is quite clear that here we have to do with a vadose flowing gallery excavated in these rocks, wrongly considered nonkarstifiable. One more evidence added to questioning the notion of „pseudo-karst“. The

Lumea Pierdută System evidences a genesis initially epiphreatic, then, massively vadose remodeled. Negru Pit and Gemănata Pit were formed in the same conditions, from down upwards, after the massive collapse, opened at the surface. As a testimony that they developed from the bottom up, are several chimneys that climb 40-50 m and end up in a „sack bottom“. As for the upstream end of the network, it was dictated by the upstream migration of the sinking stream of Pârâul Sec. There can be seen an almost perfect similitude with the Coiba Mică-Coiba Mare System (Vălenaș, 2019-2020). The gallery, occupied by the 90 m long lake corresponds with the first stream sink of Pârâul Sec. We do not know yet where this paleo-whirlpool or paleo-ponor lies but it is certain that it is at an aerial extension towards the upstream sump from the Lumea Pierdută System of 270 m (if it is about the sinking stream from SE) or most probably, at 380 m, the sinking stream from S-SE. Instead, the river active terminus (the 2.5 m waterfall) drains the sinking stream from the current upstream of Pârâul Sec which is at an aerial extension of 430 m. The Lumea Pierdută System has a total length of 3,322 m surveyed, displayed on an aerial extension of 540 m, branching coefficient: 6.1. Out of the total length, 767 m are pits or chimneys, that is 23.1% from the total.

Hydrogeology

Without any discussion, the hydrogeology of the Lumea Pierdută System is one of the most interesting in the Bihor Mountains. The main underground course represents a breakthrough of the plateau Lumea Pierdută between Pârâul Sec and Valea Izvorul Ursului. This underground course is displayed on an aerial extension of 1,580 m and a vertical range of 170 m. We appreciate the real length of this course to a minimum of 2.5 km taking into account its meanders, too, determined by the tectonic structural factor. Out of this theoretical length, only 1,100 m could be explored so far. In the terminal upstream sector of the main course (the portion with the six waterfalls) from the North five low flow tributaries converge draining only the eastern sinkholes of the Lumea Pierdută plateau. The Secondary Course, in exchange, drains the valley of the sinkholes from the NE of Gemănata Pit. From the terminal sump downstream the Lumea Pierdută System, there still remains an air distance of 720 m up to the resurgence at Izvorul Rece and a vertical range of only 10 m. But the relatively high flood wave propagation speeds sustain the idea of a flow, mainly free. Finally, the main active course which disappears upstream into a muolin with sump at -83 m depth, after a drowned course of 200 m, it appears a little upstream the Negru Pit in the gallery occupied by a 90 m long stagnant lake. The respective relation was demonstrated through a colouring made in 1982. Iancu Orășeanu and Paul Matoș (Orășeanu, 2020) made a colouring at the

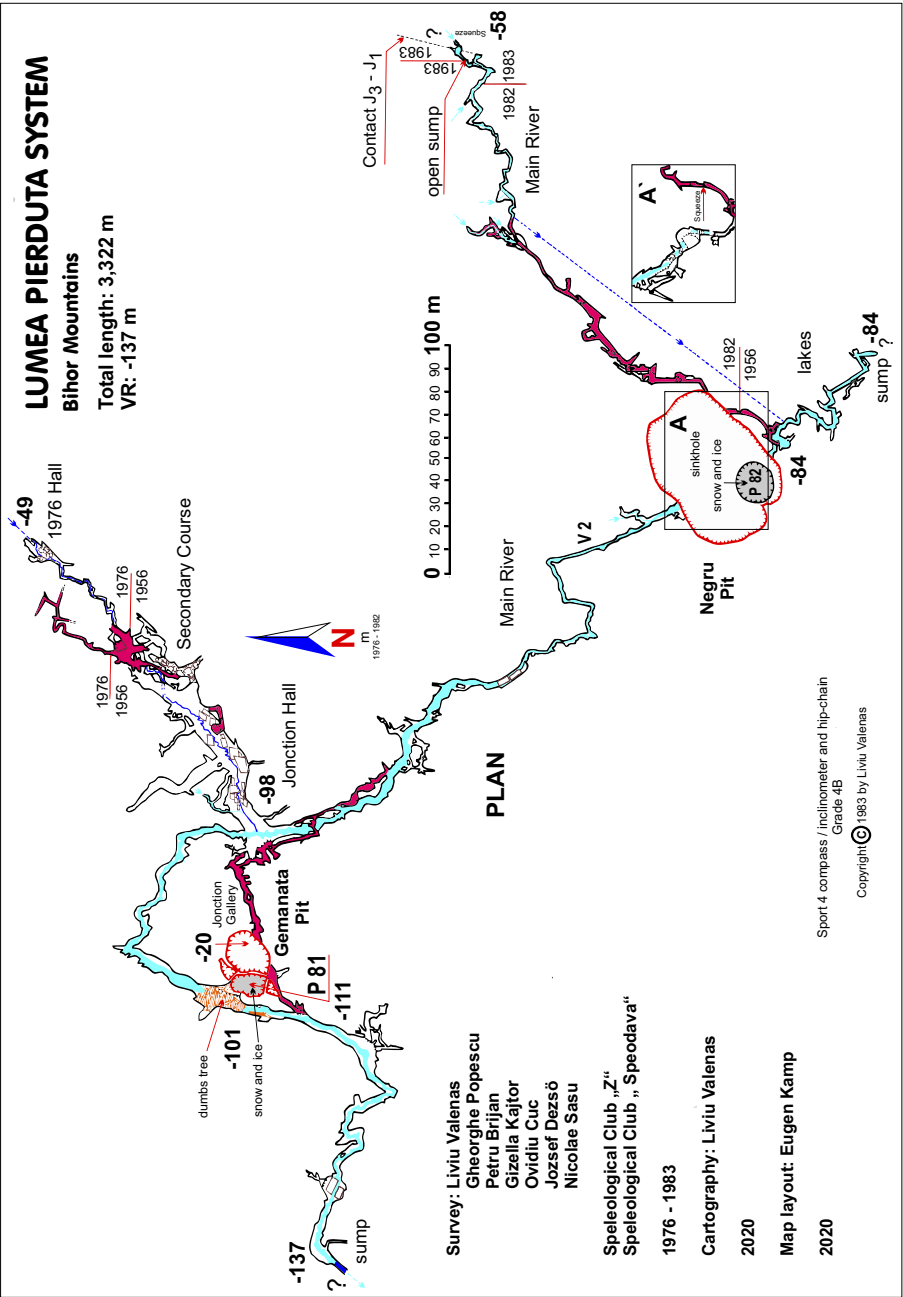


Figure 9. The Lumea Pierdută System, plan view, cartography by Liviu Vălenaș, 2020.

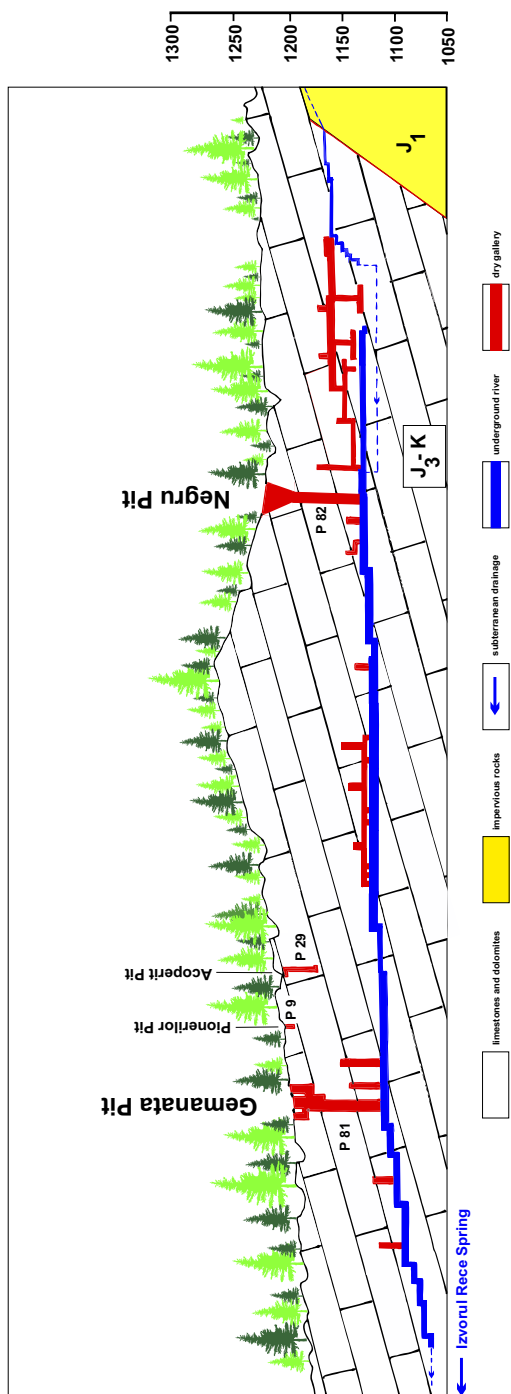


Figure 10. The Lumea Pierdută System, schematic section, graphics by Liviu Vălenas, 2020.

diffuse sinking stream of the Pârâul Sec on August 10th 1986. This was normally identified in the subterranean course Gemănata Pit and then in Izvorul Rece. The flow speed on the route Pârâul Sec - Izvorul Rece was 34.6 m/hour (Orășeanu, 2020). The medium flow rate of Izvorul Rece is 40 l/s, the temperature between 5.4 - 5.6 C degrees (Orășeanu, 2020). But on July 27, 1978, the author measured a water temperature of 6.1 C degrees in Izvorul Rece. Unfortunately, the authors of the colouring in 1986 never said precisely at what stream-sink of Pârâul Sec they made the respective colouring.

Description

We will make the description in the sense of the hydrological flow, from upstream to downstream. At the point of -58 m, on a clear fault line and on a limestone/nonkarstifiable J 3- K/J 1, lithological contact, from a fissure, the active appears through a 2.5 m waterfall. The terminal chamber is not more than 3 m in diameter after an open sump, with a open sump and after a meandering course with a succession of other five waterfalls (of 1, 4, 3, 5 and 7 m respectively) the active disappears into a muolin with sump (-83 m). After climbing an antithetical step, a fossil path follows, 215 m long made up of galleries 15-30 m high. The last portion of the fossil gallery is descending, with some verticals (V5, V15) which, in order to reach the terminus point from -58 m, must be climbed. After a severe squeeze, the main course is met again under the shape of a 90 m long lake heading towards SE. To the SW you can get after only a few meters at the bottom of Negru Pit which has a cone of river deposits and logs. At present, it is no longer possible to cross this natural dam (15 m long) towards Gemănata Pit, a fact that was possible in the 1950s. Negru Pit starts from a big sinkhole, 65 m in diameter, in which the 82 m vertical is inscribed in a hypothetical axis in the middle of the sinkhole.

Between 1956-1983 in Negru Pit there was a large perennial accumulation of snow and ice. After this stopper, the main active appears. After an almost horizontal course (with the exception of a 2 m waterfall) of 359 m long, you can get to the Confluence Hall. From here, it branches towards the NE of the Secondary Course, 188 m long. It ends impenetrably at -47 m depth in the „1976 Hall“. Above this active, a few maze-like upper floors branch, the total length of the Secondary Course being of 838 m, the main active flows almost horizontally (it presents several lakes) on a length of 153 m, up to the basis of Gemănata Pit (point of -101m). Gemănata Pit starts from the surface through four parallel verticals, which unite after 20 m. If you try to climb down directly through the western well, the pit measures 81 m. At the basis of Gemănata Pit, there are large accumulations of logs and detrital material fallen from the surface. Between 1952-1983 there were large



Figure 11. Negru Pit, photo by Attila Czumbil, 2018.



Figure 12. Gemănata Pit, photo by Attila Czumbil, 2018. **Figure 13.** Gemănata Pit, P 81 m, photo by Cătălin Rus-Herdea, 2020.

deposits of perennial snow and ice, too. Between the Confluence Hall and the basis of Gemănata Pit, you can also get through the Connection Gallery (a fossil gallery which avoids the lakes on the Main Course) 91 m long. The Main Course can still be followed on 192 m the terminal downstream sump from -135 m. The Main Course presents several rapids. The terminal sump was dived in 1982 on a length of 4.5 m up to -2 m (-137 m compared to the entrance of Negru Pit). The sump is a relatively low rolling mill with a slope of 20 degrees but continuing in the direction of the resurgence at Izvorul Rece.

Mineralogy

The Lumea Pierdută System is relatively poor in speleothems. Some of them appear in the upper floors above the Secondary Course and mainly in the fossil gallery 215 m long, between Negru Pit and the terminal sector of the main course.

Possibilities of advance

Unlike Peștera de la Căput, the Lumea Pierdută System still has a great potential. The most serious advancement could be made by forcing the downstream sump up to the resurgence at Izvorul Rece, remaining an air length of 720 m. The relatively great speed of flowing (demonstrated by colouring in 1986) sustains the idea of an active, partly vadose. Another tempting possibility is that of diving into the sump upstream the Negru Pit, the SE branch, a wide and deep sump. Here, too, hides an important potential of galleries, more than likely with halls and large lakes after the sump. And between the gallery with lakes and the muolin with sump in the upstream sector, there still remains a 200 m long sump to be surveyed. Finally, if it were to enlarge, the technical means of the XXIst century (which we did not dispose of in 1983) the final fissure, maybe we could advance on the main active upstream, too, beyond the point of -58 m. It is certain that the presence of the important air current shows that the network does not end here. And up to the sinking stream in Pârâul Sec there still is an air distance of 430 m. In conclusion, we appreciate the potential of the galleries of the Lumea Pierdută System at least double to the surveyed length so far.

Avenul Acoperit (= The Covered Pit)

The Avenul Acoperit is a fossil cavity, without continuation, with a depth of 35 m (88 m length) situated above Lumea Pierdută System (Figs. 14 - 16).

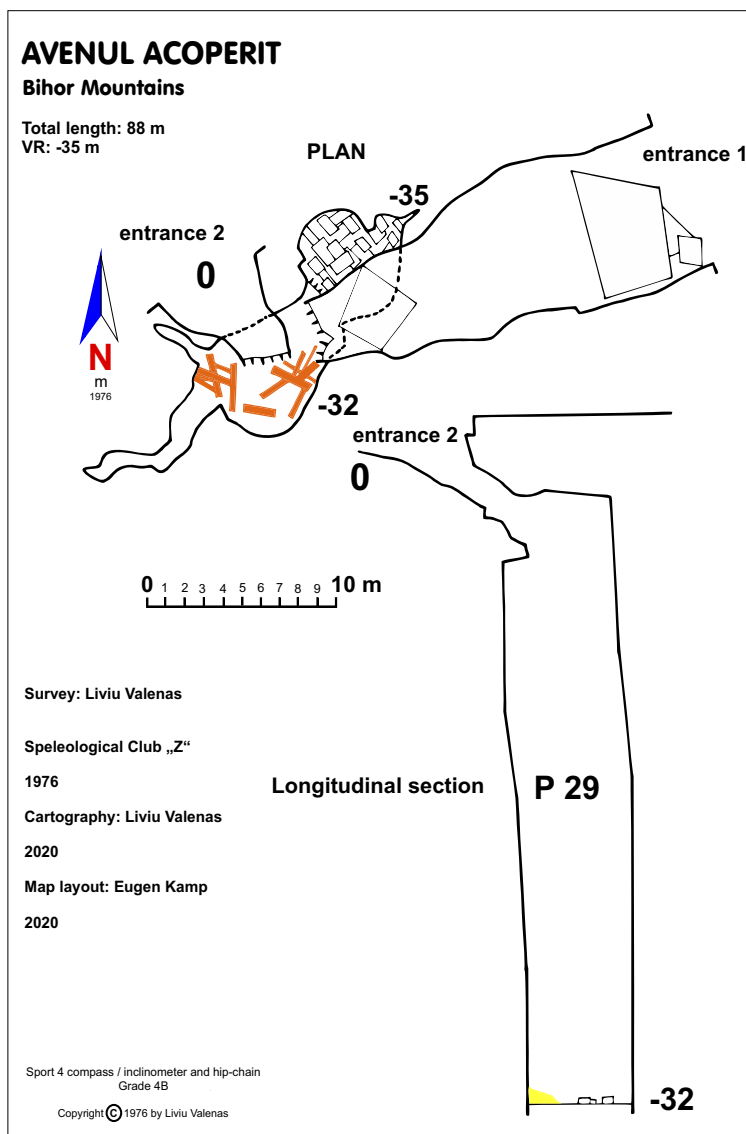


Figure 14. Avenul Acoperit, plan view and section by Liviu Vălenaș.

Explorations history

The Avenul Acoperit was discovered by Marcian Bleahu, Dan Coman and Liviu Mînzăraru in 1953. In 1976 it was precisely surveyed by Liviu Vălenaș, Eleonora Vălenaș, Nicolae Sasu and Ferenc Kulcsár (Speleological Club „Z“).



Figure 15. Avenul Acoperit, the main entrance, photo by Attila Czumbil, 2018.



Figure 16. Avenul Acoperit, the 29 m pit, photo by Attila Czumbil, 2018.

Description

From an entrance 10 m wide and 3.5 m high, there comes a horizontal gallery, 20 m long which ends through a vertical pit of 29 m. At its base, there is a small hall of blocks descending to -35 m.

Morphology

The pit developing in living rock, was initially formed in a phreatic regime, the 29 m pit, which has a ceiling above it is a proof in this respect. After the initial phreatic phase, the pit was vadose modelled. Morphologically it belongs to Lumea Pierdută System but we are not aware which gallery in the underground of this great cave it could correspond.

Peștera Mare de la Izvorul Rece (= The Great Cave at the Cold Spring)

Peștera Mare de la Izvorul Rece is a fossil cave, representing the overflow of the resurgence Izvorul Rece (Fig. 17). It is situated at 18 m vertical range reported to the resurgence having a length of 90 m and a development on the vertical range of 13 m (-4; + 9). We mention that the cave appears in „The Speleologic Inventory of the Bihor Mountains” (Vălenaș, 1977), under the name of Peștera II from Izvorul Rece.

Explorations history

The cave was discovered in 1976 by Eleonora Vălenaș (Speleological Club „Z”) and Tiberiu Luscan (Speleological Club „Speodava”), its survey in 1983 being achieved by Liviu Vălenaș, Iuliana Kövári, László Kuki and Péter Ménesi.

Morphology

The cave was formed in a phreatic regime, and no notable vadose remodelling was found. The 18 m descending of the phreatic surface let the cave suspended in relief, without any flowing.

Description

From a small entrance, a low gallery, 17 m long, gives access through a negative vertical of 3 m to a large hall 25 × 7 × 7 m, full of blocks. Unfortunately, no continuation was found towards the subterranean course between Lumea Pierdută System and the resurgence Izvorul Rece.

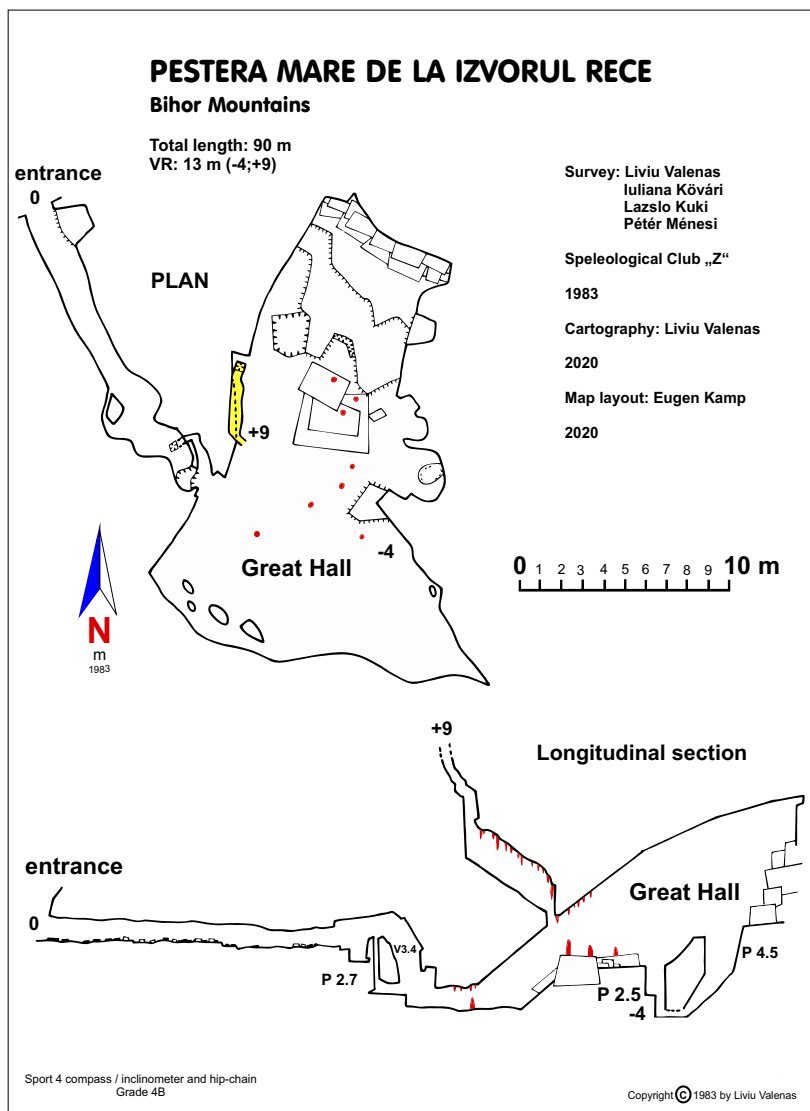
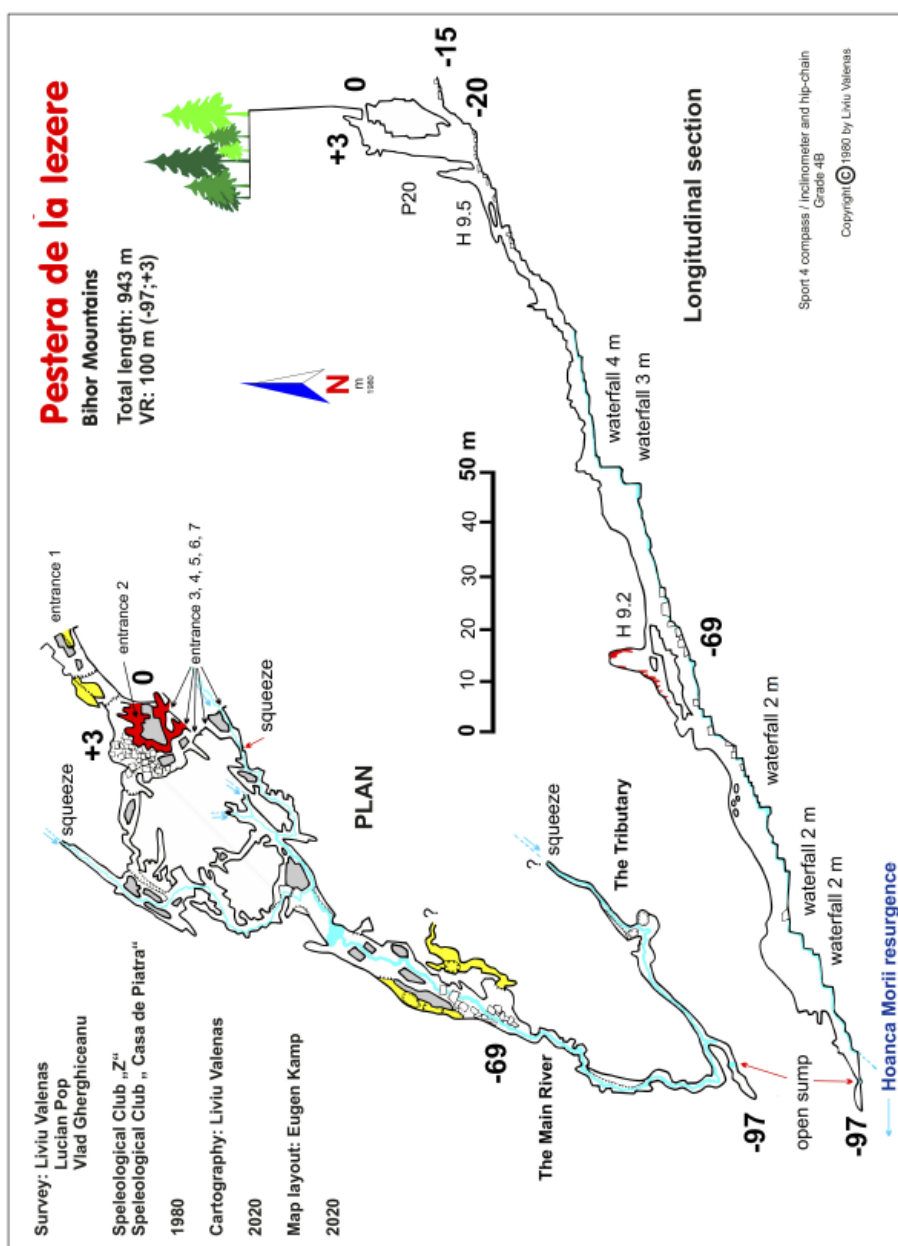


Figure 17. Peștera Mare de la Izvorul Rece, plan view by Liviu Vălenaş.

Peștera de la lezere (= lezere Cave)

Peștera de la lezere is a ponor-cave, situated at 1320 m altitude, it lies in the karstplateau of lezere - Vârtopaşul, above Pârâul Sec, at the limit of three great hydrographic basins : Galbena, Valea Ponoraş and Gârda Seacă (Fig. 18). It is dif-



difficult to consider this karst zone as belonging to a closed basin or only to a simple plateau. But it certainly contains a small pocket valley which gets lost in Iezere Cave and several big sinkholes, some of lithological contact. Small surface creeks are drained, organizing on the waterproof bundle and also some sinkholes in the neighbouring main entrance. The branching coefficient (5.93) shows clearly that we are dealing with a maze cave, mentioning that this is valid only in the upper portion from the entrance up to -60 m depth. The cavity is focused on an underground river 250 m long. Total length: 943 m, vertical range: 100 m (-97; +3 m), aerial extension: 159 m.

Exploration's history

The cave was discovered in 1861 by the great Austrian geographer Adolf Schmidl. With all this discovery of the middle XIX th century, only after 119 years, in September 1980, Liviu Vălenaș, Lucian Pop and Vlad Gherghiceanu performed a full exploration and the survey of the network. The action took place within a common expedition of the Speleological Clubs „Z” and „Casa de Piatră” – Turda.

Lithology, tectonics, morphology and genesis

Iezere Cave is excavated in upper Jurassic limestones (lower Neocomian-Aptian) strongly diacalized and faulted. The main faults and diaclasses on which the cave develops, have an orientation remarkably parallel, NE-SW, exactly the same as the andokarstic systems in the Casa de Piatră zone and from the Lumea Pierdută. Iezere Cave has developed initially in batiphreatic regime, then massively vadose remodeled.

Hydrogeology

Iezere Cave drains three small surface creeks coming from Liasic (Hettangian - lower Sinemurian) but also losses through sinkholes and probably one more ponor, unidentified so far. The final drainage of the cave has remained an enigma for a long time. Paul Damm and Horia Mitrofan (Damm, Mitrofan, 2005) assumed even an aberration: Iezere Cave would drain through Izbucul Tăuz, at 4.5 km distance! A colouring in 1986 with fluorescein made by Iancu Orășeanu and Paul Damm but afterwards, demonstrated that the resurgence of the cave is in Ponoraș valley, in Peștera de la Hoanca Morii - Hoanca Morii Cave, at 2 km air distance from the terminus -97 m depth in Iezere Cave (Orășeanu, 2020). The vertical range between this terminus and Hoanca Morii Cave is 174 m. The colouring covered the entire distance between the entrance of Iezere Cave and resurgence in only two days, The flow speed on the route entrance Iezere Cave – Hoanca Morii Cave was 15.0

m/hour Also taking into account the relatively great vertical range (174 m); it is evident that for the most part, the course must be vadose.

Description

The main entrance of the cave lies at the bottom of an impressive vertical cliff. The cavity in which the cave appears, resembles with a huge sinkhole. In reality it is about a pocket valley and the vertical wall in which the cave appears, it is nothing else but an antithetical step. In this wall, at a height of 15 m, there are three smaller entrances which give access to a small suspended maze (a small chimney reaches the maximum remount levels of +3 m) a 20 m deep pit (P 20) flows directly into the lower gallery at point of -20 m. The first portion strongly descending (but without notable verticals) is chaotic and maze-like. The galleries are generally low, full of blocks and alluvial deposits. Apart from the small main course, there appear three more tributaries with a low flow, too, which unite at -39 m, creating a unique underground course. Soon, there appear two spectacular waterfalls in the living rock, 4 m and respectively 3 m high. After the last waterfall, the subterranean course flows on a gallery 2 m wide and up to 10 m high on an average. An upper loop with a 9.2 m chimney completes the landscape. The active gallery descends the steep slope, being fragmented by other 5 smaller waterfalls of 1-2 m. The most important confluence is at -92 m, with a secondary course, parallel with the main active. The tributary could be traversed on 55 m to NE up to a portion where the gallery gets extremely narrow. Immediately after the confluence, the active course disappears into a sandy whirlpool. The gallery becomes fossil after passing a small stagnant open sump at -95.5 m after 11 m more, the gallery ends in a sack bottom (clogging with sand) at -97 m, the lowest point of the cave. But we must underline that the description between -92 m and -97 m markings correspond only to the situation in 1980, it seems that afterwards strong floods changed the morphology of the cave in the terminal sector.

Mineralogy

Iezere Cave is poor in speleothems. They appear especially in the suspended loop at -50 m.

Possibilities of advance

In 1980 there was no longer any possibility of advance: at -97 m the terminal gallery ended in a bottom sack: total clogging with sand. After 2019, Ovidiu Guja informed the author that the aspect of the final gallery seems totally changed, a small upper floor gave access to a severe strait where there is an air blow. The squeeze, totally

impenetrable should be enlarged. It is possible that repeated floods after 1990 to have partially cleared the final gallery. Anyway, the potential of the cave is great.

The geochemistry of the karstic waters

Only four water samples were taken in the past from the studied area which allow to draw some interesting conclusions. The analyses of the water samples were done in 1978 by Constantin Marin, from „Emil G. Racovitza“ Speleological Institute in Bucharest (Fig. 19). Concerning the water sample from Izbucul Ursului (The Bear Spring), it is immediately recognized that we have to do with an aquifer flowing through triassic dolomite limestones (Anisian) - the presence of the Mg ions. In opposition with this resurgence, Izvorul Rece drains nondolomitized limestones, containing only 0.8 mg M ++. In exchange, the samples no 3 and 4 contain a certain mineralization in Mg++, due to the fact that the waters of Izvorul Rece mix afterwards with those coming from Izvorul Ursului. Surprisingly, the water of Pârâul Ursului, at the entrance to Căput Cave (sample no 3) has concentrations a little higher than at its exit into the affluent gallery in Cetăţile Ponorului Cave. The only explanation is a supplementary more diluted water contribution underground. Broadly speaking, almost all water analyses are still aggressive towards limestones.

No	location of samples	lime-stone	date	water flow l/s	t°	pH	Ca ++ mg/l	Mg ++ mg/l	HCO ³ -- mg/l	Cl -- mg/l
1	Izbucul Ursului	T ₁	July 27, 1978	50	6.8	7.15	57.6	12.9	227.7	1.2
2	Izvorul Rece	J ₃	July 27, 1978	75	6.1	7.10	54.4	0.8	159.5	1.4
3	Izvorul Ursului Creek, 40 m upstream the Căput Cave	J ₃	July 27, 1978	200	9.5	7.30	54.0	5.4	176.6	0.9
4	Cetăţile Ponorului, the tributary from Căput Cave	J ₃	July 27, 1978	350	8.1	6.90	51.2	4.7	172.9	----

Figure 19. The chemical analyses of the water samples taken from the closed basin Izvorul Ursului - Pârâul Sec.

Conclusions

The closed basin Izvorul Ursului - Pârâul Sec and the plateau Vârtoapașul - lezere contain an evolved karst with specific shapes. The belonging of the great subterranean drainage systems to a phreatic genesis is an undeniable fact. The elements sustaining the phreatic genesis are extremely numerous: specific underground relief, the horizontality of the principal galleries, uninfluenced by a structural factor. But the descending of the phreatic surface has determined a vadose remodelling, the special case of Lumea Pierdută System. The process is still going on at present, especially in Căput Cave where the drainage of Izvorul Ursului stream towards Cetățile Ponorului Cave organizes at present under the galleries of this cave. Another example is the drainage upstream Negru Pit, more precisely the sump 90 m long. The age of the endokarst and of the exokarst, too, cannot be pushed lower than the Middle Pleistocene.

Acknowledgements

Many thanks to Eugen Kamp, †Gheorghe Popescu, Ioan I. Bucur, George Pleș, Cristian Victor Mircescu, Emil Silvestru, Attila Czumbil, Dan Moldovan, Cătălin Rus-Herdea and Ovidiu Guja.

References

- Bleahu, M. 1957. - Captarea carstică și importanța ei pentru morfologia regiunilor carstice, *Probl. Geogr.* **5**: 55-99.
- Bleahu, M. 1957. - Cercetări geologice în regiunea Padiș-Cetățile Ponorului, *D. S. Com. Geol.*, **42** (1953-1954): 35-66.
- Bleahu, M. 1964. - Formațiuni periglaciare în carstul din Munții Bihorului, *Lucrările Inst. de Speol. "E. Racoviță"* **3**: 35-66.
- Bleahu, M. 1971. - Les surfaces d'aplanissement karstique des Carpates Roumaines et leur évolution, *Stud. Geomorph Carp.-Balc.* **5**: 41-48.
- Bleahu, M. 1974. - Morfologia carstică, ed. Științifică, 590 p.
- Bleahu, M. 1982 - Notă, *Bul. Inform. FRTA-CCSS* **6**: 181-182.
- Bleahu, M., Bordea, S. 1967. - Munții Apuseni. Bihor-Vlădeasa, ed. UCFS, 333 p.
- Bleahu, M., Decu, V., Negrea, S., Pleșa, C., Povară, I., Viehmann, I. 1976. - Peșteri din România, ed. Științifică și Enciclopedică, 414 p.
- Bleahu, M., Șerban, M. 1956.- A travers les galeries souterraines du Padiș, *La Roumanie nouvelle*, **9**: 195.
- Bleahu, M., Șerban, M. 1959. - Bazinul endoreic Padiș-Cetățile Ponorului. Propunere pentru un viitor parc național, *Ocotirea Naturii* **4**: 89-125.
- Bleahu, M., Dimitrescu, R., Bordea, S., Bordea, J., Mantea, G. 1980. - Harta geologică a României, Foaia Poiana Horea, ed. IGG.
- Goran, C. 1981. - Catalogul sistematic al peșterilor din România, *CNEFS-FRTA-CCSS*, 496.

- Halasi, G. 1982. - Peșteri noi în Valea Seacă și Valea Izbucul Ursului (Bihor), *Carst* **2**: 74-85.
- Jeannel, R., Racoviță, E. G. 1929. - Énumération des grottes visitées, 1918-1927 (7e série), *Arch. Zool. Exp. Gén.* **62** (2): 293-608.
- Orășeanu, I. 2020, Hidrogeologia carstului din Munții Apuseni, editia a II-a, ed. Belvedere, 350.
- Orghidan T., Pușcariu, V., Bleahu, M., Decu, V., Rusu, T., Bunesco, A. 1965. - Harta regiunilor carstice din România, *Lucr. Inst. Speol. „E. Racoviță”*, **4**: 75-104.
- Schmidl, A., 1863. - Das Bihargebirge an der Grenze vom Ungarn und Siebenbürgen, Verl. Förster & Bartelmus, Wien.
- Sfâșie, M. 1982. - Explorarea cursului activ amonte din Avenul Negru (Rețeaua Lumea Pierdută – Munții Bihor), *Bul. Inform. FRTA-CCCS* **6**: 177-179.
- Silvestru, E. 1997. - Dolines in the Padiș Plateau (Bihor Mountains, Romania) – One peculiar case, many questions, *Theoretical and Applied Karstology* **10**: 127-132.
- Vălenaș, L. 1976. - Privire de ansamblu asupra carstului din Munții Bihorului, *Nymphaea* **4**: 21-58.
- Vălenaș, L. 1978. - Morfologia sistemului Coiba Mare - Coiba Mică - Izbucul Tăuz, *Nymphaea* **6**: 329-362.
- Vălenaș, L. 2020. - Morfology and hydrogeology of Vârtop - Coiba Mică-Coiba Mare - Izbucul Tăuz, *Nymphaea* **46-47**: 5-48.
- Vălenaș, L., Bleahu, M., Brijan, P., Halasi, G. 1977. - Inventarul speologic al Munților Bihor, *Nymphaea* **5**: 209-335.
- Vălenaș, L., Damm, P. 1987. - Știri interne, Munții Bihor, *Speotelex, ser. II*, **2**(14): 6.
- Vălenaș, L. Kamp, E. 2020. - Peștera de la Căput si Rețeaua Lumea Pierdută (Munții Bihor), *Cave exploring* **15**(2): 55-74.