# ARCHEOLOGICAL POTENTIAL OF KARST OF VÂRGHIȘULUI GORGE (PERȘANI MOUNTAINS). PRELIMINARY STAGES IN IMPLEMENTATION OF GEOGRAPHIC INFORMATION SYSTEM

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***ABSTRACT***
*Vârghișului Gorges represent the main karst area of Perșani Mountains, situated in their north extremity, at the boundary of Harghita Mountains. In the karst surface have been identified over 130 caves encased on 4 levels of karstification. The archaeological researches which started the year 1911, and have been going on in certain stages up to the present moment have resulted in the discovery of several occupational stages from the Paleolithic up to the modern period. In this material, starting from the studies published up until the present and from the research campaigns realized between 2014 and 2015 we present the main stages that we have achieved and that we take into consideration in the creation of a geographical informational system in which to integrate the geographic and archaeological data which refer to the caves from Vârghișului Gorges. The main intent of this step is the attainment of a detailed database which would contain characteristics of the caves, from the geographical point of view (location, height, state of preservation, the orientation of the cave entrance, the thickness and characteristics of the deposit from the cave, morphometry of the cave and so on) and from the archaeological point of view (the existence or the non-existence of traces of habitation, the periods of habitation, the continuity of the habitation and so on). All these will allow us in the future to identify a general model of selection of the caves from this area by the Paleolithic communities and eventually its extension to the Carpathian caves*

***Keywords:*** *Karst, Vârghișului Gorges, Paleolithic habitation, GIS*

## INTRODUCTION

The choice of karst Vârghișului Gorges habitat for interdisciplinary research for a long period had a couple of good reasons. First, it's the high density of caves and shelters under rocks, with a high archaeological potential and placed in a geographic area relatively small in size, but noticing that the data known so far do not allow us, only in a small part, to easy identification in the field of caves. Secondly, it is a very generous space for the realization of practical activities, both for students of history specialization - within archaeological yards from schools and for geographers students - in practical stationary activities, referring to students from the University Valahia of Targoviste, Faculty of Humanities Sciences, History and Geography specializations.

## GEOGRAPHICAL LOCATION

Vârghiș basin is developed in the south of central group of the Eastern Carpathians, at the contact between Harghita Mountains (in the north) and Persani Mountains (south) with maximum extension in Harghita Mountains, where it gathers most of the affluents (Rich Creek, Chirui, Cold Creek) (fig. 1). In the northern extremity of Persani Mountains, when crossing through formations of limestone belonging to Jurassic and Triassic in this mountain unit, develops the most important karst areal both the basin and the Perșani Mountains, not as stretch, as in terms of diversity and scale of landforms [1].

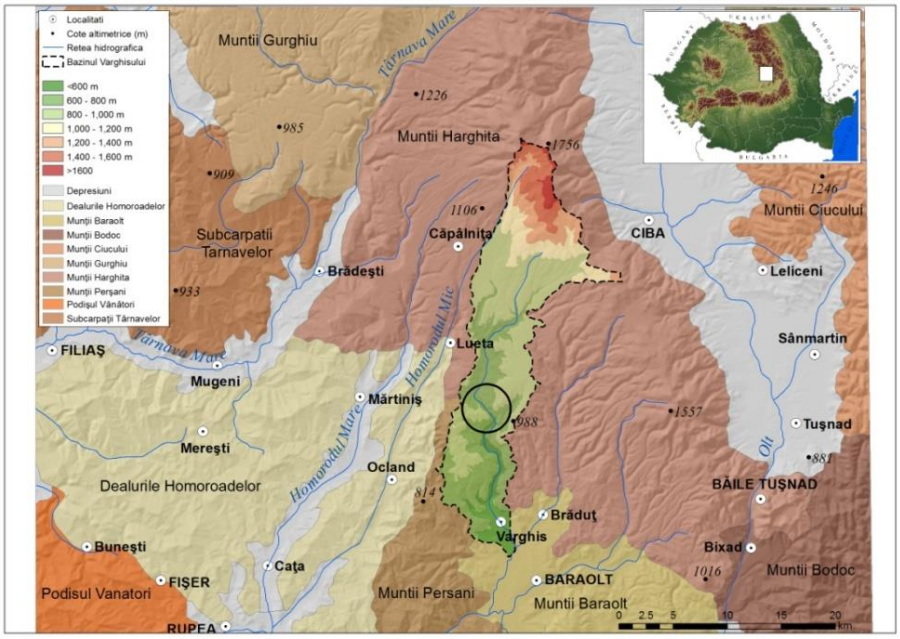


**Fig. 1.** Geographical location of Vârghiş Gorges

## HISTORY OF RESEARCH

The first mentions of the complex karst of Vârghiş Gorges are placed during the birth of a new discipline - speleology. Thus, the first description of the cave Mare from Meresti we owe to J. Friedvaldsyki in 1767, followed by Joseph Benkö (1780), J. E. von Fichtel (1780) and Kleinkauf J. (1793). In 1835 Fekete István had published the first detailed map of the Mari cave and in 1868 Orbán Balázs conducted a comprehensive description of the complex karst [6].

If the interest for karst of Vârghiş Gorge was manifested early on, in terms of their archaeological potential it was highlighted by Podek Ferenc, who in 1911 published the results of excavations of 15 caves [6]. In the years 1941 - 1942 Maria Mottl resumed the archaeological research [5]. Unfortunately, by reference to the current standards only draw attention to their studies on the archaeological potential of sedimentary packages from caves placed Vârghiş Gorge, at least for the Paleolithic period. Ferenc Podek researched caves that cannot be identified in the field and at M. Mottl if the points can be placed, we do not have plans of excavations, a description of the relevant archaeological material, the association fauna and stratigraphic profiles.

A broad description, of the most known caves and rock shelters in the Vârghiş Gorge, we owe to speleologists Tr. Orghidan and Margareta Dumitrescu [6]. In the years 1957-1958 they collected data needed for the first interdisciplinary study dedicated to this area but resumed and archaeological data are known about some of the caverns concerned. In some situations, when archaeological profiles remained open from previous excavations, they have recovered and identified prehistoric pottery and Pleistocene fauna. At this stage of the research, the monograph conducted by Tr. Orghidan and Margareta Dumitrescu, remains the most important study for the karst Vârghiş Gorge, even if it only describes the 65 caves of the approximately 130 known at this time.

In 1969 Lucian Rosu conducted excavations in the caves of Horse and Tatars, but the research results were not published. The lithic material discovered during archaeological research in Horse cave, close to a hearth arranged in association with Pleistocene fauna, was assigned by archaeologist Al. Păunescu [7] Mousterian and Aurignacian, but this classification had occurred only by resorting to typological criteria.

**RESEARCH CONDUCTED IN THE PERIOD 2014-2015**

The merits of alerting the archaeological potential, from the paleolithic period, the castle of Vârghiş Gorge belong to geomorphologist Nicholas Băcăinţan. At his suggestion, in 2011, M. Cosac and G. Muratoreanu, alongside prof. Băcăinţan visited a number of known caves and gathered data from previous consecrated researched studies.

In the year 2014, three points were discussed: Horse cave, Abri 122 and Bear cave.

a. Horse cave - is located on the right side of the Vârgişului gorge, at 60 meters in the upstream from the cave Mare and 6 m. above the riverbed. Our goal for 2014 year was to locate a section of the cave portal, close to the section performed by L. Rosu in 1969, still observable in the plane cave. The research took into account the evaluation of the cultural component of occupational stages, by unveiling in situ an archaeological material of prehistoric invoice and collecting the evidence necessary for interdisciplinary research. They identified and marked sections a cave in the previous research plan and pits due to poaching activities.

From the passim material were recovered from indeterminable prehistoric pottery fragments. The excavation reached a depth of 1.45 m. The cave bed without identifying materials of paleolithic invoice. This can be explained by the fact that the portal has not provided optimal cave dwelling reactivating due a periodicity of a sedimentary contribution due to Vârghiş. This hypothesis is supported by the succession the stratigraphic profile, where lenses are interspersed sandy gravel deposits found on high rolling, indicating a sedimentary torrential regime. At this stage of research we accept the possibility that the paleolithic material mentioned by previous research come from the main gallery of the cave, in its unflooded space [3].

b. Abri 122 - is located on the right side of the Vârgişului Gorge, in their terminal part from the Vârghiş locality, being represented by a small cave located in the lower third of the slope. The site has been excavated under the direction of I. Deneş in several stages in 1989, 1990, 1995 and 1996, but the research results have not yet been published. The excavation has affected the most part of the sedimentary deposit from the housing area, but its removal was not performed during the excavations. Please note that the previous research has not addressed the cave and space. Research objectives for 2014 were the release of the sedimentary material in the immediate vicinity of the cave and full recovery of archaeological material unidentified earlier in the excavation and mainly research packages sedimentary area of the cave, by unveiling in situ material anthropogenic and collection of evidence necessary Paleolithic habitation determining age.

Lythic collection recovered from sediments affected by the previous research consists of 561 pieces, indicating that they come from outside of a certain stratigraphic context. In the space of the cave they were identified in situ 43 pieces; these artifacts are coming from a sheltered sector unaffected by previous research, but will be presented as the collection will enrich in future research. The pieces from the passim category come from the ranging sedimentary packages researched by I. Deneş in his campaigns in 1995 and 1996, as shown by the excavation plan which I had access.

In association with lithic material from the cave, space were identified three pieces of hard materials of animal origin with an obvious peak of morphology. Preliminary analysis of these confirmed that two of them were used.

At a preliminary analysis of the faunal material recovered, both under passim and from the undisturbed sedimentary deposit from the space of the cave, has a degree of uniform fossilization and appears to be the result of an accumulation of anthropogenic nature. The assembly reflects a good representation of the skeleton, as it includes various anatomical fragments of phalanges, the bones of the skull and dentition. Were identified remains from large herbivores (Bos / Bison) and average (Goat), dogs (Canis lupus) and bear (Ursus spelaeus).

At this stage of archaeological research and preliminary analysis of the collected material, we accept the existence of two phases of habitation of the middle paleolithic in the housing area and the terminal part. The upper level has been affected by previous excavations, as is indicated by the high percentage of lythic equipment recovered from the excavated material [2].

c. Cave Bear - is located on the right side of the Vârghiş Gorge, at 107 m. Above the riverbed, at the base of a rock wall of 6-7 m high. The cave has three openings, two orientated to E-NE and third to the north. The main opening is blocked due to the collapse of rocks and boulders, but access is granted through the opening in its immediate vicinity. The cave is developed horizontally and has a main hall of 30 m long and 20 m wide, and other two secondary smaller. Our goal for 2014 year was to place a section in section A of the cave, an area affected partly by previous research, where, at least in theory, may be spotted a concentration of archaeological material of prehistoric, and the levels of occupied can be caught undisturbed.

Unfortunately, due to the hard location of the site and the time constraints of the archaeological research of Abri 122, we only managed a partial cleaning of a stratigraphic profile resulted after the excavation of M. Mottl. From the proximity of excavation was recovered prehistoric pottery, and from the surveys done by speleologists or amateur archaeologists the Pleistocene faun. The stratigraphic profile was surprised by a macroscopic lens of volcanic ash due to the eruption of a volcano in the Carpathian mountains, Massif Ciomadu very likely one of the massive eruptions of MIS 3, around 40-45 ka (chronological analyses on the proximal deposits are being an achievement). Future research will determine the relationship between this chronological marker or the local environmental changes caused by this event, and the paleolithic habitation identified by previous research [4].

## GEOGRAPHICAL FEATURES OF THE AREA

The karst system developed where the Vârghiş valley leaves the southern slopes of Harghita mountains consist of Neogene magmatic rocks and penetrate in the domain of Mesozoic sedimentary through the Triassic limestone bar and Jurassic from the northern of Perşani mountains (Fig. 2), has a length of 3.5 km and an area of 56 km$^2$. This entire area is characterized by an abundance of karst forms (key sectors, ditches, sinkholes, karst springs) and endo karstic. The last category includes more than 130 caves and potholes, with sizes ranging from a few meters to several kilometers.

The development of the karst area was carried out in successive steps, with concentrations of karst voids at three distinct levels: 5-6 m, 20 m and over 80 m [6]. This can lead to a hierarchy of the karst cavities by relative altitude as an element separating them according to the likelihood of living.

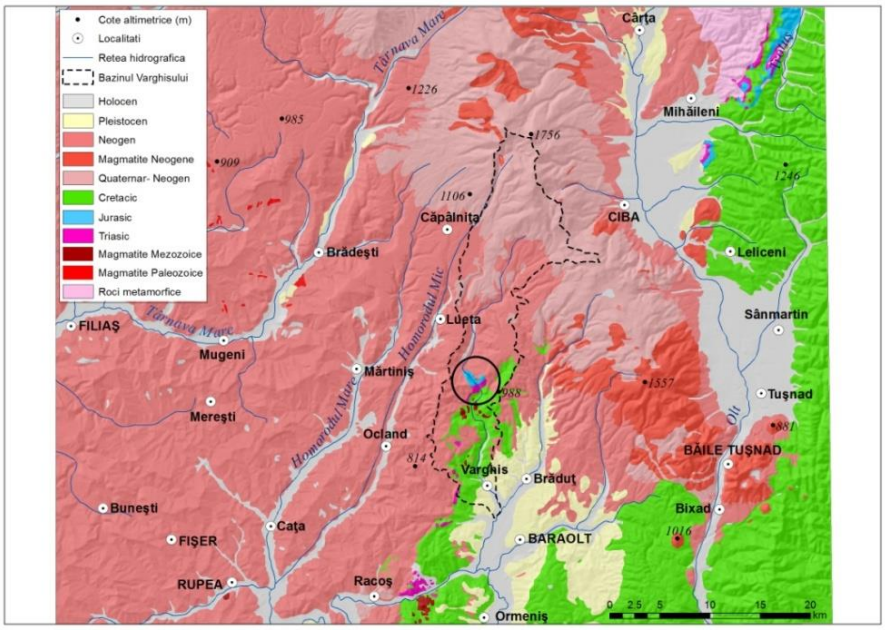


**Fig. 2.** Geological map of the studied area

## IDENTIFYING CAVES FROM VÂRGHIŞ GORGE

Identification of the caves and shelters under the rock was done from the catalog published by Traian Orghidan and Margareta Dumitrescu in 1963 [6], and from information obtained from administration of the nature reserve of Vârghiş Gorge, and to determine the coordinates of caves and their registration was used a GPS of type Garmin Oregon 457 t. The data collected, will provide support for the future database. Until now GPS points were taken for 16 caves, and in the research campaigns from the next year to identify and record the other caves to complete the database.

## GENERATING GIS DATABASE USING ARCGIS 10.3.1 DESKTOP SOFTWARE

A significant step towards the research project in karst area of Vârghiş Gorge - Harghita County is the realization of a GIS database using the ArcGIS Desktop 10.3.1 software.

A GIS database is a collection of digital information, place names, geographical, statistical, GPS etc. organized by well-defined criteria for obtaining data structure as GIS standards.

Compliance with the technological flow (methodology) of achieving this GIS database, will ensure uniformity of all products and geostatistical mapping results.

Theoretically, the main source of data is the terrain map with a scale of 1:25000 in Gauss-Kruger projection on Krasovsky ellipsoid.

To complete database attributes of the elements can be used other cartographic sources such as topographic maps at 1:5000 scale, measurements and terrain mapping, statistical data from old and new documents, orthophoto plans, previous determinations. Scanned patterns of cartographic material (topographic maps at 1:25000 or 1:5000) can be used as guidance during the process of mapping or vectorization.

The collected data are stored as classes of elements, then organized into sets of data in a geographic database. The hierarchy structure and the structure itself are consistent with the technology and design data models of ArcGIS Desktop 10.3.1 (database objects). This data can be exported from VPF format in various other GIS data formats (coverage, shape, dxf, etc.).

Stages of creating a GIS database using ArcGIS Desktop 10.3.1 software are:

1. In the ArcCatalog from ArcGIS was established a working partition. In this partition was created a directory containing GIS database created Vârghiş Gorges (fig. 3).

2. In the folder created has been generated a personal database, with an extension ".mdb".

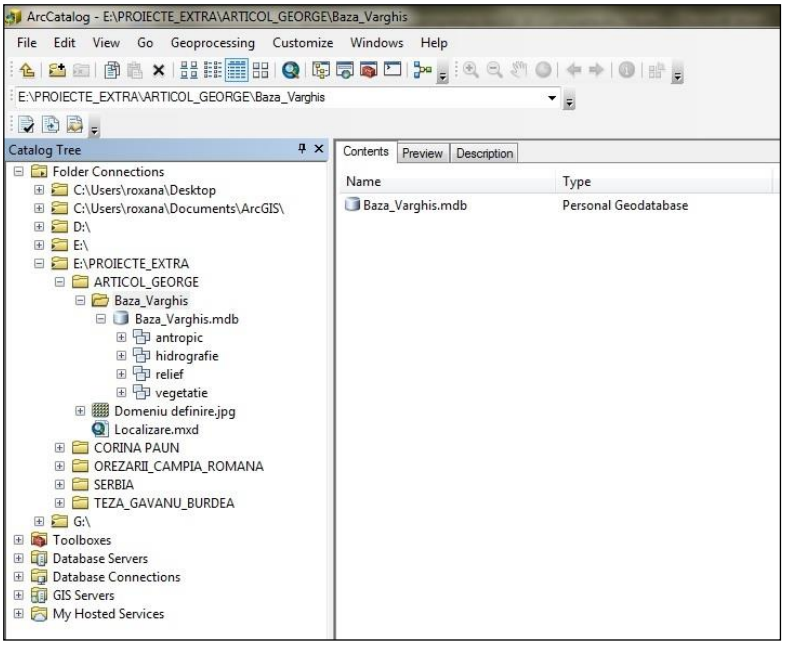


**Fig. 3.** Created database in the folder Baza_Vârghiş

3. In this database were generated datasets (classes of elements) containing vector elements like lines, point or polygon.

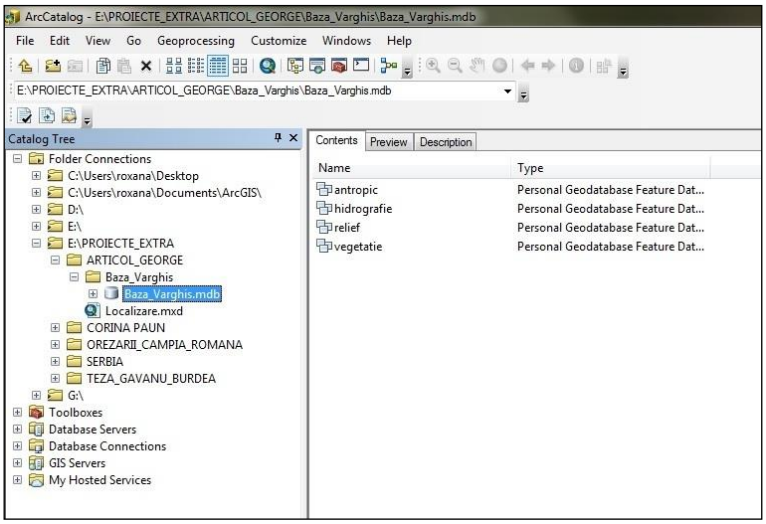


**Fig. 4.** Database structures with contained elements

4. The name of each data set was especially meaningful for items that will further comprise: relief, human, vegetation and hydrography (fig 4, fig. 5).

5. After creating data sets, each of them was queried and were generated the corresponding elements.

6. When generating elements it was taken into consideration the element type (point, line, polygon, etc.), name (Name), pseudonym (Alias) and the defining attributes and determination. The attributes assigned to each element of the class of elements and default by a database gives us the possibility of identification, classification and its analysis in relation to other elements in the base. These attributes are provided by manual input of information or implicitly defined in the definition of the database. These attributes can be "borrowed" by importing and for other elements from other databases.

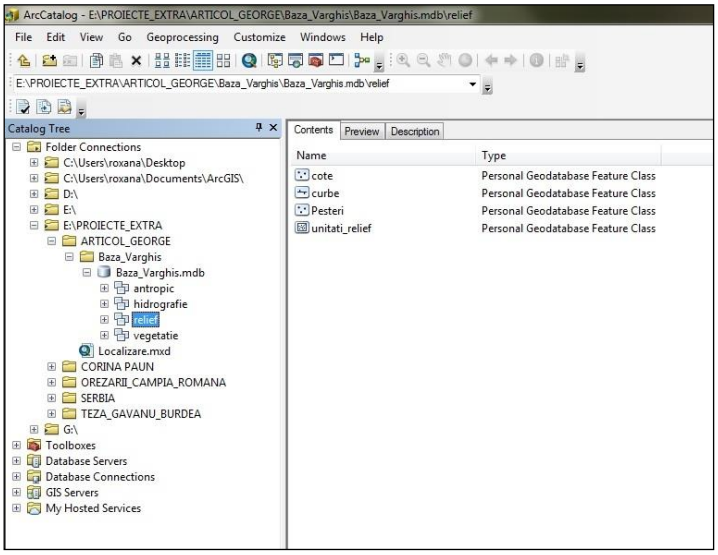


**Fig. 5.** Elements contained in chapter relief of the database

7. In our database, in the class of relief items, we have the punctual element cave type, which are assigned attributes such as *Name, Date, Sediment Thickness, Orientation, Bed configuration cave, Horizontal surface in the portal, Archaeological information, Height in the portal, Portal width, Length fossil galleries, Length of the active galleries, Slope*. Of these attributes the *Orientation, Bed*

*configuration cave*, *Archaeological information*, *Slope* is implicitly defined in the field of the database (Fig. 6). Other informations will be entered as usual.

11. The last step represents the load of the database with informations and the organization according to its structure. In the present study, the main source of data is the information published by Orghidan Dumitrescu (1963), informations that will later be filled with data from future archaeological campaigns.

## DATABASE QUERY

Database query will represent a later stage, which can be achieved only partially in this phase, but may provide a useful understanding of how establishing favorable caves inhabited by human communities.

Now, we are at the stage where we take geographical and historical information and integrate them into the database. A first feature, extracted exclusively from GPS information reported at the Digital Terrain Model, is that the caves identified this year may fall altimetry into three big stages below 630 m, 630-651 m and 651 m (fig. 7), which reported at an average altitude of 600 m riverbed indicates three levels of relative altitudes below 30 m, between 30 m and 51 m and over 51 m, thing which largely confirms the previous assertions of Orghidan and Dumitrescu.

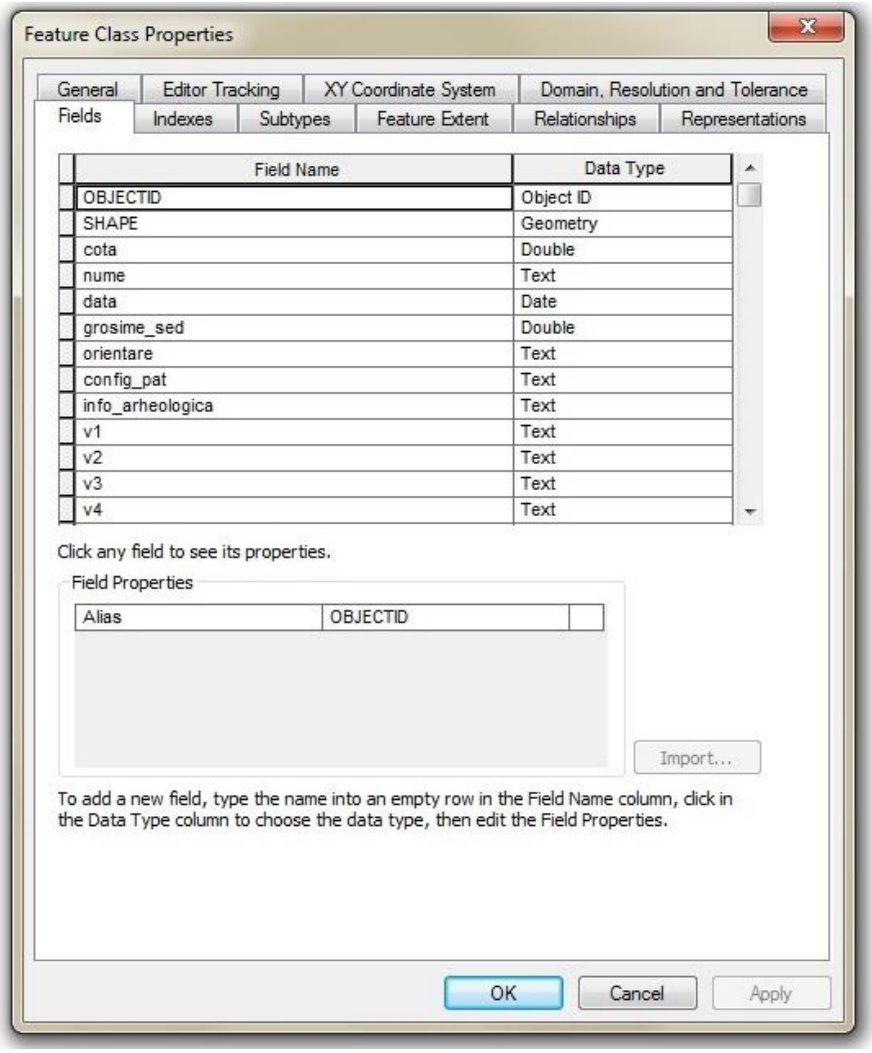


**Fig. 6.** Default elements of the database

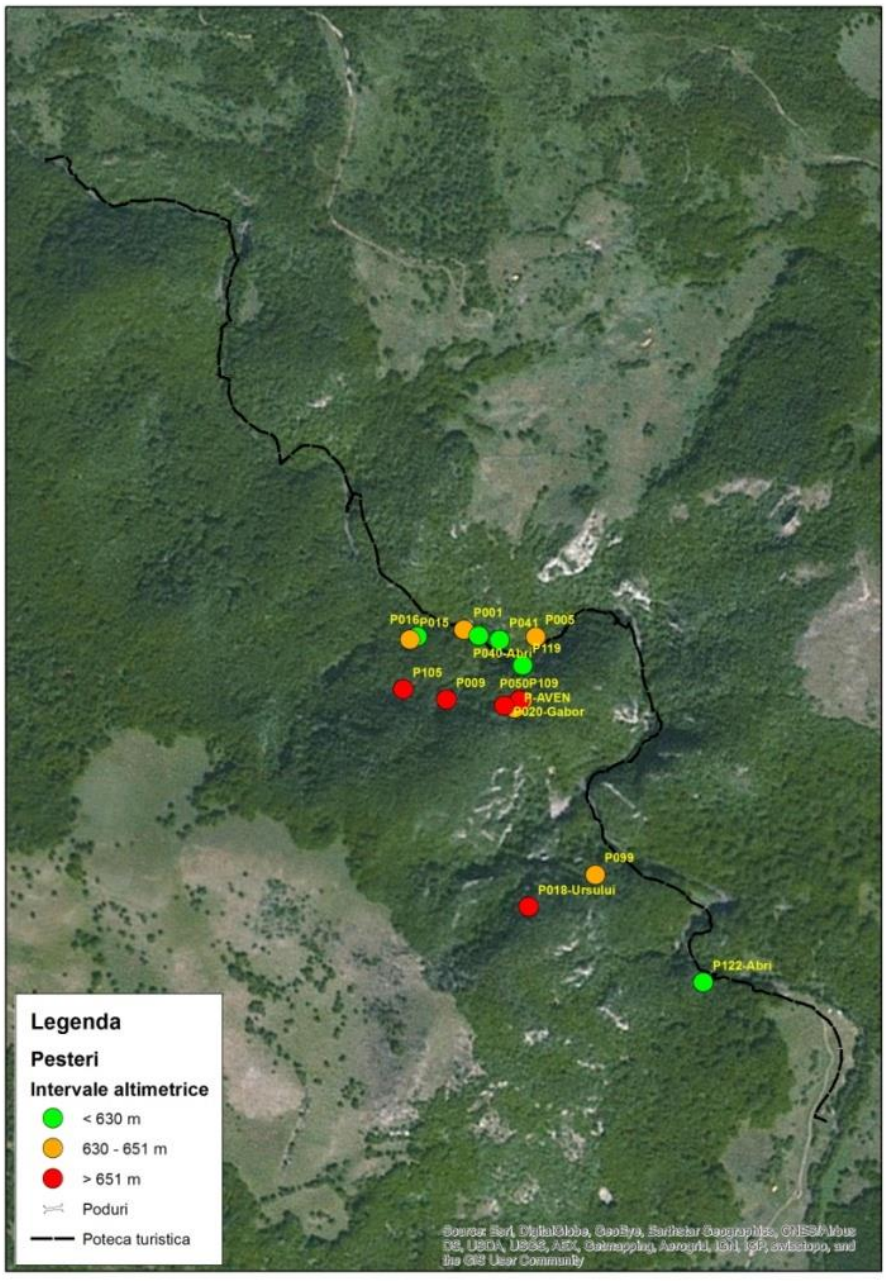


**Fig. 7.** Altimetry arrangement of the caves in Vârghiş Gorge

## CONCLUSIONS

Making a GIS database for the karst area of Vârghiş Gorge can be a starting point for creating a pattern of habitation of the caves in this region. Integration into the database of parameters such the orientation of the cave portal and its size, reported on the steps of housing, can provide the motivation for choosing caves response to the various human communities who lived in the area. Information related to the relative altitude of the caves will help us to separate the levels that could be inhabited at different periods from prehistory, depending on environmental conditions in the period.

Reporting the altitudinal position of caves to the digital terrain model (Fig. 8) will generate a complete picture of their arrangement and relations between them, in terms of visibility and access.

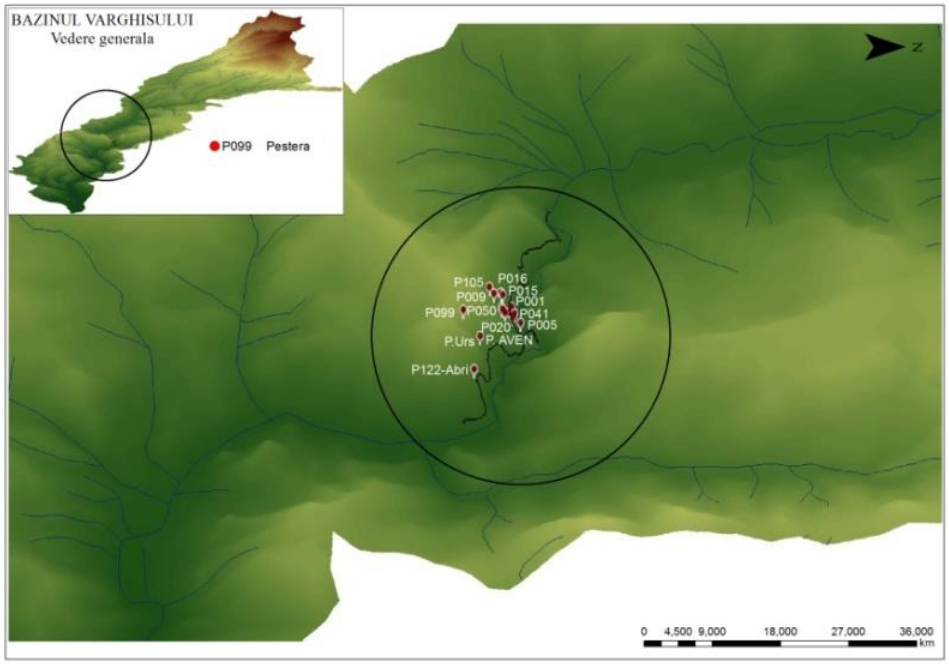


**Fig. 8.** Reporting the position of the caves at MNT

Completing, in the near future, the database information from archaeological campaigns, with absolute age dates, with results of archaeological excavations, will complete the picture of the karst area of Vârghiş Gorge.

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**REFERENCES**

[1] Cioacă, Adrian, Munții Perșani. Studiu geomorfologic, Publisher Tomorrow Foundation Romania, Bucharest, 148 p., 2002

[2] Cosac, Marian, Murătoreanu, George, Radu, Alexandru, Vereş, Dan, Buzea, Dan, Niţă, Loredana, Mărgărit, Monica, Dumitraşcu, Valentin, Ghiţă, Horia, Stroe, Doru-Bogdan, Negoi, Valentin, Niţă, Bogdan, Rus, Dorin, Hotinceanu, Iulian, Abri 122/1200 – Vârghiş Gorge, Harghita country – campaign 2014, in the Chronicle of archaeological research in Romania. Campaign 2014, ISSN 2343 – 919X, ISSN – L 2343 – 919X, p. 162 – 163

[3] Cosac, Marian, Murătoreanu, George, Radu, Alexandru, Vereş, Dan, Buzea, Dan, Niţă, Loredana, Mărgărit, Monica, Dumitraşcu, Valentin, Ghiţă, Horia, Stroe, Doru-Bogdan, Negoi, Valentin, Niţă, Bogdan, Rus, Dorin, Hotinceanu, Iulian, Horse cave –Vârghiş Gorge, Harghita country – campaign 2014, in the Chronicle of archaeological research in Romania. Campaign 2014, ISSN 2343 – 919X, ISSN – L 2343 – 919X, p. 215

[4] Cosac, Marian, Murătoreanu, George, Radu, Alexandru, Vereş, Dan, Buzea, Dan, Niţă, Loredana, Mărgărit, Monica, Dumitraşcu, Valentin, Ghiţă, Horia, Stroe, Doru-Bogdan, Negoi,

Valentin, Niţă, Bogdan, Rus, Dorin, Hotinceanu, Iulian, Bear Cave –Vârghiş Gorge, Harghita country – campaign 2014, in the Chronicle of archaeological research in Romania. Campaign 2014, ISSN 2343 – 919X, ISSN – L 2343 – 919X, p. 215

[5] Mottl, Maria, Ösemlös- ösrégészeti viszgálatok Északerdély barlangjaiban, A Magyar Kiralyi (Állami) Földtani Intézet Évi Jelentése,1943, II, 1950, p. 469-470.

[6] Orghidan, Traian, Dumitrescu, Margareta, Karst complex from Vârghiş Gorge, in the works of the Institute of Speleology „Emil Racoviţă", tom I-II, 1962-1963, Publisher Academiei, p. 122-124, 1963

[7] Păunescu, Alexandru, Paleolithic and mesolithic in the Transylvanian area, Publisher Agir, Bucureşti, p. 398, 2001