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Speleological research in the Loutra Arideas Area (Macedonia, Greece)

Zusammenfassung:

In dem vorliegenden Artikel werden die Karsthöhlen von Loutra Arideas (sogenannter „Speleologischer Park“) (Macedonia, Griechenland) vorgestellt und geologische Beobachtungen in Bezug auf ihre Entwicklung erstmals diskutiert. Der Schwerpunkt dieser Untersuchung liegt auf der Erforschung, Vermessung und Aufnahme aller bekannten Höhlen der Region.

Abstract:

In the present study the karstic caves of Loutra Arideas (so called „speleological park“) (Macedonia, Greece) are presented and geological observations in relation to their speleogenesis are preliminarily discussed. This research is focused on the exploration, mapping and recording of all the known caves of the area.

Résumé:

L'article présente les grottes de Loutra Arideas („Parc spéléologique“) en Macédoine (Grèce) et les observations géologiques préliminaires en relation avec leur genèse. Ces recherches sont focussées sur l'exploration, la cartographie et le relevé de toutes les grottes connues dans la région.

Key words: Loutra Arideas (Macedonia, Greece), speleological research

Introduction

The Loutra Arideas region is located in Almopia basin, in Northern Greece (Macedonia), 120km north-west of Thessaloniki and 2km from the Loutraki village (fig. 1). The site administratively belongs to Municipality of Aridea, Prefecture of Pella. A system of caves (figs. 2, 3) has been developed mainly in the northern side of the V-shaped gorge of Nicolaou stream (fig. 4a), on the slopes of the Voras Mt (2524m) that is one of the highest mountains of Greece, very close to the former Yugoslavian border. The broader area is situated near the geological boundary between Almopia zone to the east and Pelagonian zone to the west (MERCIER 1968, MOUNTRAKIS 1976). It consists of Mesozoic metamorphic and sedimentary rocks, and more precisely the gorge of the Nicolaou stream consists of Maastrichtian

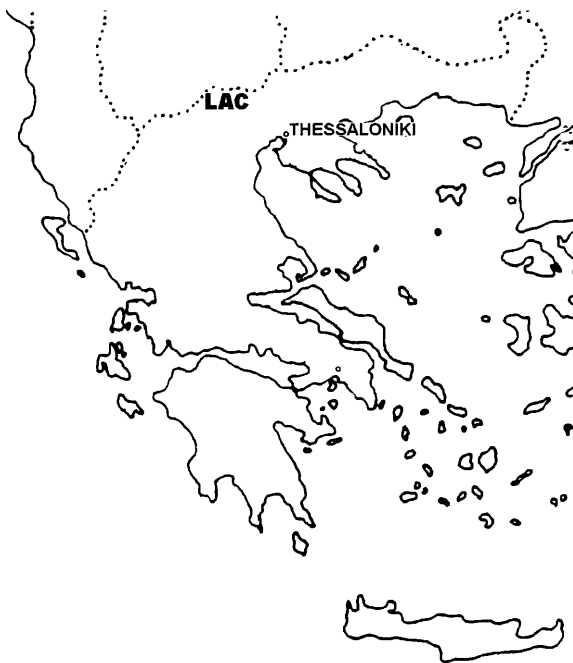


Figure 1. Map of Greece with the location of the Loutra Arideas caves (LAC).

limestone of Almopia zone. A NW-SE striking ore-bearing fault zone and the ENE-WSW striking Loutraki fault dominate the wider area. The latter with a length of more than 10km bounds the Aridea basin against the Voras Mt. The region is characterized by intense karstic phenomena that have been influenced by the preexisting faults. The 150m down-cutting erosion that formed the gorge of the Loutra, through which the Thermopotamos stream flows, could be possibly explained by the fact that the whole area has been uplifted due to the intense neotectonic activity of the Loutraki fault. Furthermore, several thermal springs and travertine deposits that occur the area are also attributed to the above-mentioned neotectonic activity of the Loutraki fault (MOUNTRAKIS 1976, ELEFThERIADIS 1977, CHATZIDIMITRIADIS 1974).

The research in the Loutra Arideas area started in 1990 due to the great palaeontological interest, when the speleologist K. Ataktidis gave information about fossil bones of a cave bear, which were brought to light by treasure seekers, in the cave A. The first excavation circle started in 1992 by School of Geology of Aristotle University (ass. Prof. E. Tsoukala), under the supervision of Ephoria of Paleoanthropology and Speleology (EPS) of Ministry of Culture, in cooperation with Prof. G. Chourmouziadis of Archaeology, with the contribution of Prof. †Eitan Tchernov (University of Jerusalem). The excavations were continued in 1993-1994 in cooperation with EPS (Dr. E. Kambouroglou) and since 1996, 1999-nowadays the excavations have been carried out by Aristotle University, EPS, with cooperation of the Vienna University (Profs G. Rabeder, †S. Verginis and their team) (TSOUKALA 1994, TSOUKALA et al. 2001).

The present research and especially the mapping of the Varathron pothole took place after the permission of the Ephoria of Paleoanthropology and Speleology of Northern Greece (EPS/NG).

„Speleological park“ of Almopia basin

The speleologist J. Ioannou, member of the first exploration in 1990, noted that the Loutra Arideas area presents special interests, either on scientific or on speleological fields and he suggested that it could be the first „speleological park“ of Greece. His idea was supported by the next researchers and it is well accepted now. This speleopark initially consists of 4 caves (horizontal development), 2 potholes (vertical development), 1

**LOUTRA ARIDEAS "SPELEOLOGICAL PARK"
CAVES OF THE NORTHERN SLOPE**

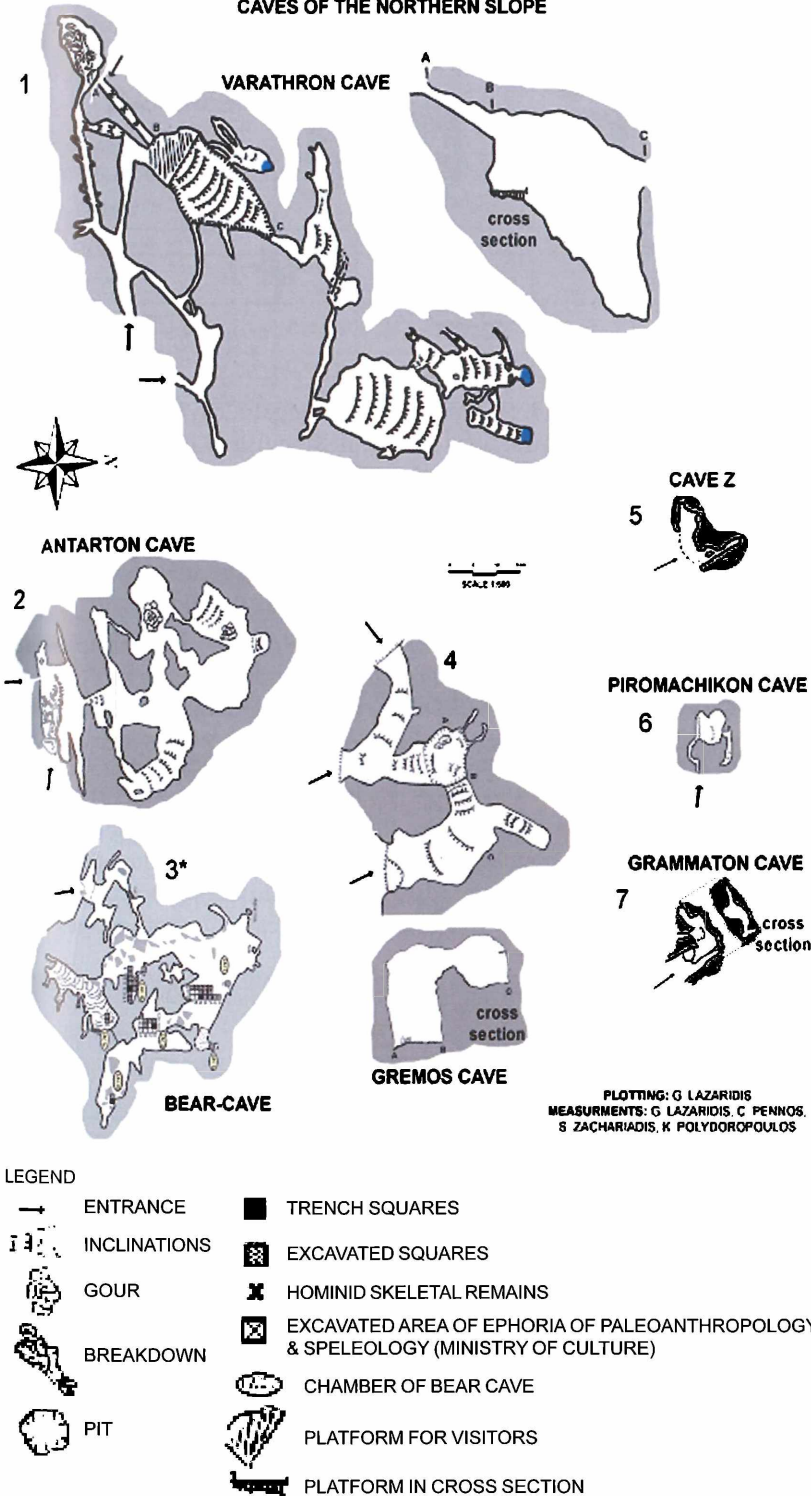
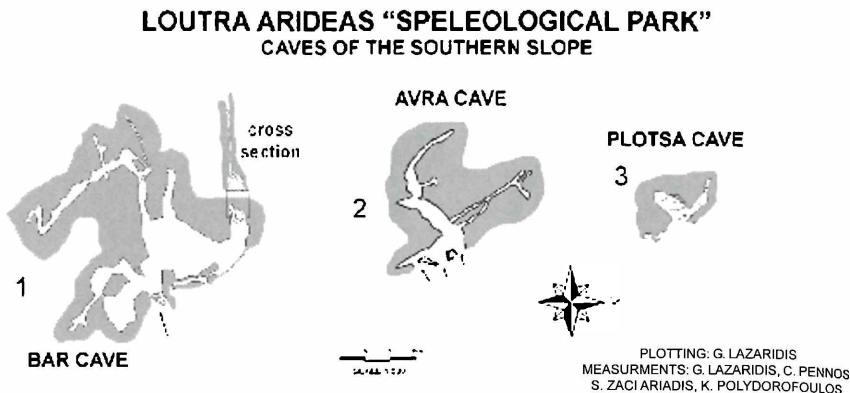


Figure 2. Ground plans, maps and cross sections of the caves (1-7, in the text) of the northern slope of the Nikolaou stream gorge of the Almopia speleological park (Legend in fig. 3).

*based on
KAMBOUROGLOU &
CHATZITHEODOROU
(1999)

Figure 3. Ground plans, maps and cross sections of the caves (1-3, in the text) of the southern slope of the Nikolaou stream gorge of the Almopia speleological park.

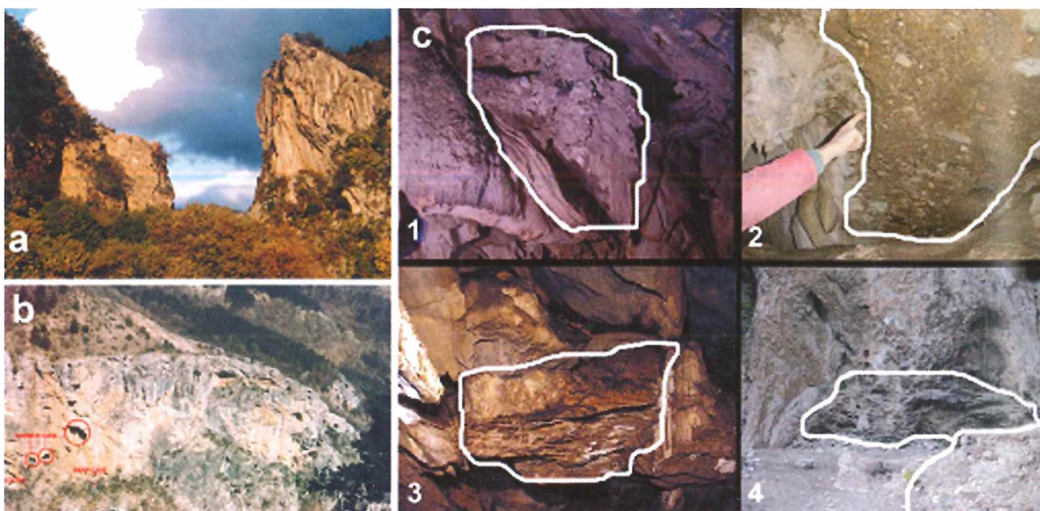


rock shelter (abris) and 4 caverns. There are small „caverns“ and karstic tubes as well. All the formations above, distinguished in respect to their morphology, are located in both slopes (north and south) of the gorge Nikolaou.

According to the first recording of 1990, in every cave was given a name with a letter from the Greek alphabet. In the present study these names have been replaced by others, given in parenthesis the old one.

On the northern slope of the gorge, the Varathron pothole (Varathron Cave) (fig. 2.1), the Antarton Cave (Cave B) (fig. 2.2), the Bear-Cave (cave A) (fig. 2.3), the Palaeoethi Rock Shelter (Cave Za), the Gremos Cave (Cave K) (fig. 2.4), the Cave Z (fig. 2.5), the Piriomachikon Cave (Cave C) (fig. 2.6), and the Grammaton Cave (Cave D) (fig. 2.7) are developed (fig. 4b). On the southern slope of the gorge the Bar Pothole (Cave H) (fig. 3.1), Avra Cave (Cave I) (fig. 3.2), and the Plotsa Cave (fig. 3.3) are developed. The altitude of their entrances varies between 450m and 550m. The caves of the northern slope are generally in higher altitudes than that of the southern one (TSAMANTOURIDIS 1990). There are caves in both slopes with

Figure 4. a) The Nikolaou stream gorge (the northern slope on the right, photo A. Tüchler), b) a part of the northern slope, where Palaeoethi, Bear-Cave and Gremos Cave are located, c) eroded sediments from 1) Varathron Cave, 2) Avra Cave, 3) Antarton Cave and 4) Palaeoethi Rock Shelter.



	Older name	Cave Category	Slope (South or North)	Altitude (m)	Eroded crusts	River sediments eroded or not Conglomerates	Palaeontological finds	Archeological finds	Breakdowns	Entrances	Siphons
Bear-cave	A	Cave	N	540	-	+	+	+	+	1	-
Antarton cave	B	Cave	N	510	+	-	-	+	+	2	-
Varathron cave	Varathron	Pothole	N	490	+	+		+	+	3	+
Avra cave	I	Cave	S	440	-	+	-	+	-	2	-
Bar cave	H	Pothole	S	450	+	+		+	+	4	-
Piromachikon cave	C	Cavern	N	480		+			-	1	-
Grammaton cave	D	Cavern	N	480	-	+	-	+	-	2	-
Gremos cave	K	Cave	N	555	+	-	-	-	-	3	-
Palaeoethi cave	Za	Rock shelter	N	540	+	+		+	+		-
Cave Z	Z	Cavern	N	480	-	+	+	-	-	1	-
Plotsa cave	Plotsa	Cavern	S	500	-	-	-	-	-	1	-

Table 1. The caves of the Almopia speleological park with various informations (location, morphology, development etc).

archeological interest, in contrast to the caves with palaeontological interest, which are very few (actually one, the Bear-Cave as in the Cave Z only a fossilized specimen of a bear has been found up to now) that are located at the northern slope. The archeological finds include Neolithic and Byzantine pottery. The palaeontological finds from the Bear-Cave that were brought to light after the extensional excavations can be attributed to *Ursus ingressus* RABEDER 2004 and to the associated spotted cave hyaena, leopard, fox, mustelids and artiodactyls, of age 30.000-35.000 years. All information concerning the old names, the morphology, the altitudes, the sediments, the palaeontology/archaeology of the caves are presented in table 1.

Most of the caves do not present distinct decoration; on the other hand very few have various speleothems (especially gours, corals, cave pearls) (table 2). The Varathron pothole is working nowadays as a showing cave

Table 2. The caves of the Almopia speleological park with the corresponding speleothems.

	Stalactites	Stalagmites	Flowstones	Cave corals	Gours	Cave pearls	Columns	Conulites	Draperies
	+	+	+	+	+	+	+	+	+
Antarton cave	+	+	+	-	+	+	+	-	+
Varathron cave	+	+	+	+	+	+	+	-	+
Avra cave	+	+	+	-	-	-	-	-	-
Bar cave	+	+	+	+	+	-	-	-	-
Piromachikon cave	+	+	+	-	+	-	+	-	-
Grammaton cave	+	+	+	-	-	-	+	-	-
	+	+	+	-	-	-	-	-	-
Bear-cave	-	-	-	-	-	-	-	-	-
Cave Z	-	-	+	-	-	-	-	-	-
Plotsa cave	+	+	+	-	+	+	+	-	-

and a platform for the visitors has been constructed for this purpose. It must be noted that in this pothole, the present research showed new parts of about the same area as the almost known one (fig. 2.1).

Speleogenesis and development

Speleogenesis of the Loutra caves is mainly due to the karstic corrosion of the seeping meteoric water. Their morphology shows a phreatic speleogenesis near to the local basic level followed by passing to the vadose zone according to KLIMCHOUK et al. (2000), while neotectonic activity by the reactivation of the Loutraki fault, during Late Quaternary, is the most possible reason. This Quaternary tectonic activity is responsible for the down-cutting of the gorge, too. The river sediments, which are observed inside the caves, are deposited during over-flow events (TSIRAMBIDIS 1998), when the river had been flowed at higher altitudes.

The cave passages are characteristic for the phreatic stage of speleogenesis, but also there are features inside the caves, which indicate their passing to the vadose stage:

- a) The potholes of the area have a level of horizontal development and present deep and wide pits inside them (Varathron and Bar pothole).
- b) Inside the caves there are usually eroded river sediments or calcite crusts (fig. 4c).
- c) All the caves haven't any known connection among them, but they are developed in different levels with a theoretical vertical continuity.

At the same time with the down-cutting of the gorge, a group of the Loutra caves was passing to the vadose zone, while, below, another group has been developing. This hypothesis allows concluding that the caves at higher altitude are older than the lower ones.

After this transition to the vadose zone, sediments were deposited in the caves, while the growth of the speleothems started too.

Parallel to the Nikolaou stream gorge there is another fault of NW-SE striking. It is possible to calculate the down-cutting per year of the Thermopotamos River (~ 100m per 30-35'10³ years) in correlation with the well-studied and dated fossiliferous sediment in the Bear-Cave, in the case that this fault didn't reactivate after the deposition.

Contemporaneously with the neotectonic activity (Loutraki fault) in the area, thermal springs were appeared. Their water is saturated to CO₂ and it could create caves during its uprising (hypogenic karst). There is no data up to now for the participation of this water to the speleogenesis and the development of the caves. But this hypothesis as well as the previous one is open question for a future research.

Conclusions

The „speleological park“ of Loutra Arideas (Almopia, Pella) presents many karstic caves and adds more interest, further its palaeontological and archeological interest.

All the caves are explored, recorded and mapped. 11 of them, the most

important, are described in the present study. Especially in the Varathron pothole, which is a showing cave, new chambers were discovered, explored and first presented here.

These caves are described as vadose caves of a phreatic origin.

The neotectonic activity of the Loutraki fault is resulted in the passing to the vadose zone.

The eroded sediments, crusts or river deposits (conglomerates, cemented or not), in the caves are due to the down-cutting into the caves, at the vadose zone.

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