HYPOGENIC FEATURES IN NICHTERIDON CAVE (N. GREECE, CHALKIDIKI, PETRALONA)

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Abstract

At the present study were examined the speleogenesis and the development of the Nichteridon cave, at Petralona village in Chalkidiki Peninsula. Also, the tectonic conditions and their impact in the speleogenetic processes were studied. In addition all the mesomorphological and the macromorphological features of the cave were examined. The results of this research showed that the Nichteridon cave can be classified as a Hypogene karstic cave, which was formed at the phreatic zone. Today, possibly due to the tectonic uplift of Mount Katsika the cave is located in the vadose zone. The characteristic morphological development of the cave indicates clearly the impact of the rising solutions in the speleogenetic procedures. Specific features inside the cave such as ceiling cupolas, feeders and blind passages consist the main features of the Hypogene speleogenesis.

ΧΑΡΑΚΤΗΡΙΣΤΙΚΑ ΥΠΟΓΕΝΟΥΣ ΣΠΗΛΑΙΟΓΕΝΕΣΗΣ ΣΤΟ ΣΠΗΛΑΙΟ ΝΥΧΤΕΡΙΔΩΝ (ΠΕΤΡΑΛΩΝΑ, ΧΑΛΚΙΔΙΚΗ)

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Περίληψη

Στην παρούσα εργασία εξετάζονται οι ιδιαίτερες συνθήκες γένεσης και εξέλιξης του σπηλαίου Νυχτερίδων στα Πετράλωνα Χαλκιδικής. Μελετάται η τεκτονική της περιοχής και ο βαθμός επίδρασης της στις σπηλαιογενετικές διαδικασίες. Ακόμα μελετώνται τα μορφολογικά χαρακτηριστικά του σε μέση και μεγάλη κλίμακα. Τα αποτελέσματα της έρευνας αυτής έδειξαν πως το σπήλαιο των Νυχτερίδων κατατάσσεται στα υπογενή καρστικά σπήλαια και αναπτύχθηκε στην φρεατική ζώνη. Σήμερα, πιθανόν εξαιτίας της τεκτονικής ανύψωσης του όρους Κατσίκα το σπήλαιο έχει περάσει στη ζώνη κατείσδυσης. Η ιδιαίτερη μορφολογική ανάπτυξη αυτού του σπηλαίου δείχνει την επίδραση ανερχομένων διαλυμάτων. Συγκεκριμένες μορφές που συναντώνται στο εσωτερικό του σπηλαίου όπως στροβιλοειδείς γλυφές στην οροφή του (Cupolas), αγωγοί τροφοδοσίας (Feeders), αδιέξοδοι καρστικοί αγωγοί (Blind passages) αποτελούν τα κύρια χαρακτηριστικά γνωρίσματα υπογενούς σπηλαιογένεσης.

Λέξεις κλειδιά: Υπογενή σπήλαια, Χαλκιδική, Όρος Κατσίκα
Key words: hypogenic caves, Chalkidiki, Mount Katsika.

- **Introduction**

The Nichteridon cave is located (position at the Chalkidiki peninsula in Macedonia province at the Northern Greece. Its entrance coordinates are 429722.09m - 4468682.791m (Greek Grid) The cave is 300m south east from Petralona village. The access to the cave is possible through a short rural road.

At the present study, morphological data from Nichteridon cave in Petralona area are being described and genetically interpreted (Fig. 1). Rising flow morphologies imply thermal ascending solutions (Ford, 2003).

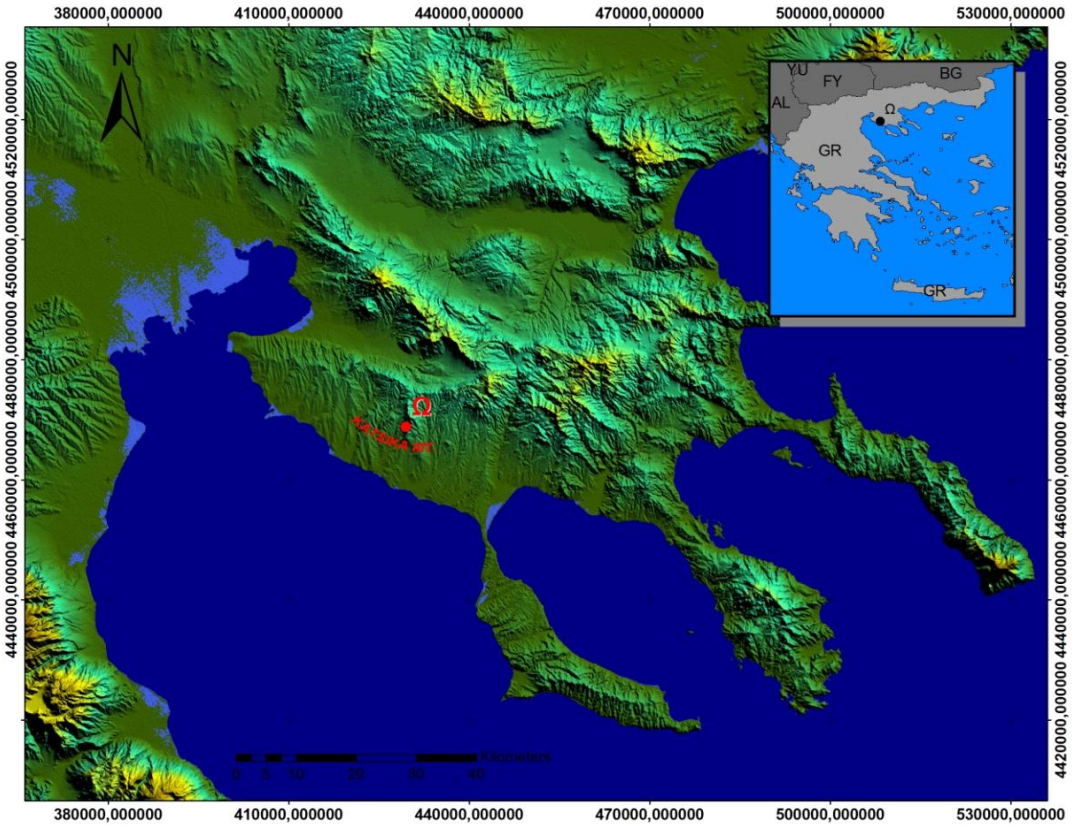

Figure 1. Map of the broader area of Chalkidiki peninsula with the Nichteridon cave (Ω) depicted (reference system is Greek Grid).

- **Geological setting**

Nichteridon cave is situated at the Katsika Mountain. The cave is formed in a Limestone with Late Jurassic age. According to Gardikas (1939) the Limestone consists of two layers with different ages. The lower one, of Kimmeridian age, is characterized by the presence of *Cladocoropsis mirabilis* while the upper one is of Portlandian age with *Parugonia* (Christaras, 1984). The formation lies comfortably on the underlying Phyllites.

The limestone is presented thick-bedded, with tabular form that is owed in his fragmentation system. Inside the Limestone are presented certain small Bauxite layers infilling karstic caverns. These Karstic caverns were exposed by the erosion of the upper part Limestone in the places Barres, Tripes, Prinochori and Mikralona (Fig. 2).

- **Methodology**

At the first stage of the research all the surface landforms are investigated under the prism of speleogenetical processes. Secondly, measurements of the tectonic

discontinuities of the region were taken in order to plot them and define the tectonic impact on the region. Finally speleological investigation of the Nichteridon cave took part in order to survey the cave and to depict the various meso-morphological features (Lauritzen and Lundberg, 2000).

The macro-morphological analysis, based on the cave survey, indicates a relevant spongework maze pattern, with highly irregular passages interconnected with champers (Palmer 2005). This pattern is used in combination with the medium scale features in order to interpret the speleogenetical function. The meso-morphological features, including cupolas, roof pendants, partitions, dead ends and calcite spar geoids situated in two different levels, display morphologic suite of uprising flow.

Simplified Geological map of the broader area of Nichteridon cave

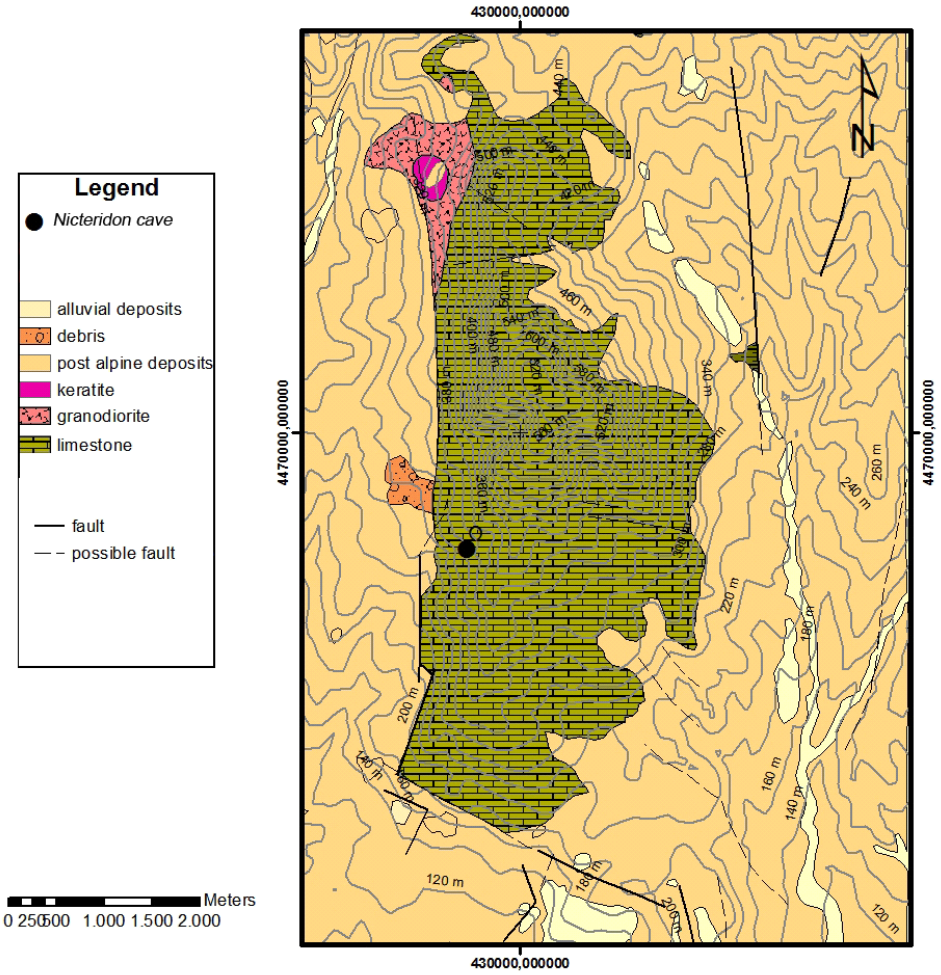

Figure 2. Simplified Geological map of the broader area of Nichteridon cave based on IGME… (Reference system is Greek Grid)

- **Nicteridon cave**

The cave is located southeast of the Petralona village and 500m southwards from the widely known, for its paleontological findings, Petralona cave.

The cave with an N–S direction, is developed in two major chambers of 29,6m and 64m respectively. These chambers are parallel to the N-S discontinuities and they are divided in smaller chambers because of the dominant breakdown morphology.

The entrance of the cave is actually a vertical pit of 4.5m deep. At the bottom of the entrance there is a debris cone. The second chamber of the cave with 14.5m length and 18.3m width is characterized by breakdowns and the absence of speleothemes. At the north side of that chamber there is an 11.3m long gallery, abundant in cave corals, and at the eastern part the cave continues to the biggest chamber (64m width) shaped by two major breakdowns. At the west part of that chamber there is a debris cone which indicates probably an older entrance of the cave. This hypothesis is enforced by the existence of roots at the upper part of the cone (Vaxevanopoulos, 2003) showing a thin limestone layer forming the roof of the cave.

- **Cave morphology**

Features as cupolas, feeders, calcite spars (fig.4) and blind passages (fig. 3) and pendants are finding in the Nichteridon cave. The main criteria to distinguish the hypogenic transverse origin for caves are the pattern of the cave and its meso-morphological features. These features were created by the incoming ascending or the outgoing solutions.

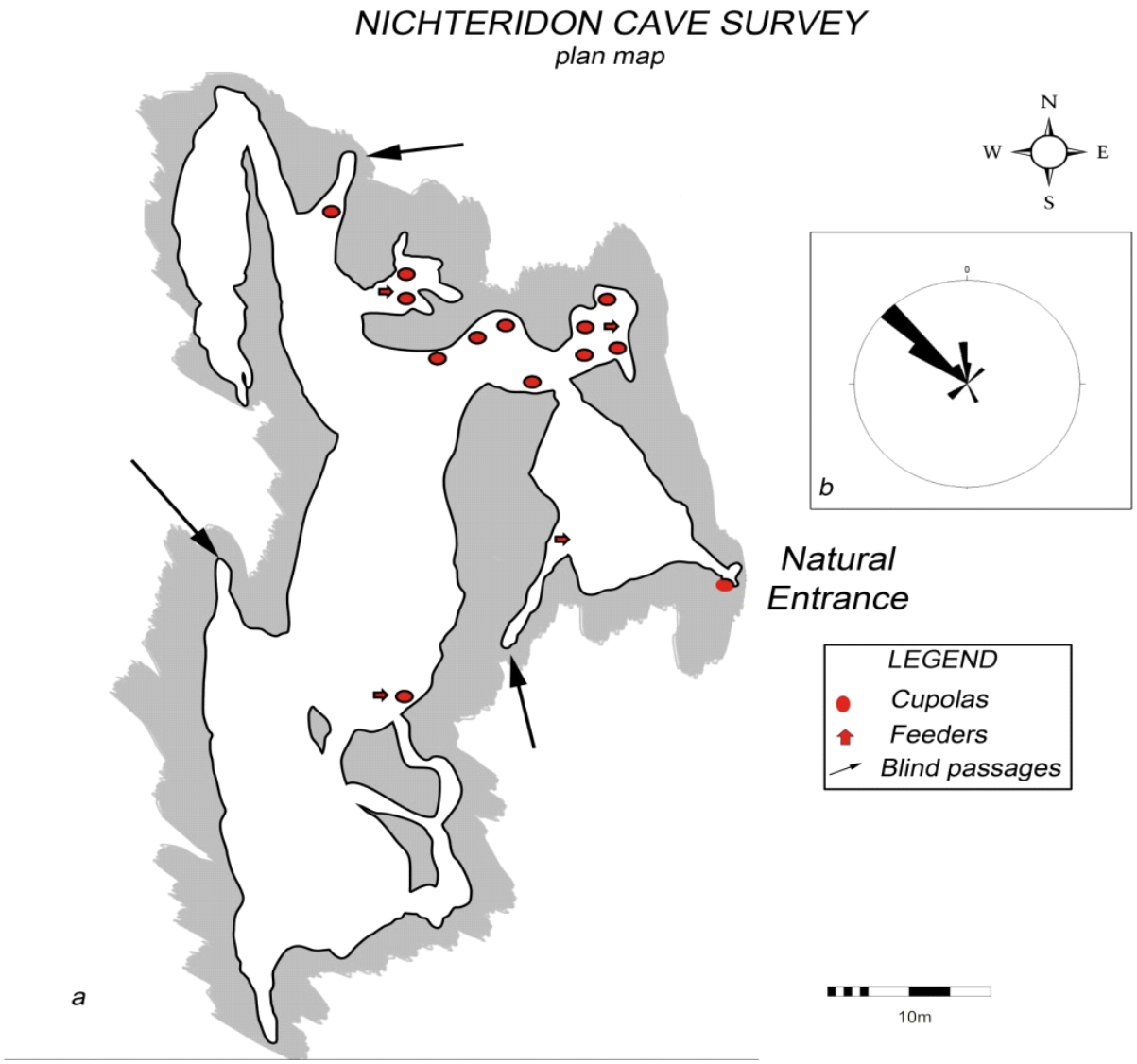

Figure 3. a) Plan view of the Nichteridon cave with the locations of the various features.
b) Rose-diagram of the measured tectonic discontinuities from the broader area of the cave.

Cupolas are in fact ceiling pockets that commonly occur in unconfined phreatic caves depicting an older confinement of water inside that particular tube (Fig.4c). Convections are that cupolas form sub-aerial conditions by moist air convection driven by the heat from a pool of thermal water, when the chamber closed to outside airflow (Cigna and Forti, 1986 from Klimchouck, 2007). At the Nichteridon cave cupolas are abundant in most parts of the cave. They are located mostly at the ceilings composing ceiling channels. They are rounded and they indicating slow moving thermal water. Some cupolas are hosted at inclined cave walls.

Pendants are residual pillars of rock between channels cut into ceiling and interpreted as bedding plane anastomoses or as pillars between closely-spaced paragenetic ceiling channels. The latter fits well to epigenetic processes as well. However, the hypogenic explanation best fits to the model of buoyancy currents rising from multiple feeders (Klimchouk, 2009). They have widespread occurrence at

the Nichteridon cave. In many cases, they are covered by epigenetic speleothemes (stalactites, coralloids).

Feeders (inlets) are found scattered on the floor of the cave. Most of them are covered with clastic sediments. They represent basal input points of hypogenic solutions.

Calcite spar geodes are found at the central part of the cave. The crystals (dogtooth spars) have dimensions from 2 to 4cm (main axis) (fig.4d).

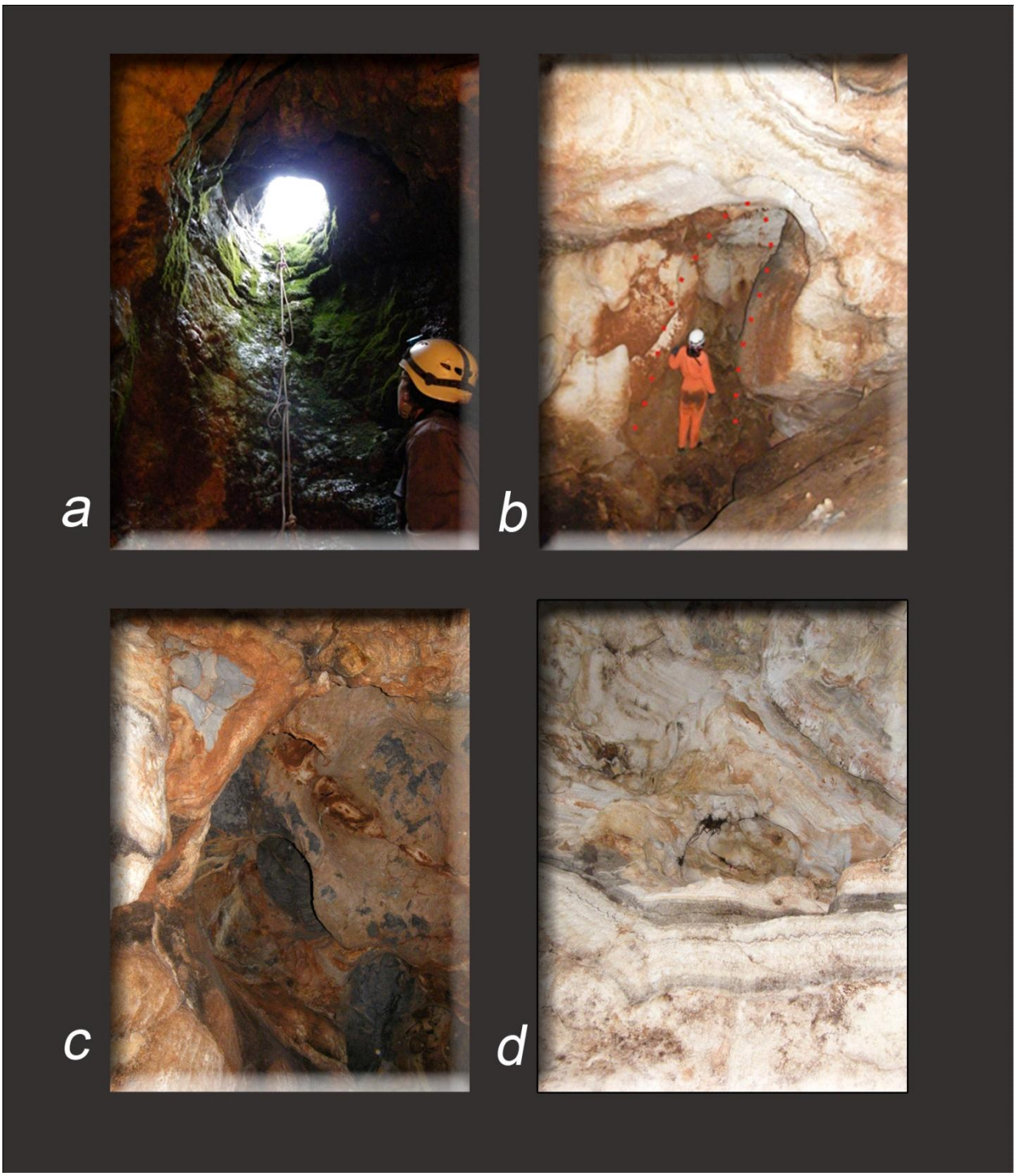

Figure 4. Hypogenic morphology in Nichteridon cave. a, b = outlet; c = cupolas; d = calcite spars.

Partitions and blind terminations (Fig. 3) are indicative of hypogenism. They are thin separations between adjacent passages or chambers formed by intense dissolution of the bedrock. Several blind passages are separated by partition walls. Blind terminations of passages in the Nichteridon cave can be clearly distinguished at the plan view of the cave. They are widespread and formed by the enlargement of a single, isolated fracture.

- **Conclusions**

In the present study were examined the unique speleogenetic processes which formed the Nichteridon cave. After detailed field work were mapped all the meso-morphological features that consist to an hypogenic speleogenetic model such as cupolas, feeders - inlets, outlets, roof pendants and calcite dogtooth like spars.

After the survey of the cave a detailed map was plotted. Studying the plan of the cave blind terminations were observed enforcing the hypothesis of hypogenic speleogenesis.

Keeping in mind all these morphological features of the Nichteridon cave, we conclude that in the western part of Mount Katsika the speleogenetical processes occurred due to ascending solutions. These solutions enriched the water table and were speeding up the speleogenesis.

Finally, due to the rapid uplift of Mount Katsika (Christaras, 1984) the cave passed from the phreatic zone at the vadose zone. At this zone $CaCO_3$ deposition occurs, creating various formations. The large chambers of the cave are controlled by the breakdown morphology in combination with the low angle dip of the limestone strata. Eventually, the enlargement of the chambers will lead in the creation of numerous breakdown dolines.

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