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Support techniques for the preservation of Poliphimos cave in Maronia, Thrace – Greece

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Abstract

The cave is located in a distance of 5 km from Maronia Town, near Komotini City, in Thrace – Eastern Greece. It is considered as an important natural monument which unfortunately has not already developed. According to the Greek mythology, Cyclope Poliphimos is considered that was living in the cave. According to the archaeological research, the cave was used as living and religious site, from the Neolithic until the Byzantine period. The cave is 2000 m long and covers an area of 10.000 m^2, according to Petrohilou, A. (1984), who investigated the cave for first time. The present study was a part of a project, of touristic development of the cave, included in the 3rd EU Framework Program. For this purpose, the stability conditions and the more appropriate protection measures of the cave were determined (Christaras et al. 2004[1]).

The area consists of compact coarse-grained karstic limestone which is traversed by faults of NNW-SSE to NW-SE and E-W directions. The cave is formed in low depth and for this reason, the stability is determined by discontinuities of the following directions: kl1: 089/68, kl2: 344/80, kl3: 246/75 and kl4: 041/77 while he bedding is almost horizontal (Fig. 1). The spacing between the discontinuities changes from 20 to 100 cm, their length appears to be more than 1 m and their dip is close to vertical. The majority of the discontinuities are opened and filled with calcite carbonate. The above mentioned geometrical features in conjunction to the practically horizontal bedding of the limestone form probably unstable blocks on the roof of the cave (Fig. 1). Wedge failures could also be created according to our observations. The RQD of the rock mass is estimated 75-90, the compressive strength 35-60 MPa and the RMR is 61-70, according to Bieniawski (1989).

Fig. 1. Failure on the roof, along bedding.

Table 1: Proposed support measures

Section	Potential wedges	Arrangement and length of rock bolts	Safety Factors after bolting
152-151	kl1-kl3-ss2	2.0 x 2.5 m – L=3 m	2.24
	kl1-kl2-ss2	2.0 x 2.5 m – L=3 m	2.04
154-153	kl1-kl2-ss2	2.0 x 2.0 m – L=3 m	3.32
	kl1-kl3-ss2	2.0 x 2.0 m – L=3 m	2.00
156-155	kl1-kl3-ss2	2.0 x 2.0 m – L=3 m	2.33
158-157	kl1-kl3-ss2	2.0 x 2.0 m – L=5 m	2.21
	Kl2-kl3-ss2	2.0 x 2.0 m – L=5 m	2.51
160-159	kl1-kl3-ss2	2.0 x 2.0 m – L=5 m	2.31
	Kl1-kl2-ss2	2.0 x 2.0 m – L=5 m	2.14
162-161	kl1-kl3-ss2	2.0 x 2.0 m – L=5 m	1.97
151-150	kl1-kl3-ss2	2.0 x 2.5 m – L=3 m	2.45

The tectonic data were elaborated, using UNWEDGE software, in order to determine the unstable wedges or blocks. For this purpose, the following pairs of values were used: a) c = 10 t/m^2, φ = 30^o b) c = 16 t/m^2, φ = 30^o. The geometry of the blocks formed by the combination of the vertical discontinuities with the horizontal bedding creates potential unstable blocks, falling from the roof. The sides of the cave seem to be stable.

For the reinforcement support of the roof, an arrangement of stainless pre-tensioned self-drilling rockbolts is suggested (2X2m and 2X2.5m, length 3m and 5m [Table 1, Fig. 2]) as the optimum scenario of intervention, giving safety factors >2 .

According to our investigation, we arrived to the following conclusions:

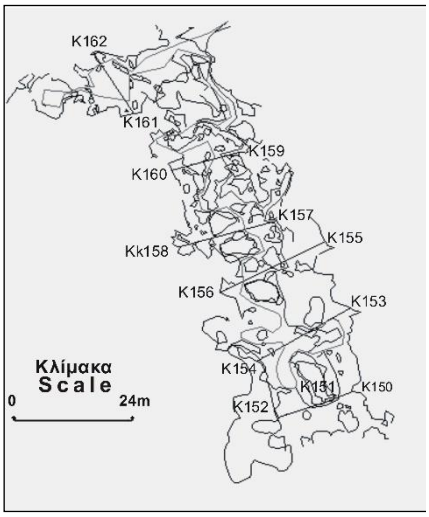

Fig. 2. The studded cross-sections.

1. As the thickness of the overlying layers is small, the stability analysis was only based on the probable creation of unstable wedges due to the tectonic system and not to a stress pattern due to the load of the overlaying layers.
2. The probable unstable wedges are mainly observed at the roof of the cave, creating either falling or sliding blocks
3. The proposed support measures take into account the specific conditions and the monumental character of the cave.
4. The safety factors, after the application of the proposed support measures, are generally enough high (SF>2), having using relatively moderate admissions and mechanical characteristics for the rock mass.
5. For the reinforcement support of the roof, an arrangement of stainless pre-tensioned self-drilling rockbolts is suggested (2X2m and 2X2.5m, length 3m and 5m [Table 1]) as the optimum scenario of intervention, giving safety factors >2.

Acknowledgements

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