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Documenting condensation corrosion in Agios Georgios cave (Kilkis, Greece)

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The Agios Georgios show cave is located at a small hill in the town of Kilkis (N. Greece). It has been formed in the Middle- Upper Triassic limestones that belong to the Deve Koran-Doubia subzone of the Circum-Rhodope geotectonic zone (i.e. Mountrakis, 2010 and references therein).

Morphologically the cave is an 800 m^2 2-dimensional maze with narrow and high fracture-guided passages (Fig. 1). Some chambers are mainly formed due to breakdown. Even though the entrance of the cave is artificially opened, there were multiple entrances in the past. These are nowadays obscured by sediment filling of Late Pleistocene age, as it is indicated by large mammal fossils (Tsoukala, 1992).

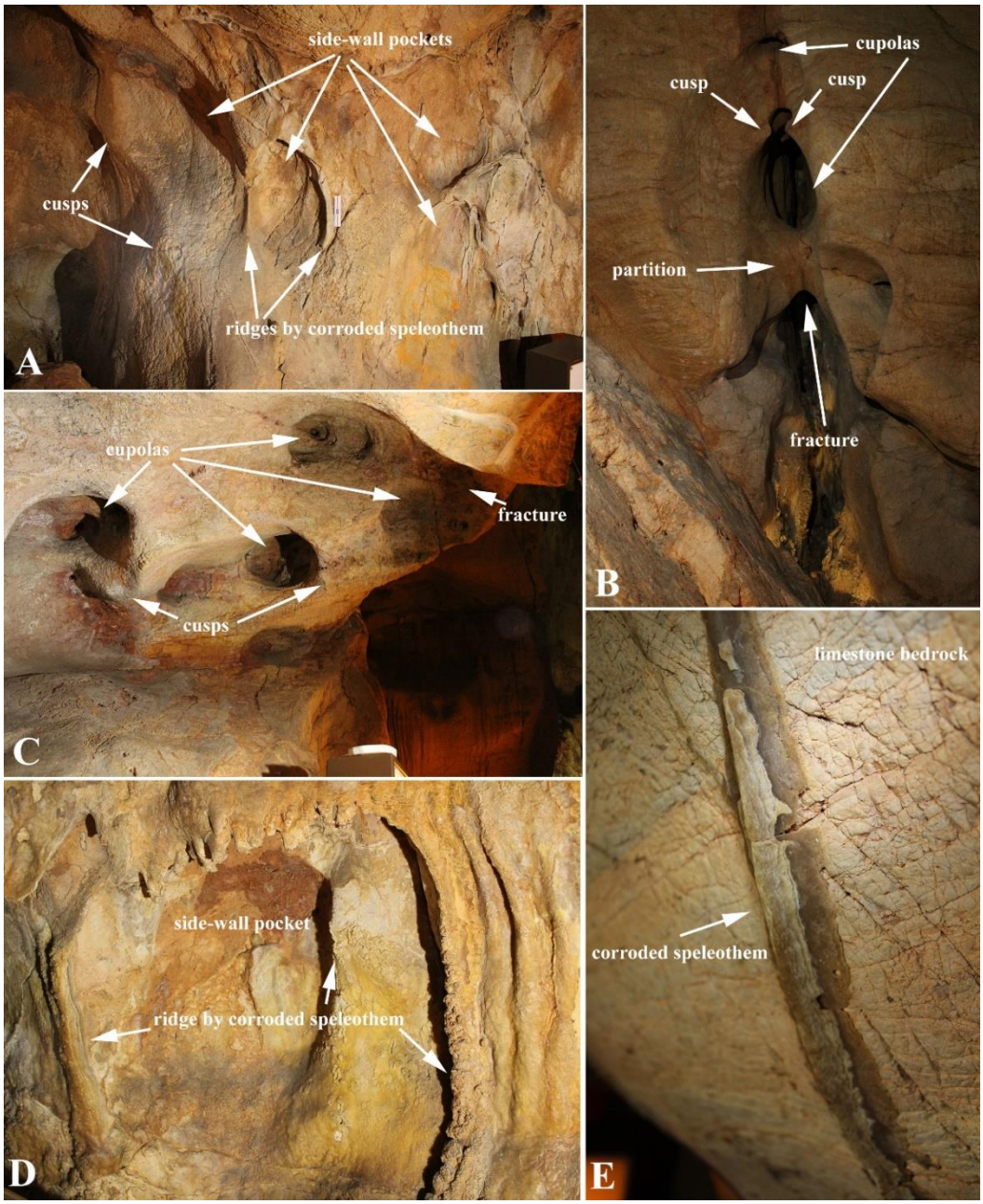

Figure 1. Characteristic condensation corrosion features of Agios Georgios show cave. A. Solution-smoothed wall with cupolas, cusps and corroded speleothems that delimit cupolas. B. Fracture-guided cupolas on the ceiling of a narrow passage and accompanying forms. C. Ceiling cupolas along bedding and a more susceptible to solution bed in limestone. D. Wall-pockets and corroded speleothems. E. Solution-smoothed wall and remnant of corroded speleothem.

Regarding the (chemical) depositional forms the cave appears moderately decorated. The predominant speleothem in Agios Georgios cave is the coralloids with globular or button-like shape. Other speleothems recorded in the cave are stalactites, stalagmites, columns, draperies, flowstones, eccentrics and shields. A number of studies has been done on stalactites and stalagmites to investigate the paleo-environment of the cave (Antonelou, 2007; Antonelou *et al*., 2010; Dotsika *et al*., 2010; Ifandi, *et al*., 2015).

Meso- and small-scale morphology includes cupolas, cusps, partitions, echinoliths, rock bridges and pendants (Figure 1). Some of these dissolutional forms, such as the cupolas, partitions etc., are polygenetic (e.g. Dublyansky, 2013), causing difficulties in the interpretation of speleogenesis. Especially in the broader area of Agios Georgios cave, it has been already noticed that these dissolutional forms are developed over both the speleothems and the limestone (Lazaridis, 2017). This observation dates their formation as post-speleogenetic and means that although the origin of the cave has been considered hydrothermal-phreatic (Lazaridis, 2017), many of the cupolas and related forms have developed when the cave drained and after the deposition of speleothems by seepage water. Thus, these features are the result of condensation corrosion, which is a process of bedrock and speleothem removal from film water that condenses on the rock-mineral substrate, when their temperature is below dew point of cave air (e.g. Dreybrodt *et al*., 2005).

The aim of this study is to document the dissolutional forms by condensation corrosion, their distribution in the cave and set some questions for further investigation.

Condensation corrosion morphology

The related to condensation corrosion features are widespread all over the cave. However, the significant extend of coralloids in the area that is known as “second floor”, obscures the observation of dissolutional forms. Their dimensions range from few centimeters up to the passage diameter. They are either side-wall pockets (Fig. 1A, D) or ceiling cupolas (Fig. 1B). Accompanying forms, such as cusps and partitions do exist (Fig. 1B, C). Some of them are fracture guided (Fig. 1B). In general they contribute in the formation of solution-smoothed walls or boneyard morphology on the ceiling.

Conclusions

- This study provided a detailed documentation of condensation corrosion morphology in Agios Georgios cave and verified previous report of the process (Lazaridis, 2017).
- The morphological features that are observed are quite similar to those described in other caves (e.g. Dublyansky and Spötl, 2014) and have been attributed to condensation corrosion.
- Since Agios Georgios is a show cave, the study of condensation corrosion is crucial because visitors could affect the cave climate and enhance that process.
- Among others, in our future goals is to create a data-set with dimensions of these dissolutional forms, measure and estimate the amount of dissolution and possibly the rate, to correlate their formation to the environmental conditions and check if the process is still active.

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