

Acqua Fitusa Cave: an example of inactive water-table sulphuric acid cave in Central Sicily

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Key words: *gypsum, hypogenic caves, sulphuric acid cave, thermal waters, Sicily.*

ABSTRACT

Hypogenic caves are generated by water recharging from below independently of seepage from the overlying or immediately adjacent surface. These waters are often thermal and enriched in dissolved gases, the most common of which are CO₂ and H₂S. Hypogenic caves can be thermal caves, sulphuric acid caves, basal injection caves. They differ from epigenic caves in many ways, such as: speleogenetic mechanisms, morphological features, chemical deposits, and lack of alluvial sediments (KLIMCHOUK, 2007; KLIMCHOUK & FORD, 2009; PALMER, 2011).

Several studies were conducted to evaluate the hypogenic origin of a large number of caves (AUDRA *et alii*, 2010; KLIMCHOUK & FORD, 2009; STAFFORD *et alii*, 2009). A significant contribution was given by the work of Klimchouk (2007) that systematically provided instruments and models to better understand and well define the hypogenic karst processes and landforms.

Detailed studies on hypogenic caves were carried out in Italy since the 90s in different karst systems, especially in the Central and Southern Apennines. These studies mainly concerned chemical deposits related to ascending water and micro-biological action (GALDENZI & MENICETTI, 1995; GALDENZI, 1997; PICCINI, 2000; GALDENZI & MARUOKA, 2003, FORTI & MOCCHIUTTI, 2004; GALDENZI, 2012).

In this paper, we present the first results of researches conducted in Acqua Fitusa cave that was believed to be an epigenic cave until today.

Acqua Fitusa cave is located in Central Sicily, along the

north-eastern scarp of a N-S anticline, westward vergent, forming the Mt. La Montagnola. The cave formed in the Upper Cretaceous Rudist breccias member of the Crisanti Fm., composed of conglomerates and reworked calcarenites with rudist fragments and benthic foraminifers (CATALANO *et alii*, 2011).

The cave consists at least of three stories of subhorizontal conduits, displaying a total length of 700 m, and a vertical range of 25 m. It represents a clear example of inactive water-table sulphuric acid cave, produced mainly by H₂S degassing in the cave atmosphere.

Despite the small size, Acqua Fitusa cave is very interesting for the abundance and variety of forms and deposits related to rising waters and air flow. A ~ 7 m deep inactive thermo-sulphuric discharge slot intersects the floor of some passages for several meters (Fig. 1). Different morphologies of small and large sizes, generated by condensation-corrosion processes, can be observed along the ceiling and walls: ceiling cupolas and large wall convection niches occur in the largest rooms of the cave; deep wall convection niches, in places forming notches, incise cave walls at different heights; condensation-corrosion channels similar to ceiling-half tubes carve the roof of some passages; replacements pockets due to corrosion-substitution processes are widespread; boxwork due to differential condensation-corrosion were observed in the upper parts of the conduits.

Sulphuric notches with flat roof, linked to lateral corrosion of the thermal water table, carve the cave walls at different heights recording past stages of base-level lowering.



Fig. 1 – Passage with discharge slot at the floor and different levels of wall convection niches.

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Gypsum deposits have been found in many parts of the cave. Replacement gypsum crusts are common in many passages; the gypsum is located in large vertical fissures along the walls, it can partially cover wall convection notches, or replacement pockets (Fig. 2). A gypsum body of about 50 cm of thickness was found on the floor of the biggest room in correspondence of which small ceiling cupolas are associated on the roof. Finally, centimetric euhedral gypsum crystals grew inside mud sediments.



Fig. 2 – Replacement pockets partially covered by gypsum crusts.

At present the cave is inactive with the thermal spring occurring 300 m north and at a lower altitude than the cave. These H₂S-rich waters are indicated as chlorine-sulphate alkaline, and have a temperature of about 25°C (CARAPEZZA *et alii*, 1977).

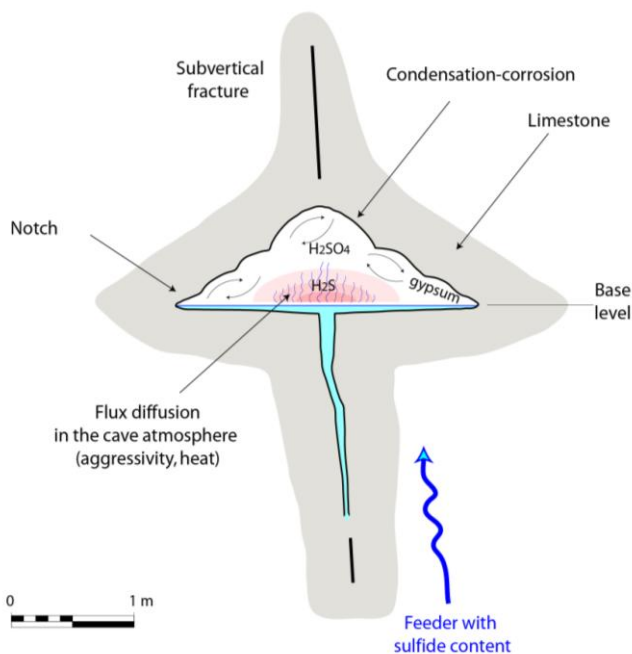


Fig. 3 – Sketch of the genetic mechanism of the Acqua Fitusa cave conduits due to H₂S degassing in the cave atmosphere.

The origin of the Acqua Fitusa cave is due to corrosion processes of carbonate rocks with replacement of gypsum by H₂S-rich thermal water (Fig. 3). In particular, the enlargement of voids and formation of the main morphologies are due to H₂S degassing in the cave atmosphere, oxidation of sulphides and thermal convection that produce strong condensation-corrosion processes above the watertable, according to the origin of sulphuric acid caves (FORD & WILLIAMS, 2007; AUDRA *et alii*, 2010).

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