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Speleogenesis of Alecrineiros Shaft

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Abstract: *The Alecrineiros Shaft is a cave developed in the St. Antonio Plateau, Portugal. This cave develops on a gently dipping monocline structure, along two major fracture families. These discontinuities are sub-vertical and exhibit the following directions: E-W to N70W and N-S to N30E. The shaft presents evidences of several speleogenetic processes compatible with a genesis and development in a vadose regime at the base of the epikarstic zone.*
Keywords: *Shafts; St, Antonio Plateau; Speleogenesis; Vadose regime; Epikarst.*

1. Introduction

The Alecrineiros Shaft is a cavity located in the St. António Plateau, Portugal. The St. António Plateau is a geomorphologic unit of several square kilometres in area, of triangular shape, whose vertex direct to the north (Fig. 1). This geomorphologic unit is a part of Portugal's largest and more important karst massif, the Maciço Calcário Estremenho, such as it was defined by Fernandes Martins (1949). According to Manuppela et al. (2000), the plateau consists of elevated surfaces surrounded at west and east by steep cliffs. The southern surface of the plateau drops more gently to the southern border, from elevations above 500 m to little above 200 m. The entire perimeter of the plateau is bordered by faults, along witch the plateau has been elevated in relation the surrounding area.

The surface of the St. António Plateau is almost flat, slightly tilting to the south, presenting some traces of an ancient fluvial applanation surface. The later is rearranged by karst and also normal erosion in a limited extent (Fernandes Martins, 1949). The plateau surface shows several typical karst forms such as karren fields, uvalas, and a considerable number of dolines according to Manuppella et al. (2000).

At the St. Antonio Plateau there is a large number of caves (at the order of some hundreds) which are represented mainly of shafts with depths usually on the order of some tenths of meters but reaching 200 m in some cases. The deepest known cave is 220 m depth. These karst shafts have no access to active horizontal caves, although at least one of these shafts has reached what seems to be a fossil conduit.

There is very little information regarding the epikarst in this area, beside the existence of several caves like the one described in this paper. In such karst shafts there is usually water dripping and film flows along the walls, active during weeks and in some cases even months (in the late summer) after any significant rain, pointing to the existence of a suspended groundwater body that supplies the water.

To the south of the plateau, a major spring, the Alviela Spring, at the altitude of around 60 m, is located (Fig. 1). The Alviela spring, according to Manuppella et al. (2000), is the largest spring that drains the St. Antonio Plateau.

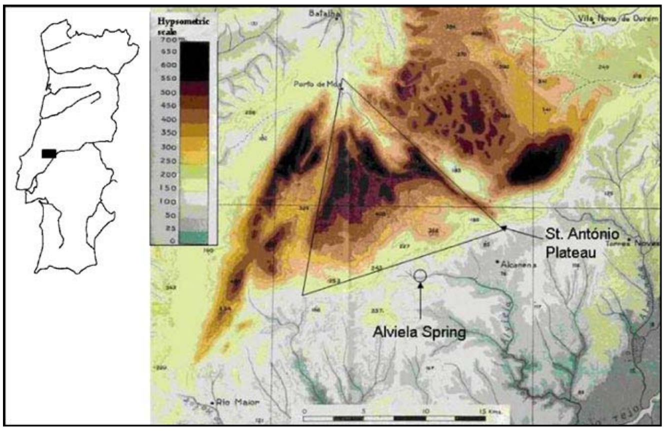

Fig. 1. St. Antonio plateau location in the Maciço Calcário Estremenho. The massif area is represented by dark colours. (Figure adapted from Fernandes Martins, 1949).

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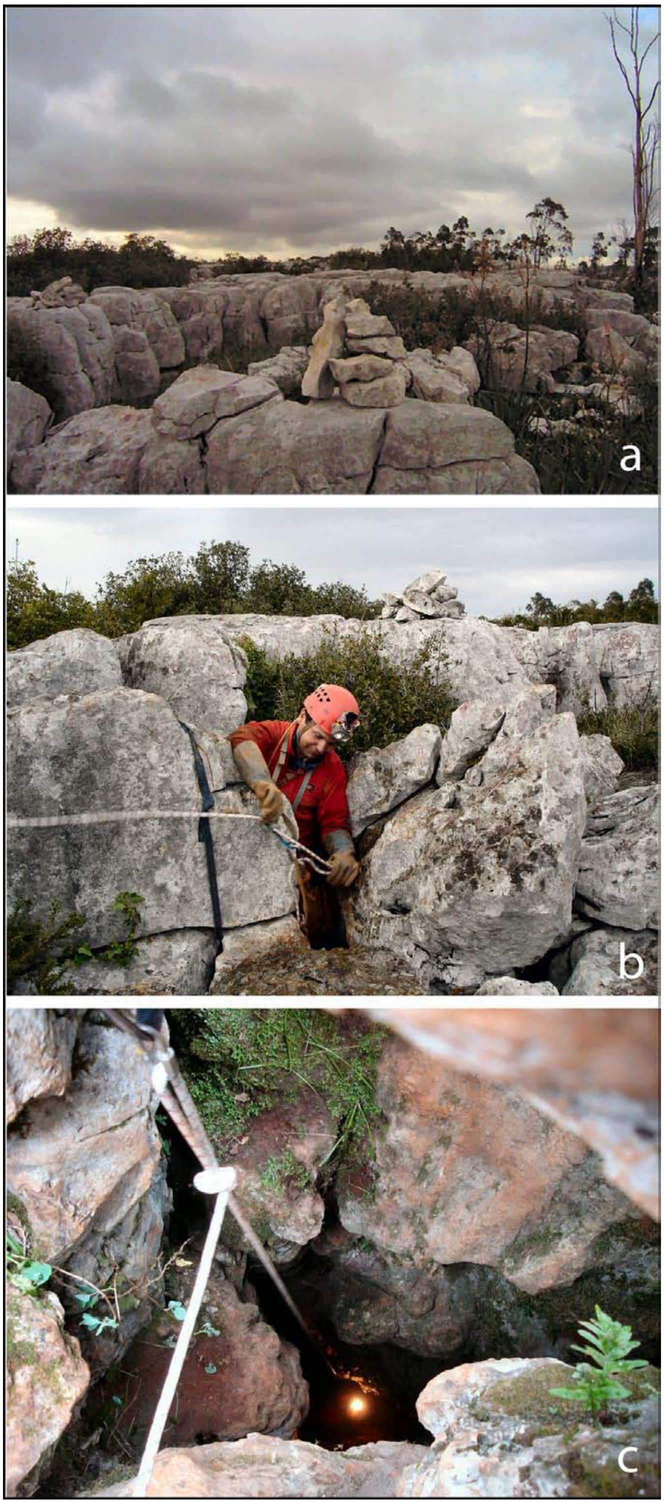

Fig. 2. Location (a, b) and the character (c) of the cave entrance.

2. Geological and geomorphologic setting

Based on the analysis of the Geological map of Portugal, sheet 27-A-Vila Nova de Ourém at the scale 1:50,000, one can observe that the cavity develops along the formation of "Calcários mícriticos da Serra de Aire", composed mostly of micrite limestone. Regarding the structural geology, and based upon an expedite analysis of the above mentioned geological map, the St. António Plateau is a monocline with some flexures, where the bedding present a regional direction that ranges from approximately WNW-ESE to NW-SE, gently dipping to the southwest. This monocline is crossed by a series of faults with directions approximate WNW-ESE - NW-SE.

3. Cave characteristics

The cave entrance (540 m high) opens at the base of a karren field developed on a flat surface (Fig.2, a-b). Within the karren field the depth of grooves reaches 2-5 m. This karren field, according to Rodrigues (1998), holds a large number of kart depressions, some of which are incipient. The cave entrance is located on a flat surface between karst depressions (Fig. 2, c).

The cave is structurally controlled by two major fracture families intersecting each other. One of them has a direction approximately EW to N70W, the other is about N-S to N30E, both are sub- vertical fractures (Fig. 3). The cave zones controlled by discontinuities with directions N-S to N30E, present a lesser development than the zones controlled by discontinuities which directions range from EW to N70W. The depth of the shafts ranges generally between ten to twenty meters and the maximum shaft width is around 4-5 m. The connections between the various shafts often occur through passages of relatively small section, located near the bottom of the shafts or at higher positions.

The shafts bottoms are usually covered of debris resulting mostly from the ceiling and walls breakdown. The western pit is different from the other shafts as it does not has a bottom covered with blocks; the pit's width suddenly shrink at about 10 m above its bottom, so that the pit ends on an impassable vertical opening that develops along a sub-vertical discontinuity (Fig. 3). As a result of the ceiling breakdown along an almost horizontal bedding surface, the ceilings are usually flat.

The cave presents a very simple organization. Where there was no breakdown, the morphology of the cave is high and narrow, keeping in a rough way the form of the discontinuities along witch it was developed. It should be noted that virtually all sections of the cave follow sub-vertical discontinuities. These characteristics were defined by Bögli (1980) as typical of cavities of primary vadose origin. The shafts present vertical troughs on the walls, developed along the entire depths of the shafts, with sections reaching several decimetres. These troughs are very similar to those described by Baroñ (2003). According to this author, the troughs are formed by the corrosive and erosive effect of water that flows and drips along the shaft walls. According to Lauritzen and Lundberg (2000), the troughs can also be formed by the sprinkling of water, along the walls of sub-vertical fractures, which is also typical of caves developed in the vadose zone.

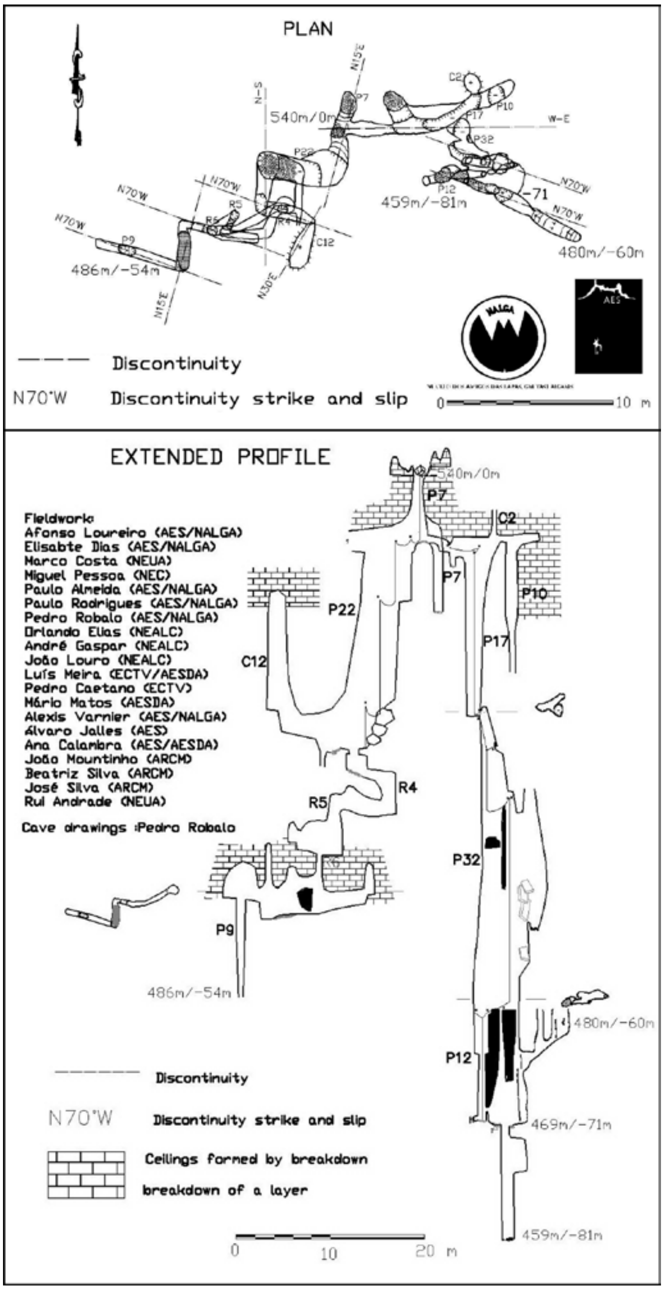

Fig. 3. Alecrineiros Shaft topography with geological survey.

4. Speleogenesis

The development of the cave along sub-vertical discontinuities, as well as the existence of several shafts developed along the same discontinuity families, raises the possibility of a separate evolution of the pits before they intersected each other. The development in the upper part of the vadose zone, and the termination of the cave shafts either on impenetrable cave passages or in block chaos, indicate that this cave should have been developed in the base of the epikarst zone as defined by Klimchouk (2000). The morphology of this cave and its setting has many similarities to the "Karst Shafts" described by Baroñ (2003). The shaft genesis also seems to fit the proposed model of shaft development. According to the above mentioned model the cave should be classified on the d stage of Baroñ (2003), corresponding to a fully developed shaft.

5. Conclusions

The Alecrineiros Shaft is a cavity that seems to have been developed at the base of the St. António Plateau epikarst, under a vadose hydrogeological regime. Regarding the development stage, as defined by Baroñ (2003), the cavity is a fully developed shaft. Some other cavities of the plateau and surrounding karst areas present shafts with very similar characteristics.

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References

Baroñ, I. 2003. Speleogenesis along subvertical joints: A model of plateau karst shaft development: A case study: the Dolný Vrch Plateau (Slovak Republic), *Cave & Karst Science* 29 (1), 2002, 5-12. Also available at: http://www.speleogenesis.net

Bogli, A. 1980. *Karst Hydrology and Physical Speleology*, Springer-Verlag, Berlin Heildelberg New York, 286 p.

Manupella, G., Telles Antunes, M., Costa Almeida, C.A., Azerêdo, A.C., Barbosa, B., Cardoso, J.L., Crispim, J.A., Duarte, L.V., Henriques, M.H., Martins, L.T., Ramalho, M.M.; Santos, V.F.; Terrinha. P. (2000). *Carta Geológica de Portugal - Vila Nova de Ourém,* Folha 27-A, scale 1:50000, and Explanation note, Instituto Geológico e Mineiro, Lisboa.

Klimchouk, A. 2000. The Formation of Epikarst and its role in Vadose Speleogenesis, in Klimchouk A.B., Ford, D.C., Palmer, A.N., Dreybrodt W. (eds.) Speleogenesis: Evolution of karst aquifers. Huntsville: National Speleological Society, pp 91-99.

Lauritzen, S. and Lundberg, J.2000. Solutional and Erosional Morphology, in Klimchouk A.B., Ford, D.C., Palmer, A.N., Dreybrodt W. (eds.) Speleogenesis: Evolution of karst aquifers. Huntsville: National Speleological Society, pp 408-426.

Martins, A. F.1949. *Maciço Calcário Estremenho – Contribuição para um estudo de Geografia Física.* Doctoral Thesis, Coimbra University, Coimbra.

Osborne, R. Amstrong L. 2003. Halls and Narrows: Network caves in dipping limestone, examples from eastern Australia. *Cave & Karst Science* 28 (1), 2001, 3-14. Also available at: http://www.speleogenesis.net".

Rodrigues, Maria Luísa Estevão. 1998. Evolução geomorfológica quaternária e dinâmica actual – Aplicações ao ordenamento do território – Exemplos no maciço calcário estremenho. Universidade de Lisboa, Lisboa