Carsic Complex From Cabeço da Pedra do Sino

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Summary

The study presented here was developed by members of *Associação de Estudos Subterrâneos e Defesa do Ambiente* (Subterranean Studies and Environment Protection Association) during 1999/2000 and 2001. Localized in Maceira, Lisboa, Portugal, the cave system was - before the studies were started - referenced as a group of small caves (entrances) within the Vimeiro region limestone (Upper Kimmeridgian). Subsequently it was found that the system develops into an orthogonal pattern, after a series of both desobstruction and surveying work. The configuration was shown to have 11 entrances and an extension of 900m. The study will show that the system is of shallow phreatic formation.

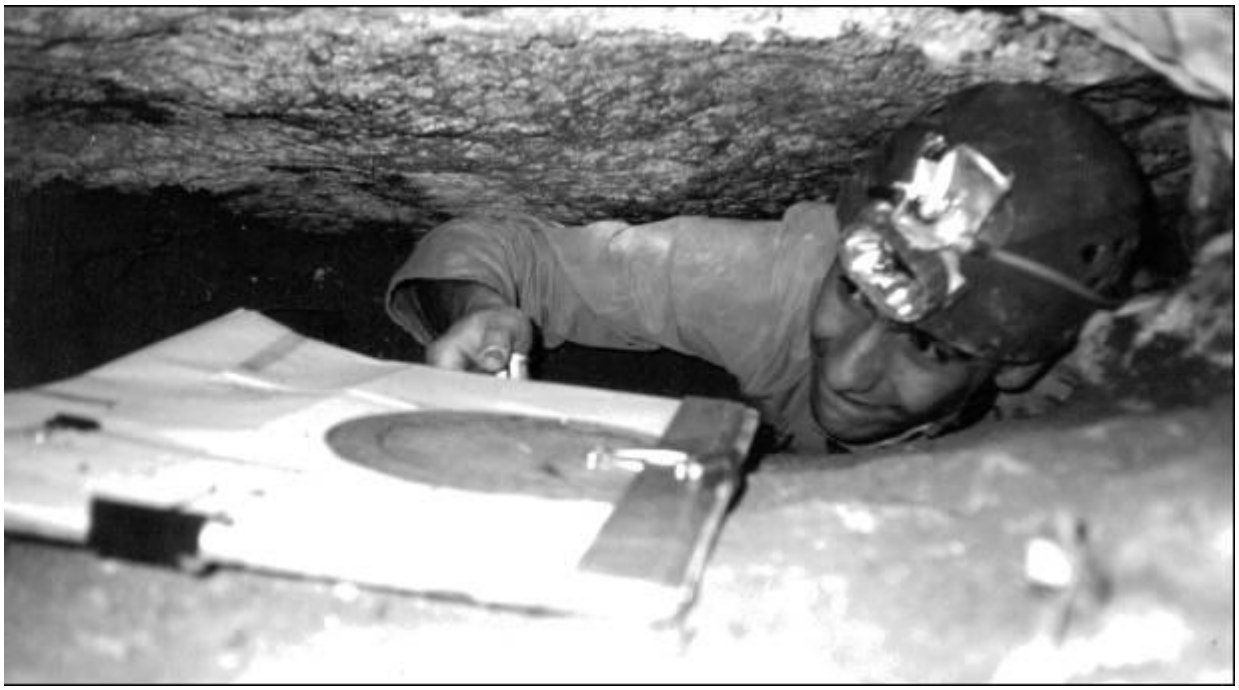

Photo: A.E.S.D.A. - Rui Mergulho 2000 – Chifruda Cave – Maceira - Portugal

Location

The limy top hill (locally known by Cabeço da Pedra do Sino) where the Texugo´s Cave is situated belongs to the district of Lisbon and it is located close to the limits of the municipalities of Torres Vedras and Lourinhã, being positioned in this last one. To the SE we have the village of Ribamar and to the NNE the village of the Maceira. The cave is located at a distance of 625 m from Ribamar and 1250 m from Maceira.

The Lourinhã Fault is sited in the East side of the limy area of Cabeço da Pedra do Sino in a NNE-SSW direction.

The access normally is made from Maceira, along side one of the margins of the Ribamar stream, which flows, towards the Alcabrichel River.

Geology and Geomorphology of the Region

The Texugo´s Cave is located in the top of the Limy unit of Vimeiro (part of Layers of Alcobaça), which begins in Casais dos Netos, and ends at the North going up to Casais dos Arneiro, to the South.

According to the cut of (F. P. TEIXEIRA SILVA, 1989), the unit is constituted, from its lower middle part to the top, by calcareous rocks strongly bioclasts (calcareous algae), in general with oncoliths. The set develops throughout more compact and more poor in fauna calcareous rocks.

The sedimentation of this unit, with a thickness of about 160 m, was occurred in a frankly marine environment, of little depth and weak energy, still well illuminated and oxygenated.

From the base to the top it is possible to found variations in the features of the marine environment. This unit is probable on a saliferous anticline (MANUPPELLA et al., 1999).

The age of the formation of Vimeiros limestone is recognised to be from the Upper Kimmeridgian, due to the micrographical study of the cut, carried out under M. M. Ramalho orientation. It was possible to identify the presence of *Alveosepta jaccardi Schrodt*, *Campbelliella striata* (Carozzi) and *Everticyclammina virguliana Koechlin* (MANUPPELLA et al., 1999).

The Calcareous rocks of Vimeiro encircles a tifonic valley, where Maceira is located, originated by the extrusion of Dagorda marls dated from the Hettangian, injected in the Lourinhã fault.

The tifonic valleys, according to the definition of Paul Chauffat, are limited to a series of faults and have the deep raised through more recent soils, and in contact with these, in its entire perimeter.

These areas are generally of great importance for their hidrominerals and for the presence of certain minerals, as gypsum and mineral salt, amongst others factors (P. G. ANACLETO, 1965).

In this case, the gypsum outcrops in the core of the diapir of the Maceira / Vimeiro (G. C. FRANCE et al., 1961) without, being subjected to any exploration.

In this area there is commercial exploration of two springs of mineral water in the Vimeiro Spa, situated in the valley of the river Alcabrichel. These springs are located in the SE far end of the Hattangian outcrops, called Rainha Santa Isabel and Fonte dos Frades (Saint Isabel Queen and Monks Fountain).

Rainha Santa Isabel waters emerge of calcareous rocks while the ones from Fontes dos Frades arrive at the surface in the contact fault between marls and calcareous rocks.

Beyond the Fault of Lourinhã and the diapiric contact, it is possible to observe on the map another set of transversal faults.

They are the results of tectonic processes and of great tensions, causing complete alteration in the original position of the stratus. Thus, along outcrops side is possible to obtain very different values for strike and dip.

The top hill where the Texugo´s Cave is located has stratus with a dip of 15º NW. Its West slope is very abrupt, being the highest point 65 m and the lowest one 35 m on the East and 45 m on the West (at rivers levels which bound the top hill).

The bottom of the valley interconnected to the West slope resembles a small Canyon that would have been formed by the river erosion.

It is possible to observe Lapias with rounded off edges at the surface over the underground system, and in the West valley it is visible the ceiling collapse of a cave forming a small Canyon.

Speleogenesis and Cave Description

The complex in study has a total extension of approximately 900m of galleries. These are of average difficulty of progression and follow the orientation of the limestone layer fracturation. The orientations, almost perpendicular, promote an extensive web of labyrinthic galleries providing a complex exploration, only accomplished with surveying support.

The system possesses, in totality, eleven entrances subdivided in three zones of the hill under study. In the hill's North zone, is the *Cova do Urso* (the Hollow of the Bear). The cave crosses the hill in a West-East direction, with galleries of vertical/joint form and maximum height of 8 meters. It has a medium precipitation and deposition of calcite, which increases in its interior, emerging with frequency stalactites and stalagmites. At ground level, the clay deposits are frequent in the final part of the cave. The cave has a single connection with *Cova da Chifruda* through a narrow (20 cm) and high (4 m) gallery.

The *Cova da Chifruda* (North zone), has a semi-vertical entrance and, in its interior, a shaft of 4 m providing access to the top level as the *Cova do Urso*. In the cave, it is possible to verify the existence of main galleries (following the main fracture systems) and of low and ample rooms, with several clay deposits and

areas with a large deposition of calcite. The cave does not present any large enough connection that allows the passage to the remaining complex (*Cova do Texugo and Gruta da Pedra do Sino)*, despite the proximity 38 m and the identical arrangement of galleries.

In the Central zone, and turned to the West, are the *Cova da Presa* (the Hollow of the Prey) and the *Lapa da Meio* (the Cave of the Middle). These two caves, of small dimensions, represent old entrances to the system and are obstructed with consolidated clay of difficult removal. Nonetheless, the main galleries oriented to the interior of the hill can be observed. These small entrances have large clay deposits at ground level. Also in the Central zone, but to the East, exists the *Lapa da Pulga* (the Cave of the Flea); one of the four entrances to the East for the main system of galleries. The *Lapa da Pulga* has, in all its extension and at ground level, large amounts of clay. The connection with the *Cova do Texugo* (the Cave of the Badger) is through a narrow (0.30 m) gallery with a level change of 4 m.

In the South zone of the hill, it is found the most important (known) part of the system, with an entrance to the West (*Cova do Texugo*), four to the East (*Pedro do Sino*, *Lapa da Luz*, *Cova do Mongo* and *Lapa da Pinha*) and a vertical entrance in the top of the hill (*Pedra do Sino II*). In this zone is well apparent the large number of main galleries (high 6m of vertical/joint configuration), successively intersecting each other through narrower galleries of a smaller cross-section and height. It is also possible to verify, on those same interceptions, the existence of collapses of the ceiling. In these galleries, it is rare to observe calcite deposits and the limestone rock is regular and with marks of physical erosion. Visualising the galleries cross-section, it can be evidenced that two distinct formation levels exist. At the top, they meet with a higher frequency, varying from 3 m to 1.0 m, with an abrupt variation for the remaining portion of the gallery, which is almost constant (averaging approximately 0.5 m), funnelling a little towards the base. This type of cross-section is directly connected on with the speed of formation of the galleries, very slow in the early stage and increasing near to the base. The existence of zones with clay deposits is also visible in the system, originating from the rise and fall of the water level

Conclusion

Given the pattern of the galleries that compose the system and because it is situated between two water courses, we are led to believe that it was initially created due to the variation of the water level associated to the excavation of the stream bed of the *Ribamar* stream (Shallow Phreatic or Water Table Theories – iniciated by Swinnerton, 1932). This happened in a period when the watercourse at East was found in a superior level when compared with the level at the present time. Later, with the increasing change of level of the watercourse at East, the widening by mechanical action of moving water occurred on some galleries. We also believe that the great accumulation of sediments that is verifiable throughout almost all the complex, took place in a sufficiently short time period (last homogeneous and very thick layer), possibly due to agricultural use of the land to the North.

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