# Gruta do Frade – The Costa Azul Trejure. A Monument to Preserve

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## Abstract

The subterranean world continuously reveals a hidden universe, a living laboratory and authentic monuments. The Frade Cave was discovered on 21st of June 1999, its an example of such a world. Currently, there are several non-classified geological formations and the occurrence of geological phenomena that put into question previous studies, as well as the existence of unknown biospeleological aspects. Identification and studies are necessary to reveal to the world these phenomena, since only knowing and understanding them is the only way to preserve and avoid the errors committed in the past.

## Introduction

The Núcleo de Espeleologia da Costa Azul-NECA (blue coast speleology group) has been in official existence since 24th of October 1995 is has filed, until the date of the writing of this document, one thousand five hundred and thirty seven activity reports.

The main objective of NECA is to explore and catalogue the Arrábida Massive. NECA has registered a hundred and twenty cavities, some of them with considerable developments.

On one of the prospections done through a sea route it was discovered, on 29th of May 1996, a cavity near the sea. This cavity revealed a set of small galleries and a shaft with considerable circulation of air. It was later observed that the circulation would vary in intensity and direction depending on the weather conditions on the outside, such as temperature and high or low air pressures. This factor led a team of four (Armando Jorge, João Luz, Francisco Rasteiro e Pedro Costa) to undergo five desobstruction activities equipped with all the necessary materials (e.g. generator, electric hammer, boat and support boat, etc…), the team was able to negotiate the pass on June 11th of 1999. After the desobstruction, a series of exploratory activities where carried out covering proximately, three hundred meters of cave on a linear development; twenty rooms (some with siphons) all presenting a high concentration of carbonate concretions and speleothems of great scientific and aesthetic beauty.

After this gratifying experience several prospecting campaigns where done in the upward area of the cave. Several cavities where discovered, some of them had a airflow and are in the line up geographical area of the Frade cave. One of this starts roughly at sea level datum 85 meters, there is an existing group of 12 cavities between the sea level datum 180 and 200 meters and another group between the sea level datum 200 and 220 meters. All the data available seems to indicate the existence of a well developed and extensive endokarstic formation.

## Geological Settings

**General features of the Arrábida Chain**

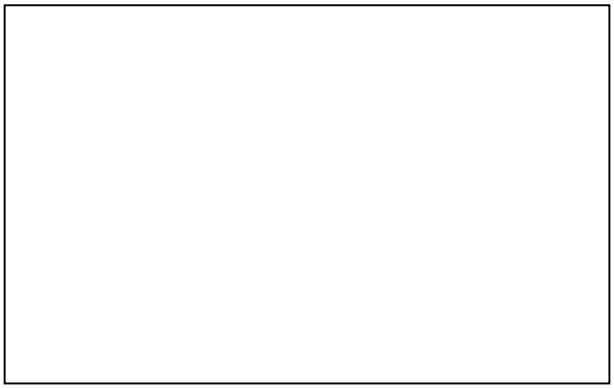
The Arrábida chain is located in the southern end of the Lusitanian Basin and constitutes its south border. This important relief is built up on limestone, marl and some clastic deposits interbedded and constitute the most important feature of the Alpine tectonic inversion of the basin.

The Lusitanian Basin is a Meso-Cenozoic basin located on the western border of the Iberian plate and belongs to a family of periatlantic basins. This structure was formed during a late Triassic rifting phase and extends some 250-300 Km in a NNE-SSW trend and 100-150 Km in a E-W trend, including the immerse zones. During the late Miocene age a maximum compressive stress, with a nearly NNW-SSW direction caused the inversion of the main Mesozoic structures of the Lusitanian Basin (PENA DOS REIS et al, 1996). According to RIBEIRO & RAMALHO (1986, in RIBEIRO et al, 1990) the Arrábida thrust belt represents the most elegant example of thin-skinned Alpine tectonic in west Iberia and was formed by several pulses, the latest one takes place in the Upper Miocene. This chain consists in a 3D imbricated structure of "S-wards directed ENE-WSW striking thrusts and oblique to the thrusts, sinistral lateral ramps striking NNE-SSW to N-S" (KULLBERG et al, 1995). The style of deformation was the result of a combination between a thin-skinned tectonic style and a thick-skinned style, with involving of the paleozoic basement.

Located next to the contact of the Meso-Cenozoic cover and the Paleozoic basement exists the Hettangian evaporite-redbed complex. This plastic material take an important role in the lubrication of the thrust surfaces or even in the bending of the upper layers inside the thrust-bound blocks. The simple geometry of the Arrábida and his thin-skinned tectonics style is owing to the existence of only one, or one main detachment layer constituted by the evaporitic material (KULLBERG, 1996).

**Frade Settings**

The Frade cave is located in the occidental sector of the Arrábida, in Serra dos Pinheirinhos. The cave development under the "Rechã dos Arcos" with a WNW-ESE direction, nearly of the sedimentary stratification direction. This structure is built up on limestone of the Batoniano sup.a Caloviano age commonly designed by "Calcários de Pedreiras – $J^2_P$" (Limestones of Pedreiras).



The cave is inserted in a tectonic unit denominated by "Doma da Cova da Mijona". This exhibit a radial geometry due to the arrangement of stratification directions and the dip vary from the core to borders, between 70º and 40º.

The structure is affected by normal faults with directions between NW-SE and NE-SW and exhibits a radial geometry. These normal faults are conjugated with other faults with less importance and they produced grabens structure in the cupola of the dome structure (KULLBERG et al, 1995).

The dome was interpreted by KULLBERG AND ROCHA (1991 in KULLBERG et al, 1995) as a diapiric dome, however KULLBERG (1996) proposed also magmatic activity in the genesis of the dome. The same authors had ascribed a Cretacic age to the event of installation of the Hettangian evaporitic clay material and established a pillow phase stage.

This cave seems to have its genesis owing to a gravitic collapse of the layer stratification caused by unsustainable of the layers.

## Cave Description

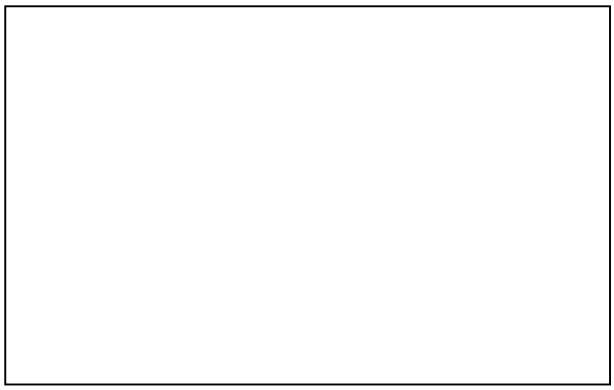
**Geographical location**

The Frade cave is located roughly at 2 kilometers South-West of the Sesimbra Village, at medium sea level. Near the cave there is a quarry of dimensions superior to the village itself and within is located the Zambujal cave (a location classified as of speleological interes – in the nº5 of the 1st Article of the Government Decree nº613/76 if 27th of July) the cave is in risk of being lost forever. The development of the Frade Cave seems to happen according to the same direction of the stratification layers, by the cleavage, succeeding cave-in of materials due to the unsustainable nature of the material present in the ceiling, culminating in it's collapse. The fracturing of the dome of the Cova da Mijona cave seems to favour this gravitical instability.

**Cave development**

Access to the Frade cave is done trough a sea route, for it is necessary a transport dingy and a support dingy to carry the speleologists to the area near the camp site. The disencumbered shaft is from where access is gained towards the area that was discovered on May 19 1999. After a few narrow spots that very much condition the access and progression into the cavity, we arrive into the "Torre de Piza" (Piza Tower) (that seems to develop parallel to the main collector), with some signs of an ancient, filled by mantel. To point out among them the "Disco de Medusa" (Medusa Disc).

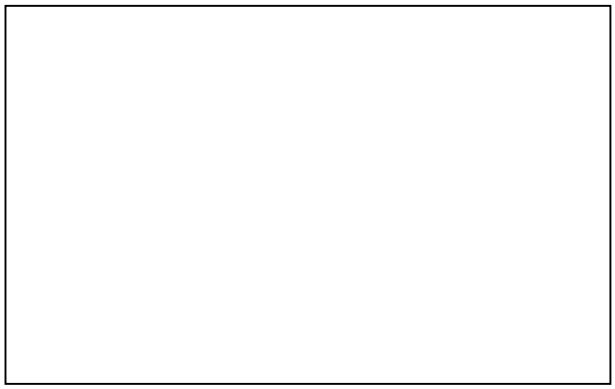
Back to the main collector and after approximately 15 meters one arrives into the dazzling room of the "Tubulares" (Tubular), presenting a vast number of speleothems.



The excentrics are a constant as well as the gours. There exists in parts of the room mineral deposits with colorings never before found in our country.

Passing trough the "Cruzamento" (Crossroads), following the gour with "árvores de calcite" (Calcite trees) we are faced with a flag of unbelievable dimensions. We then come into the "Sala das Bolas" (The Balls Room) with an approximate size of 25 meters of height and 8 meters of length that has in it formations that have not been identified in Portugal.

Throughout the cave it is filled with stalagmites and the watermark delineating water levels are a constant as can be shown in the "Sala do Manto" (Mantel Room) and in the "Sala dos Cogumelos" (Mushroom Room).

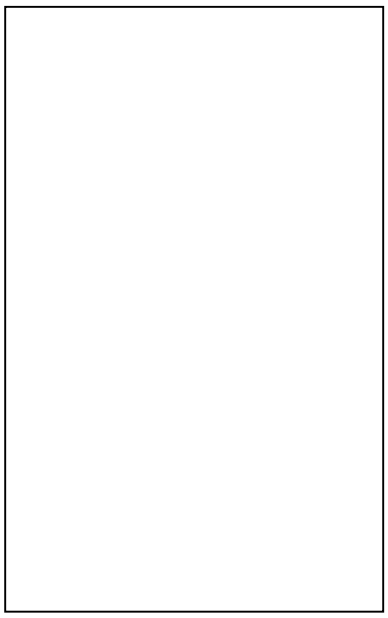


The "Sala Branca" (White Room) with approximately 200 square meters is one of the most beautiful formations with a high profusion; to note are the tubular crowns of calcite and aragonite, the eccentrics, gours and tubulars with mineral deposits (that make us to think of iron oxide) as well as the uncommon spherical forms.

The unforgettable experience is the passage trough the “Sala de Encantos” (Room of Charms), once more the rarity and density of the calcite and aragonite formations really leave us dazzled. The Sala Grande (Big Room) the largest in the cave is 40 meters long and 24 meters width, it is in this room that lies the uncertainty concerning the development of the cave, is it a siphon of brackish water (as all the others), or is it in the adjoining rooms that we find the continuation of what is tought to be the Frade system?

The Frade cave reserves us another room of special notice, the “Sala das Flores” (Flower Room) where strange large stalagmites, and mineral deposits still to be identified, rare and beautiful eccentric forms composed of what seems to be aragonite.

The direct development of the cave, so far established if of 280 meters, tough it’s total development is beyond a kilometer.



## Conclusion

There is an imperative need to systematically study what seems to be the Frade System.Neca has presented, to the able governmental bodies, a work project for the next four years that is awaiting approval. This study is aimed at the complete topographical knowledge of the Frade Cave and the cavities in the absorption zone, a geological and precise litological study and a thorough survey of the fauna to be found in the cave system, as well as retaining photographical and film record of the cave. The collection of photograph and digital film footage aims to, not only assisting the scientific work, as well as serving as the basis for the creation of a CD-ROM and a documentary film becoming an instrumental way to present this speleological monument to the general public. This work is of extreme importance to classify and protect this monument as well as to open the door for future research that we hope will be much more detailed and in-depth.

## Thanks to:

André Moura Guedes and André Vieira from Youth for Human Rights Network – Project "Palhota Viva"

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