

INTERNATIONALLY SIGNIFICANT LAVA TUBE CAVES OF THE CANARY ISLANDS

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INTRODUCTION

The Canary Islands are a group of seven large and innumerable tiny volcanic islands off the northwestern coast of Africa. Major lava tube caves are known on at least three of the main islands: Tenerife, Lanzarote, and Hierro.

In recent years, the title of world's largest lava tube cave has been claimed successively for two of these caves: the Cueva de Los Verdes system on the island of Lanzarote (von Fritsch, cited by Stone, 1889, Montoriol, 1969), and the Cueva del Viento system (Fig. 11-1) on the island of Tenerife ("Anombro", 1970, Teigell, 1970, "Troglonio", 1970). Almost a century earlier, a British visitor casually mentioned local estimates of a length of 11,000 feet for La Cueva de San Marcos at the seaward end of the flow in which Cueva del Viento is located (Stone, 1889), a figure far exceeding the mapped length of any lava tube cave until 1958 (Halliday, 1972).

In November, 1971, my wife and I conducted a vulcanospeleological reconnaissance of the archipelago, with special reference to Lanzarote. This report is based on that expedition, plus study of some of the pertinent literature.

CUEVA DE LOS VERDES SYSTEM AND THE MONTE CORONA FLOWS

The Cueva de Los Verdes system takes its name from a particularly spectacular now-commercial segment of this moderately extensive lava tube system, bearing that name. The origin of the term "Los Verdes" (Spanish for "The Greens" or "The Greenery") seems lost in antiquity. Several modern explanations have been advanced. My own conjecture is that it derives from the relative abundance of small plants living on this part of the Monte Corona flows. Seasonally they color much of the lava, contrasting vividly with the brown, red, grey, and black face of most of the remainder of this near-desert island.

Monte Corona is a large cinder cone or small volcano located near the northeast end of Lanzarote, with the appearance of being of early Recent or late Pleistocene age. Nearly all the Monte Corona flows coursed east, fanning out over about 50 km² and extending the coastline as much as 3 km (Macau, 1965). Aside from short surface tubes which are widely distributed and have no apparent relationship to the main caves, lava tubes and sinks are known in only one narrow, sinuous zone of the flows. Probably the flows predated human habitation of the island; the main cave figured prominently as a shelter from Moorish raiders in pre-conquest days (prior to 1400 A.D.).

Speleological features of this area divide naturally into three groups: (1) a group of small sinks and very short segments of lava tube located close to the east side of Monte Corona and separated from the Cueva de Los Verdes system by a steep slope about 100 feet high, perhaps a flow front; (2) the Cueva de Los Verdes system, described in some detail below; (3) a group of small tubes and sinks near the ocean, the most important and largest of which is the Jameo del Agua, site of a delightful underground nightclub, marine nature reserve, and cultural center (Fig. 11-3). This is probably a segmentally isolated continuation of the Cueva de Los Verdes thoroughway. The position of some smaller sinks and short branches of tube nearby suggests that a small amount of distributary branching may be present. However these instead may be features of independent flow units. The most seaward jameo (the local word for collapse sink) shows invasion by two small solid surface tongues (Fig. 11-4).

The Cueva de Los Verdes system occupies the central half of the cavernous zone, and is entered through the following orifices listed from west to east, progressively down-flow: Jameo de Prendes; Jameo de la Gente; Jameo Cumplida; Puerta Falsa or Jameo de los Almacenes; Cueva de Los Verdes (commercial entrance) or Jameo de la Puerta Mora.

A considerable literature describes and discusses this system in several languages. I have been unable to find the source of the description Stone (1889) attributed to a Herr von Fritsch, but the now-commercial cave was discussed and one section rather amusingly depicted by Hartung (n.d., ca. 1860). Earlier Spanish-language citations were tabulated by Puig (1894). In modern times it has been studied especially by Macau (1965) and Montoriol (1969).

The system is comprised of five cavernous segments separated by jameos. Two of these collapse sinks - Jameo de la Gente (Fig. 11-6) and Puerta Falsa (Fig. 11-7) - are awesomely enormous. The overall pattern of the system is unitary, with multiple superposed levels variously interconnected. The dominant impression is vast spaciousness. A splendid variety of flow

features is profuse in some areas; other sections consist largely of breakdown-demarcated tube. Considerable minutely crystalline gypsum is present in some areas, and some lateral breakdown is due to elongation of gypsum crystals in cracks.

EXTREMITY SEGMENTS

At each end of the system are short caves of such little importance that they can be dismissed for the purposes of this account. The lowest segment houses the electrical generator for the commercial section, and a resulting fume problem precluded study at the time of our visit. Montoriol (1969) recorded a length of 130 m and depth of 20 m. This segment consists of a spacious corridor descending, ascending and finally redescending. The floor is composed of breakdown slopes. Uptube from Jameo de Prendes is a tube segment about half as long as that at the lower end of the system. We did not visit it, and no investigator seems to have described it in detail. Jameo de Prendes is the smallest of the orifices of the system, measuring about 12 m in diameter.

THREE MAJOR CAVERNOUS SEGMENTS

The three main caves of the system are (from west to east): (1) The upper cave or Jameo de Prendes - Jameo de la Gente segment, 1,170 meters long (Montoriol, 1969); (2) the middle cave or Jameo de la Gente - Puerta Falsa segment, with about 1,650 meters of single-level and stacked passages over a distance of about 1,165 meters; (3) the Cueva de Los Verdes proper, with about 1,900 meters of single-level and stacked passages over a distance of about 1,350 meters.

As the system is most conveniently traversed upslope from the lowest point of the Cueva de Los Verdes proper, each will be described here in that direction and order.

CUEVA DE LOS VERDES AND PUERTA FALSA

The Cueva de Los Verdes proper was well mapped and described by Macau in 1965. Its downslope (commercial) entrance (Fig. 11-9) is the more convenient, but quite confusing and the spelologist will probably prefer to obtain special permission to approach by way of the Puerta Falsa, located about 4 km downslope from Monte Corona. This is a spectacular collapse sink, slightly sinuous, and 92 by 18 m in length and width (Montoriol, 1969) and five to fifteen m deep. Its deeper downslope end opens into the undeveloped up-tube segment of the Cueva de Los Verdes. This is an impressively spacious but comparatively featureless breakdown passage about 800 m long and averaging about 12 m in diameter. One short length of superposed passage is present. Considerable powdery gypsum occurs on the floor and walls.

The commercialized 1/2 km length of this cave is radically different. Comparatively linear, it consists of a stacked sequence of two major and several rudimentary levels. The lower (commercial) entrance opens directly only into the upper level, hence that level is about 50 meters shorter than the lower.

Throughout this section of the cave breakdown is comparatively scant. Well developed flow features include lateral ridges and gutters, lava balls, slumped glaze, tapered stalactites, and some unusual forms meriting special study beyond the scope of this report. Lateral coatings vary from pellicular to thick multiples. Large, spacious chambers are demarcated by flow-determined narrows. The principal characteristic of this section is complexity so marked as to merit even more intensive study than it has received to date. For example, not all the rudimentary levels are of similar genesis. "La Crypta" is a short length of rudimentary level consisting mostly of a tube-in-tube within a short sub-tube. An upward-sloping crawlway above "El Refugio" in the upper level leads to a small tumulus chamber not shown on Macau's map.

The commercial entrance is a collapse sink terminating the upper level. By proceeding seaward a few dozen meters in the jameo, a small hole permits descent into the lower level near its lower end, at a point where it is as much as 20 m below the surface of the flow.

Total length of all the passages in this lowest of the three caves including rudimentary levels, is about 1,900 m.

MIDDLE CAVE (Jameo de la Gente - Puerta Falsa segment)

This cave possesses other vertical complexities. Proceeding west (up-slope) from the Puerta Falsa jameo, the twilight zone consists of a single spacious corridor containing remnants of multi-level development in the form of partially collapsed flow ledges about halfway up the 10-m walls. After a few dozen meters, the visitor encounters a short segment where the multilevel structure is intact, forming a short natural bridge. Beyond is a short gap in the interlevel partition, thence the remainder of this cave is stacked as far as the termination of the upper level at the Jameo

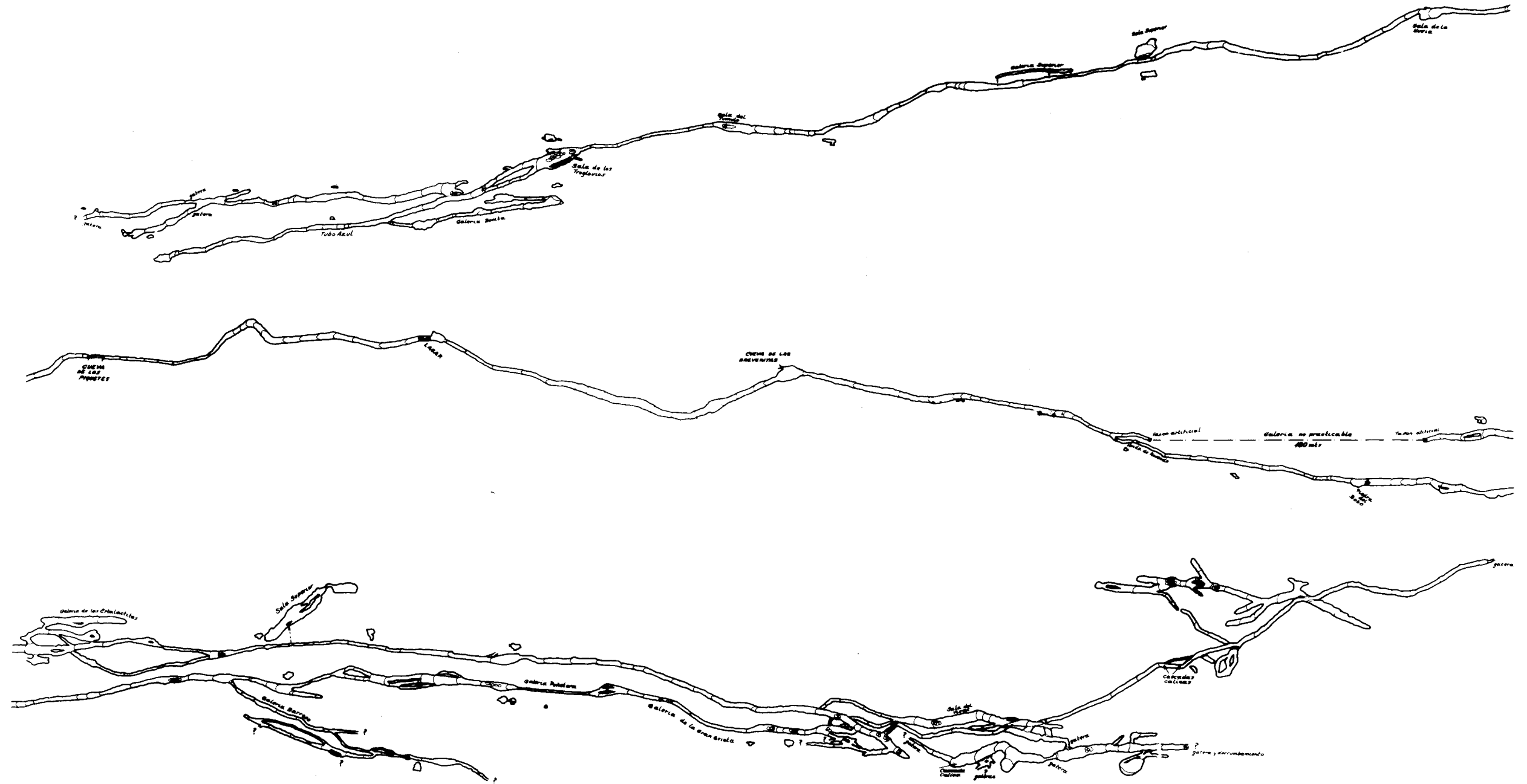


Figure 11-1: Map of Cueva del Viento, Tenerife, courtesy of G.A.M.



Cueva del Viento
Jardín de los Vientos (Tenerife)
 Sección de Exploraciones Volcanospeleológicas de La Guancha (S.E.V.S.)
 Sección de Exploraciones Subterráneas (S.E.S.) de la S.R.E.F. de Barcelona

Escala gráfica: 0 20 40 60 mts.

Longitud topográfica = 6.183 mts.

CUEVA DE LOS VERDES

HARIA - LANZAROTE (ARCHIPIELAGO CANARIO)

LEVANTAMIENTO TOPOGRAFICO

JORGE DE MIER, FRANCISCO MONMANY, JOAQUIN MONTORIOL-POUS

CON LA COLABORACION DE

FRANCISCO REYES, NICOLAS REYES, OSCAR TORRES,

REALIZADO DURANTE LAS EXPEDICIONES G.E.S. DE LOS AÑOS 1961 y 1962.

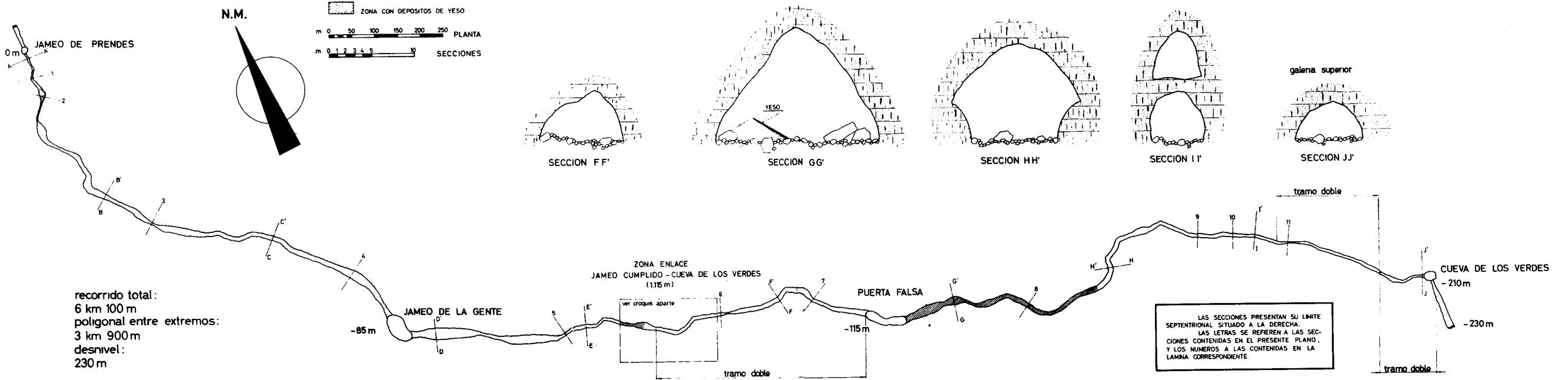




Figure 11-3: Jameo del Agua. Photo by Gabriel, photo courtesy Cabildo Insular de Lanzarote.



Figure 11-4: Lava Tongue invading Jameo del Tesoro.

GEO y BIO

"KARST"

Revista de Espeleología

Octubre 1969 Barcelona, Año VI - N.º 22

ESTUDIO MORFOGENICO DE LAS CAVIDADES VOLCANICAS DESARROLLADAS EN EL MALPAIS DE LA CORONA

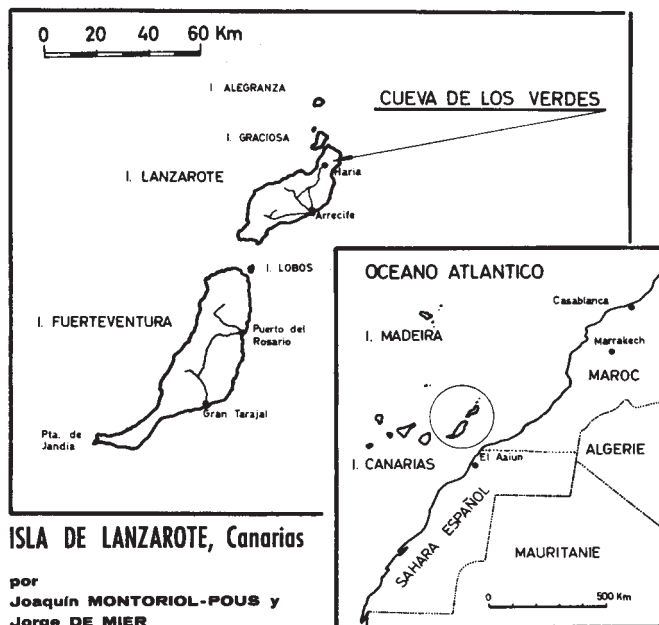


Figure 11-5: Cover of Montoriol's study showing Lanzarote and its relationship to Africa and adjoining islands.



Figure 11-6: Down-tube end of Jameo de la Gente.



Figure 11-7: Down-tube end of Puerta Falsa.

Cumplida. Both upper and lower levels are major throughway tubes. An intermediate small tube is seen at the lower end of the stacked levels but this is rudimentary and is not seen at a small collapse pit connecting the levels some meters up-tube.

UPPER LEVEL OF MIDDLE CAVE

Much of the 450 meter length of the upper level of this segment of the system is floored with a soft mixture of gypsum and earth material. At first this passage is about 5 meters in diameter. At a point about 100 meters up-tube from the natural bridge, it is almost blocked by a lava plug, but a tight ascending crawl leads to a continuation several meters higher. Initially this is small, but enlarges markedly up-tube toward the Jameo Cumplida where it terminates with an orifice about 10 meters in diameter. This part of the cave is only slightly sinuous.

JAMEO CUMPLIDA AND UP-SLOPE CAVES AND SINKS

The Jameo Cumplida is a sinuous collapse trench about 300 meters long, terminating the upper level of the middle cave. Its midpoint is spanned by a short natural bridge. Its portion up-slope from the bridge is about 5 meters deep, but the down-slope section is about twice as deep, suggesting single- and multi-level collapse respectively.

A shallower sink is present about 100 meters further up-slope. No penetrable openings connect it and the Jameo Cumplida although a small cave about 30 meters long extends toward Jameo Cumplida from the jameo up-slope. It is almost entirely walled by breakdown but terminates with two short superposed tube segments, each about one meter in diameter. These appear to be local rudimentary tubes.

LOWER LEVEL OF MIDDLE CAVE

The lower level of this segment of the system is comparatively featureless but considerably longer than the upper level. A few hundred meters up-tube from the natural bridge in the Puerta Falsa twilight zone, it appears to end in a huge talus pile which fills the passage to the ceiling. However, a small opening high on the north wall permits the explorer to continue into a section with fine flow patterns and some siliceous dripstone, virtually free of breakdown. The mass of breakdown seemed to be located beneath or near the lower end of the Jameo Cumplida but I was unable to perform the mapping necessary to evaluate this.

Up-tube from the point where the passage is almost plugged by breakdown, the lower level enlarges to a diameter of about 15 meters. This section is slightly sinuous. It contains much amorphous and some finely acicular gypsum. A few tiny oulopholites are present. A few short, rudimentary ceiling channels were observed. This corridor terminates at the lower end of the Jameo de la Gente.

Montoriol (1969) found the length of this level to be about 1,165 meters, so the total length of the middle cave is about 1,650 meters. It descends 29 meters (Montoriol, 1969).

JAMEO DE LA GENTE

Montoriol (1969) recorded the length of this jameo (Fig. s 11-10 and 11-11) as 70 meters, and its width as 35 meters. Deeper and more sheer-walled than the Puerta Falsa, it is indeed a spectacular sink. The down-tube end is about 20 meters deep, but the up-tube section (Fig. 11-12) is considerably shallower. Here a lower level extends partway under the breakdown pile, producing an overhang about five meters high.

UPPER CAVE

(Jameo de Prendes - Jameo de la Gente segment)

I was able to study only the lower end of this cave. There, multiple lateral coatings and flow ledges were especially well developed. Montoriol (1969) found it to be a unitary tube 1,170 meters long, with a descent of 86 meters. Near the upper end are gypsum deposits. Height and width are more variable than in other parts of the system but except at the lower end, as mentioned, no stacked multilevel sections were recorded.

* * *

THE CUEVA DEL VIENTO SYSTEM

The Cueva del Viento system differs radically from that just described. It is in the steep Pico Viejo flows near the west end of the north side of the island of Tenerife. These flows descend about 3 km in a slope distance of about 15 km; the steepest speleoliferous flows I have observed

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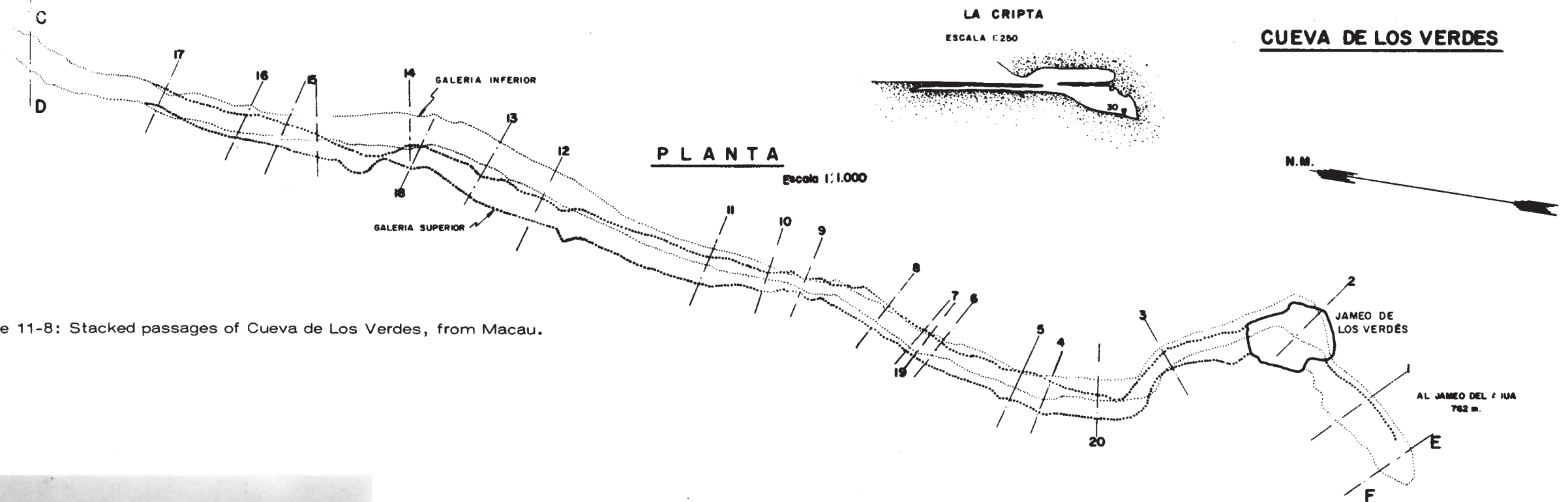
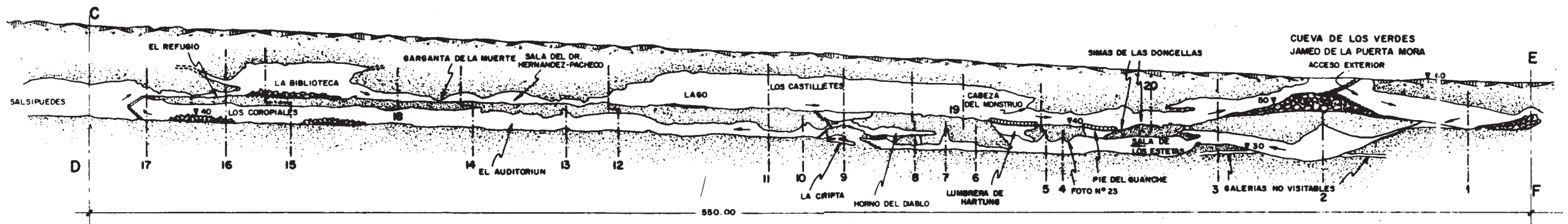


Figure 11-8: Stacked passages of Cueva de Los Verdes, from Macau.



Figure 11-9: Commercial entrance to Cueva de Los Verdes, looking up-tube on a hazy day.



Figure 11-10: Surface of the lava flow downslope from Jameo de la Gente (left edge). Jameo Cumplida is barely visible on the horizon.



Figure 11-11: Looking across part of Jameo de la Gente to Monte Corona.



Figure 11-16: Siliceous microgours in Cuevo del Viento.



Figure 11-12: Up-tube end of Jameo de la Gente.



Figure 11-15: Up-tube end of collapse sink which segments the Cuevo del Viento.

(Fig. 11-13). They terminate in a sea cliff containing the lower entrance of Cueva de San Marcos, mentioned above. The descent of the then-mapped portion of the system is about 580 meters (Montoriol, written communication, 28 October 1971).

This system consists of an elongated, braided complex of superficial, small- to medium-sized passages (Fig. 11-15), interrupted by a single 10-meter collapse sink (Fig. 11-16) which divides it into upper and lower caves (some artificial barriers also are present). These caves are being mapped by the Grupo Vulcano espeleologico de La Guancha of the Grupo Montanero de Tenerife, with 4,632 and 1,578 meters completed in the upper and lower caves, respectively, as of November 1971. Exploration is continuing at both extremities, and also at the upper end of Cueva de San Marcos where about 2,000 meters of passage have been penetrated (Teigell, oral communication, November 1971).

Parallel to the Cueva del Viento system but at a higher elevation are at least two more lava tube caves, one unitary, one braided (Teigell, oral communication, November, 1971). It seems likely that all these caves are integral parts of a "super-system" of a type not previously delineated. For this the term "megasystem" may be appropriate.

With the exception of recent press reports ("Anambro", 1970; Teigell, 1970; "Troglobio", 1970) the literature on this system is almost entirely limited to Cueva de San Marcos. Under a variety of names (Cave of Icod, Cave of Guanches, etc.) it was an object of considerable celebrity in the late 19th Century because of the discovery of mummified remains of Guanches, aboriginal inhabitants of the island. Its relationship to the lower cave of the Cueva del Viento system is not yet clear.

While the diameters of these caves are much smaller than those of the Cueva de Los Verdes system (mostly being one to two meters in size), they are of exceptional scientific interest, and contain numerous features meriting detailed study. Closed white siliceous microgours are dramatic locally (Fig.). The variety of lava features is exceptional. In some areas, flow patterns are extremely sharp and clear-cut; elsewhere they are unusually rounded and smoothed. In a few locations are thread-like speleothems somewhat resembling Pele's Hair, and bizarre spider-like helictites. Unique in my experience is a succession of hollow lava tongues which enlarge downslope and take on throughway characteristics.

SUMMARY and CONCLUSIONS

Both the Cueva de Los Verdes and Cueva del Viento systems are of international significance because of their size and scientific interests. Together with Manjang Cave, Korea, Ape Cave, Washington state, U. S. A. (Halliday, 1972) and Kazumura Cave, Hawaii, U. S. A., the upper cave of the Cueva del Viento system is one of the four longest lava tube caves in the world. Although possessing no single cavernous segment of near-record length, the Cueva de Los Verdes system is of additional significance because of its awesome spaciousness.

ACKNOWLEDGMENTS

D. Carlos Teigell assisted greatly in field work on Tenerife, and Dr. Joaquin Montoriol Pous, in many ways. Our field studies on Lanzarote were made possible by authorization by the Direccion General de Seguridad de Espana (Ministerio de la Governacion), obtained with the assistance of D. Rafael Ferrer Sagreras, Consul-General of Spain in San Francisco, California. Addi-



Figure 11-13: Silhouette of the Pico Viejo flows with El Teide visible above and beyond Pico Viejo. Photo courtesy Spanish Tourist Bureau.

tional authorizations and assistance on Lanzarote were kindly provided by D. Jose Ramirez Cerda and D. Antonio Alvarez Rodriguez, president and vice-president of the Cabildo Insular, and by D. Serafin Martin Rodriguez of Arrecife and D. Aquilino Rodriguez of Haria.

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ORIGINAL CONTRIBUTIONS TO VULCANO-SPELEOLOGY FROM ICELAND

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The study of Icelandic lava caves by members of the Shepton Mallet Caving Club began in 1969 in preparation for the club's 21st anniversary expedition to Raufarhólshellir, the famous lava tube cave in the south-west of the island. As a result of the preparatory bibliographic work and the experience gained in the field during the 1970 project, research has continued in the compilation of a comprehensive bibliography of Icelandic lava caves, in the improvement of the accuracy of cave surveying in basalt terrains, and in the improvement of geological field techniques. This paper traces the lines of research which this group has followed in the study of Icelandic lava caves, and discusses future plans of research which are based tentatively upon a new model of lava tube evolution.

ICELANDIC CAVES AND CAVE EXPLORATION

In order that considerations might be given to the area in which the group would cave in the summer of 1970, a bibliography was compiled by one of us (M. T. M.) and this now much expanded has allowed a map to be compiled of the location of cave sites in Iceland. It must be remembered that the cave sites mentioned here are those recorded in the literature and as such do not represent a complete picture. The majority lie in post-glacial basaltic lava flows and it is in some of these enormous expanses of unexplored lava that future discoveries would seem inevitable.

Examination of the literature of known caves provides an interesting study concerning their age and the history of cave exploration. Some references to Icelandic caves may be traced to the saga period of the twelfth to the fourteenth centuries. The sagas are also of great importance to the vulcanospeleologist in that they contain records of volcanic eruptions which help to date lava flows. The Völuspá, a Sibylline poem descriptive of Scandinavian mythology, and the Daemi-