Memories of the 52nd speleological exploration campaing in the Sierra de Tendeñera

ARAÑONERA 2024

Espeleo Club Muntanyenc Barcelonès

Written by: Eduard Segura and Pau Balart

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Figure 1. Official poster of the 2024 campaign.

1. Participating groups and collaborating organizations

Organizing group and participating groups

- **Espeleo Club Muntanyenc Barcelonès** (ECMB), Barcelona, Spain (organizer)
- **AENIGMA**, Vilnius, Lithuania
- **Espeleo Club Castelló** (ECC), Castelló, Spain
- **Equip de Recerques Espeleològiques** (ERE) de l'Agrupació Excursionista Catalunya (AEC), Barcelona, Spain
- **CERE Abisme**, Sant Andreu de la Barca, Spain
- **Societat Esportiva ESPEMO**, Morella, Spain
- **Grupo de Exploraciones Subterráneas Alto Palancia** (GESAP), Segorbe, Spain
- **Grup d'Investigacions i Recerques Espeleològiques Sesrovires** (GIRES),Sant Esteve Sesrovires, Spain
- **Caving club Kranj** (DZRJ), Kranj, Slovenia
- **Benedek Endre Barlangkutató és Természetvédelmi Egyesület** (BEBTE), Hungary

Collaborating organizations:

- Federació Catalana d'Espeleologia (FCE) Catalunya, Spain
- European Speleological Federation (FSE), Europe
- Federación Aragonesa de Espeleología (FAE), Aragón, Spain
- Federación Española de Espeleología (FEE), Spain
- Centre Sant Pere 1982, Catalunya, Spain
- KORDA'S, Catalunya, Spain
- Confederación de Espeleología y Cañones (CEC), Spain

2. List of participants

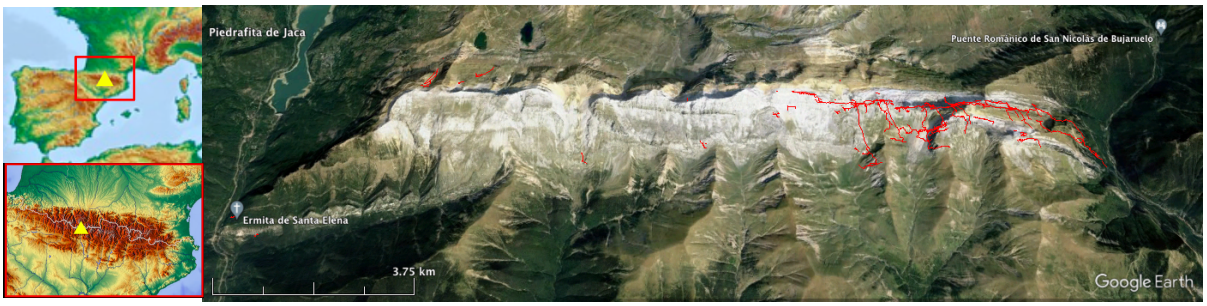
Table 1: Participants in the Arañonera 2024 campaign.

	Name	Club	Federation	Country
1	Ana Isabel	CERE -ABISME	Asociación Española de Espeleología y Barrancos (ASEDEB)	Spain
2	Anastasiya Ianina	ECMB	Federació Catalana d'Espeleologia (FCE)	Russia
3	Ausriné Cepènaitè	Aenigma	Lithuanian Speleology Association (LSA)	Lithuania
4	Barbara Golya	BEBTE	Hungarian Karst and Cave Research Society (MKBT)	Hungary
5	Cubi	GIRES	Federació Catalana d'Espeleologia (FCE)	Spain
6	Dani Mur	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
7	David Fabregat	ESPEMO	Federacion Espeleología Comunidad Valenciana (FECV)	Spain
8	Eduard Segura	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
9	Eduardo Porras	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
10	Francisco Guerrero	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
11	Hector Martinez	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
12	Jaime Garcia	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
13	Jaume Ferreres	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
14	Jordi Borras	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
15	Jordi Mayos	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
16	Josep Cubillo	GIRES	Federació Catalana d'Espeleologia (FCE)	Spain
17	Linas Tomkevicius	Aenigma	Lithuanian Speleology Association (LSA)	Lithuania
18	Liudas Stakenas	Aenigma	Lithuanian Speleology Association (LSA)	Lithuania
19	Luís Almela	ECC	Federacion Espeleología Comunidad Valenciana (FECV)	Spain
20	Manel Alfaro	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
21	Marc Navarro	ERE AEC	Federació Catalana d'Espeleologia (FCE)	Spain
22	Matjaz Bozic	DZRJ	Speleological Association of Slovenia (SAS)	Slovenia
23	Maria Prokhorova	ECMB	Federació Catalana d'Espeleologia (FCE)	Russia
24	Miguel Oury	GESAP	Federacion Espeleología Comunidad Valenciana (FECV)	Spain
25	Pau Balart	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
26	Pau Bordàs	ESPEMO	Federacion Espeleología Comunidad Valenciana (FECV)	Spain
27	Petr Koveshnikov	ECMB	Federació Catalana d'Espeleologia (FCE)	Russia
28	Pol Duran	ERE AEC	Federació Catalana d'Espeleologia (FCE)	Spain
29	Raul Alvarez	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
30	Saulè Vas	Aenigma	Lithuanian Speleology Association (LSA)	Lithuania
31	Sergi Tremosa	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain
32	Xavi Garza	ECMB	Federació Catalana d'Espeleologia (FCE)	Spain

3. Geographical, geological and speleological context

Tendeñera mountain range is located in the Central Pyrenees, in the province of Huesca (Spain) (Fig. 2A). It is characterised by an abrupt relief formed by Pleistocene and Holocene karst glaciers, with a strong east-west trend between the Ara and Gállego rivers. Its location between the Axial Pyrenees and the Central Depression creates an important barrier to hydrological and climatic conditions.

A



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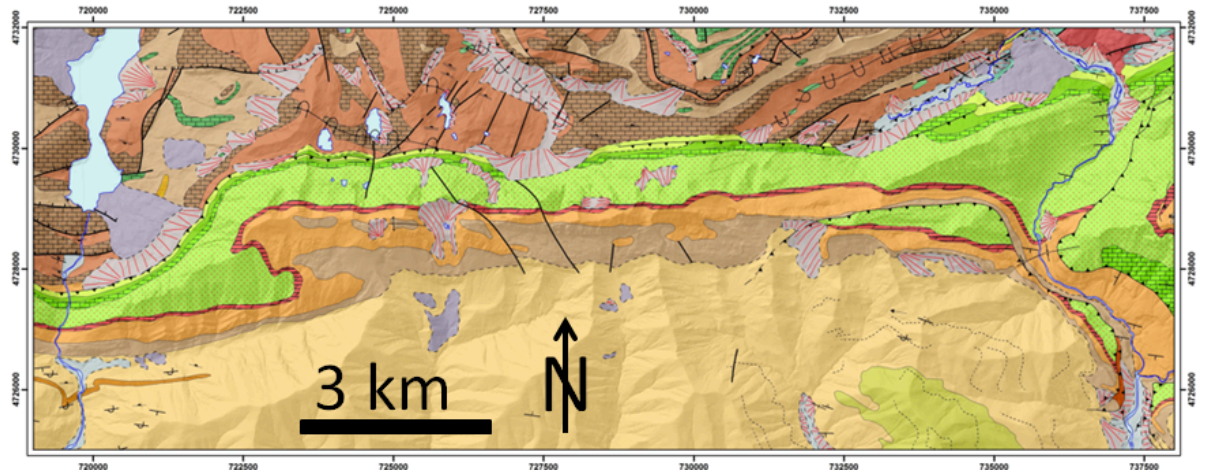

Figure 2. A. Sierra de Tendeñera (Central Pyrenees, Huesca, Spain) and Arañonera cave system (red). Satellite photo from Google Earth. **B.** Geological map of the karstic massif of the Tendeñera. The east-west band of green, red, orange and dark brown colours represents the Upper Cretaceous (green), Paleocene (red and orange) and Early Eocene (dark brown) calcareous sandstones and carbonate materials of the Sierra de Tendeñera. To the northern part there are Palaeozoic materials and to the southern part there are Cenozoic flysch materials (light brown). Source: Durán-Valsero et al. (2023)

Limestones, dolomites, marls and sandstones highly stratified in vertical layers characterise the geology of the Sierra de Tendeñera (Fig. 2B). These strata are clearly observable in some areas of the sierra. Due to the verticality and low power of the strata, the absorption zone is relatively small. For this reason, there is a poorly developed exokarst and a remarkable endokarst that reaches great depths. Networks of fossil galleries predominate, which connect with the active collector at greater depths by means of pits, forming some cavities that are more than -1,000 m deep. There are springs on both sides of the mountain range (Fuente Pantoja, Santa Elena and Batanes in the Gállego river and Santa Elena, Bozo and La Gloriosa in the Ara river), with a groundwater boundary near the Tendeñera peak (2,853 m), the highest peak in this mountain range.

The Arañonera cave system is the most important of the Sierra de Tendeñera, with 1,349 m of depth, a survey of more than 47 km and 8 cave entrances (Foratón, Foratín, S-1, S-2, S-3, A-31, T-1 and Santa Elena) (Fig. 3). It is the 21st cave in the world and the 6th in Spain in terms of depth. It is possible to make an underground traverse from the highest entrance located at the peak of Tendeñera (C7 or Foratón) to the spring located in the Ara river (Santa Elena).

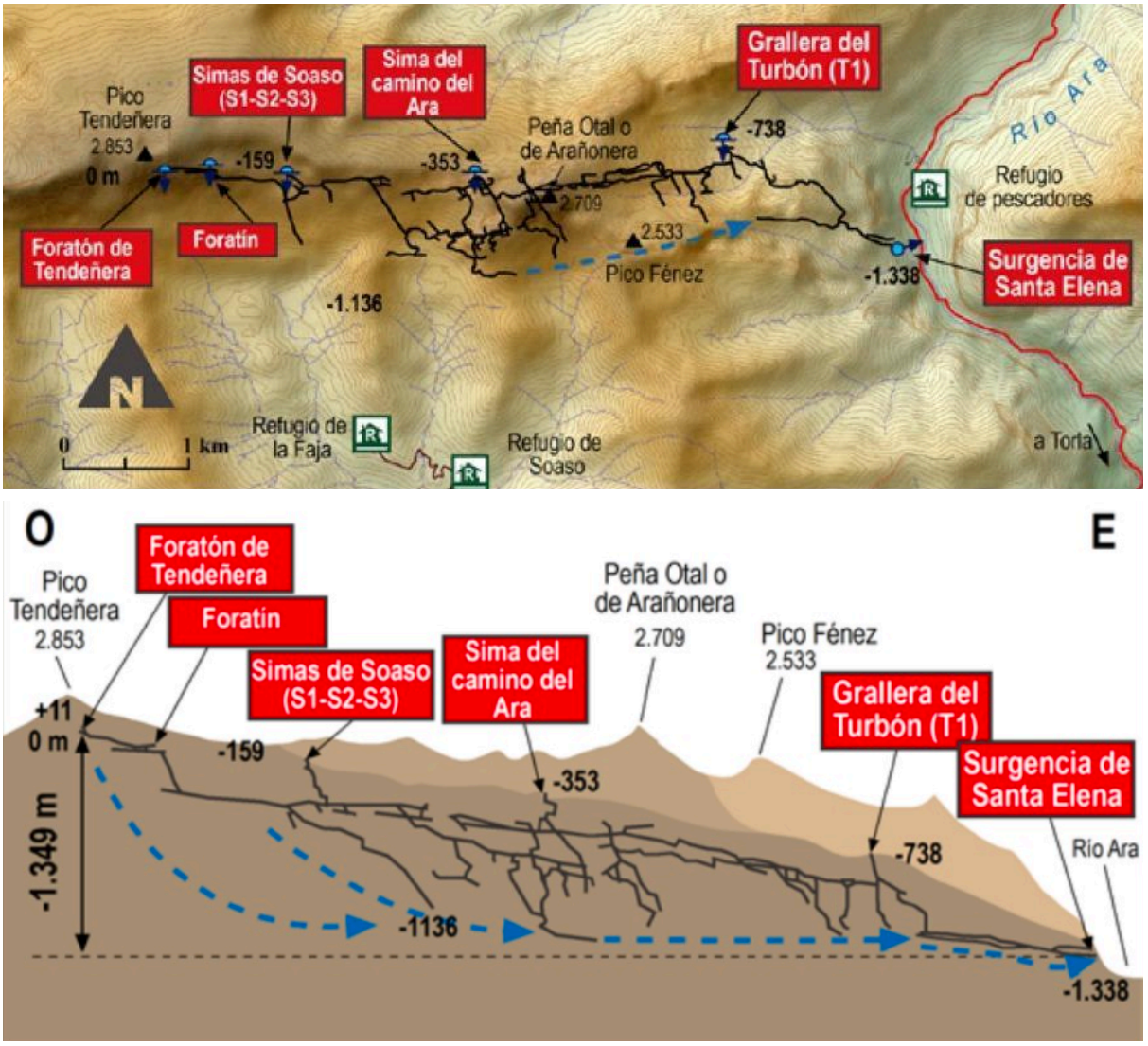

Figure 3. Simplified topography of the Arañonera System in plan (top) and projected elevation (bottom). Illustrations by the Geology and Mining Institute of Spain (IGME) based on the surveys of the ECMB.

With a distance of almost 10 km and a difference in altitude of 1,348 m, Arañonera's greatest traverse is currently the second in the world with the highest elevation difference between the upper and lower cave entrances, only surpassed by the Lamprechtsofen System (Austria). Arañonera is one of the largest underground systems in Spain and its characteristics (verticality, alpine conditions, difficult access) make it one of the most complex cave systems to explore. The Espeleo Club Muntanyenc Barcelonès (ECMB), previously Espeleo Club de Gràcia (ECG), has been organising exploration campaigns for the last 51 years. The exploration of this super-karst has been possible through the efforts of 3 generations of speleologists, multiple collaborations with other clubs and international campaigns. Currently, the Arañonera cave system occupies one third (East) of the

Tendeñera karst massif, having a great potential for development and slope to the west side, in addition to the speleological potential of several deep routes located along the system, including multiple uncharted areas yet to be explored.

Figure 4. The international camp, located at 2,200m.a.s.l. at a short distance from the S1 cave entrance, facilitates speleological advances especially in deep exploration sections. Photos: Kristina Girčytė, Saulius Žemaitaitis and Pau Balart.

4. Summary of the 2024 campaign

After completing the exploration of the new *Groga* line and the review of the *Somnis de Glòria* collector, both upstream and at the terminal siphon, work carried out during the last two campaigns, we set new objectives. These are aimed at resolving uncertainties that could expand the system to the west, reviewing and dismissing all doubts in the upper part of the system, up to the *Primigeni* river.

The main objectives include continuing with the exploration of the new passage discovered the previous year, the *Crunxi and Riuet Zig-Zag* line, reviewing the *Primigeni* river upstream, and finishing the exploration and topography of the *Eclipse* line.

On the other hand, outside the system, we also have important objectives. One of them is to review the area near the pass between Ripera and Tendeñera, as well as the prospection and exploration of hanging entrances. A notable project is the C10 cave, known and explored in 2006. This entrance, with significant unexplored blockage, has high potential due to its location. It is the highest entrance on the southwest face of Tendeñera and presents a remarkable air flow, making it a difficult but promising objective.

In addition to continuing with the explorations, we have set another major goal: conducting a large-scale cleaning of the system. This would include the bivouac at -600 meters, located in the S1 gallery, and the entire path of the S1 cave up to the entrance. During the explorations in the *Somnis de Glòria* collector, we found numerous remnants of past explorations and old ropes, which were removed during the re-equipping of the S1 galleries in 2022 and 2023. Therefore, we believe it is an ethical responsibility to make an effort to keep the system clean.

During the cleaning, we also observed that the S1 cave is not in optimal safety conditions for intensive transit of speleologists. For this reason, the need to re-equip some precarious sections has become evident to avoid possible accidents.

Figure 5. View from the Soaso base camp. Photo: Jaume Ferreres.

5. Logistics

This year, we decided to organize two self-sufficient camps to work in both areas simultaneously: (i) Soaso (base camp) and (ii) the pass between Ripera Peak and Tendeñera (high-altitude camp). Two helicopter loads of supplies were made at the beginning of the August campaign to supply both camps with food, water, kitchenware, generators, and materials necessary for exploration. The Soaso base camp had a kitchen-dining tent, a solar panel battery storage, a “fridge cave” installed in a blowhole covered with tarps, a pool to melt water from the ice plug in S25, and a material storage area (additional tent and natural shelter). The high-altitude camp at the pass had a gasoline generator, tents, and a small natural shelter to store materials. Finally, in September, a helicopter load was made to remove the waste collected during the S1 cleaning campaign and to bring down the remaining material from the August camp.

Figure 6. Logistics of the international exploration campaign in August. Photos: Jaume Ferreres.

6. Results

Review and climbing in the terminal siphon of *Somnis de Glòria* and new line *I ja que estem aquí*

During the Christmas of 2023-2024, a team of two speleologists carried out an exploration attack under winter conditions, lasting 4 days and 3 nights, in the terminal siphon *Somnis de Glòria* (-1082 m). The access was made from the end of the Soaso track, requiring alpinism equipment in the final approach sections. The bivouac at -900 m, at the end of the *Mili KK* line, was used as the operations base, as has been done in recent years.

The attack consisted of a 16-hour effort from the -900 m bivouac, with the aim of overcoming the terminal siphon via a potential aerial by-pass, located at the end of the 2023 campaign. This by-pass is situated between the last waterfall of the river and the terminal siphon. It was overcome with a 20-meter artificial climb, which allowed access to an upper gallery, where a second siphon was found, halting the exploration.

Figure 7. Tendeñera Peak from the entrance of S1 (left) and new siphon in the by-pass of Somnis de Glòria at -1082m (right). Photos: Lluís Almela.

During the same effort, another 5-meter climb was made, discovering a new ascending passage called *I ja que estem aquí* (And since we're here). This passage was halted when an ascending shaft was encountered, requiring artificial climbing. Although the passage is long, its dimensions are modest and uncomfortable. The problem is that it heads in a

different direction from the siphon and is strongly ascending, which causes it to lose the initial interest of the effort. For this reason, it was named "And since we're here".

This passage seems to be another tributary of the collector, in a strongly fractured system, where numerous vertical passages emerge in search of the main collector. The path of these waters to the *Bozo* and *Gloriosa* springs remains an unsolved mystery. The idea of diving was ruled out for several reasons: the large amount of mud in the siphon water, the depth and exposure of diving, and the lack of skilled personnel to transport the equipment to this point, as well as the precariousness of the bivouac at -900 m, which is only suitable for 3 speleologists.

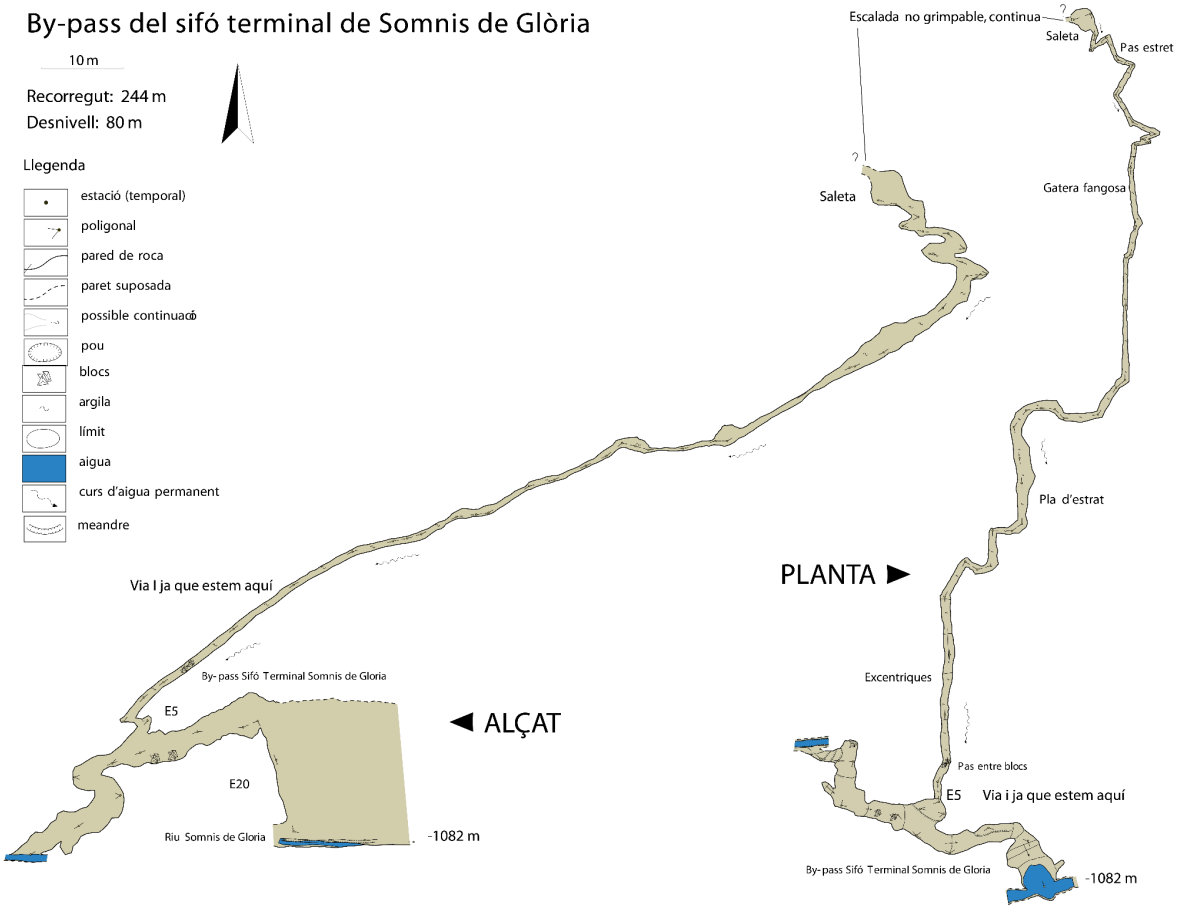

Figure 8. Topography of the Somnis de Glòria river by-pass and the newly explored gallery *I ja que estem aquí*.

Review and unblocking of the C10

The C10 was reviewed, presenting a complex and demanding approach in a remote location in the Tendeñera mountain range. Its location, close to the pass between Ripera and Tendeñera, makes it the best base camp for explorations. Attacks from below were dismissed due to the length and rugged terrain of the area, which would require excessive effort to ascend and descend in a single attempt.

There are several options to reach the Ripera pass:

1. Ascend the entire Soaso valley, climb Tendeñera from the east (the classic ascent to Tendeñera), and descend steeply to the west until reaching the pass.
2. Climb to the last refuge in the Soaso valley (the shepherd's hut), continue ascending to the last meadows, reach the cirque, go westward to the pass, reach the next valley, and from there, ascend directly to the Ripera and Tendeñera pass by a very steep path. This option is similar to the ascent of Tendeñera from Gabín, but starting from Soaso, as the latter valley requires a 4x4 vehicle.
3. Climb to the *Foratín* cave (S50), traverse the *Foratín-Foraton* section inside the system, and then perform an exposed traverse of about 300 meters to the pass.

Figure 9. Speleologists at the entrance of the Foratón, after completing the Foratín – Foraton traverse, as part of the approach to the C10 from the Soaso camp. Photo: Anastasiya Ianina.

Although it may seem unbelievable, all three access options are used multiple times, depending on different factors such as off-camp attacks during August, access between camps throughout the campaign, arrivals and returns of participants during the August camp, material transport, and other reasons. Once at the Ripera pass, an easy but somewhat exposed climb is necessary to reach the C10 cave, which takes about 10 minutes.

Prior to the August camp, a 3-day effort was carried out, composed of 4 speleologists, who accessed the area from the end of the track and camp in tents at the pass. During this effort, the approach is recognized, the cavity is located, the cave is re-equipped, and the descent is

made to the narrow meander. The best way to proceed with the unblocking was evaluated, which was done at the end of the first day and throughout the second day. The base of the shaft allows for the storage of a large amount of rocks and gravel. However, the main problem is the inclination of the terrain. Due to an incident during the work, several dams are constructed to prevent accidental material falls down the slope. The last day was dedicated to wrapping up and descending with the equipment, before finally returning to civilization.

Due to the complexity of the location, this year we decided to set up a self-sufficient camp at the pass between Ripera Peak and Tendeñera. The helicopter transport of material at the beginning of the August campaign helped supply food, water, and the materials needed for the exploration of the C10. Additionally, this infrastructure was used to carry out other work in the area, which will be described later.

During the August camp, many days were spent unblocking the C10. However, as the exploration progressed, it became clear that the unblocking was too dangerous at that time, at least until a more experienced group of speleologists could evaluate the feasibility and risks. The unblocking seemed to be a narrow meander filled with debris, starting from the ramp at the base of the shaft. As the progress continued, the meander completely turned, descending below the ramp between more or less stable blocks.

Figure 10. C10 unblocking work: before (left) and after (right). Photos: Jaime García and Saulė Vaš.

After the August camp, the situation was reassessed with more experienced speleologists, who considered the unblocking feasible and believed that it could continue. Therefore, the exploration was not considered finished at that time. The passage presents a strong air flow, even when it is blocked with stones and gravel. Due to its location, this suggests that it could

be key if the unblocking is successful, although the time and effort required are difficult to estimate.

With the goal of continuing to explore this cave and conducting other work in the surrounding area in the future, it was decided to use a nearby small cave at the end of the August camp. This cave would be used for overnight stays in the future and for storing materials, food, and equipment. It is important to note that there is no water source in the area, and thunderstorms are very frequent and intense, as was observed during this campaign.

Exploration of the *Primigeni* river upstream

During the August camp, due to a drill breakdown in the area of the pass, where the hanging entrances of the Ripera ridge were being explored, two team members decided to descend from the pass camp to the Soaso camp to investigate an unresolved issue in the *Primigeni* river. Since this exploration didn't require a drill, they would make the best use of time while a replacement drill was obtained. The issue was to check the continuity of the *Primigeni* river upstream.

Up to that point, it was only known that two people had tried to force the narrow sections upstream, and only one managed to advance, which led to aborting the exploration that day, and it was never attempted again. From the bottom of the *Foratín* cave (S50), following the classic route, if the river is ascended, it leads to a chamber that is the confluence with the *Mallorquines* passage, a more comfortable alternative descent route. If the course is continued upstream, shallow waters lead to another known chamber. In this chamber, a climb was attempted but was closed; however, it was confirmed that the continuity persisted, as it was neither topographed nor fully explored from here.

The exploration began at that point. The narrow gallery, with a low ceiling and flooded floor, was forced, advancing uncomfortably as they tried to stay as dry as possible. After a slow progress of about 60 meters, a new chamber was reached. In this new chamber, an ascending chimney was visible, which opened a new question.

An attempt was made to continue upstream from the end of the chamber, but unfortunately, the ceiling was low, and the floor was completely flooded, making further progress impossible. The exploration was considered finished at that point. On the way out, topography was done up to the last known chamber, a complicated and uncomfortable task due to the reduced dimensions of the gallery and the flooded floor.

On the way back, a tributary of the *Primigeni* river was explored, but it too became impassable. This tributary gave the impression of being the end of the *Eclipse* passage, as it had a similar morphology and comparable flow. It will be necessary to plot the topography of the *Eclipse* passage with the polygonal survey to confirm this suspicion.

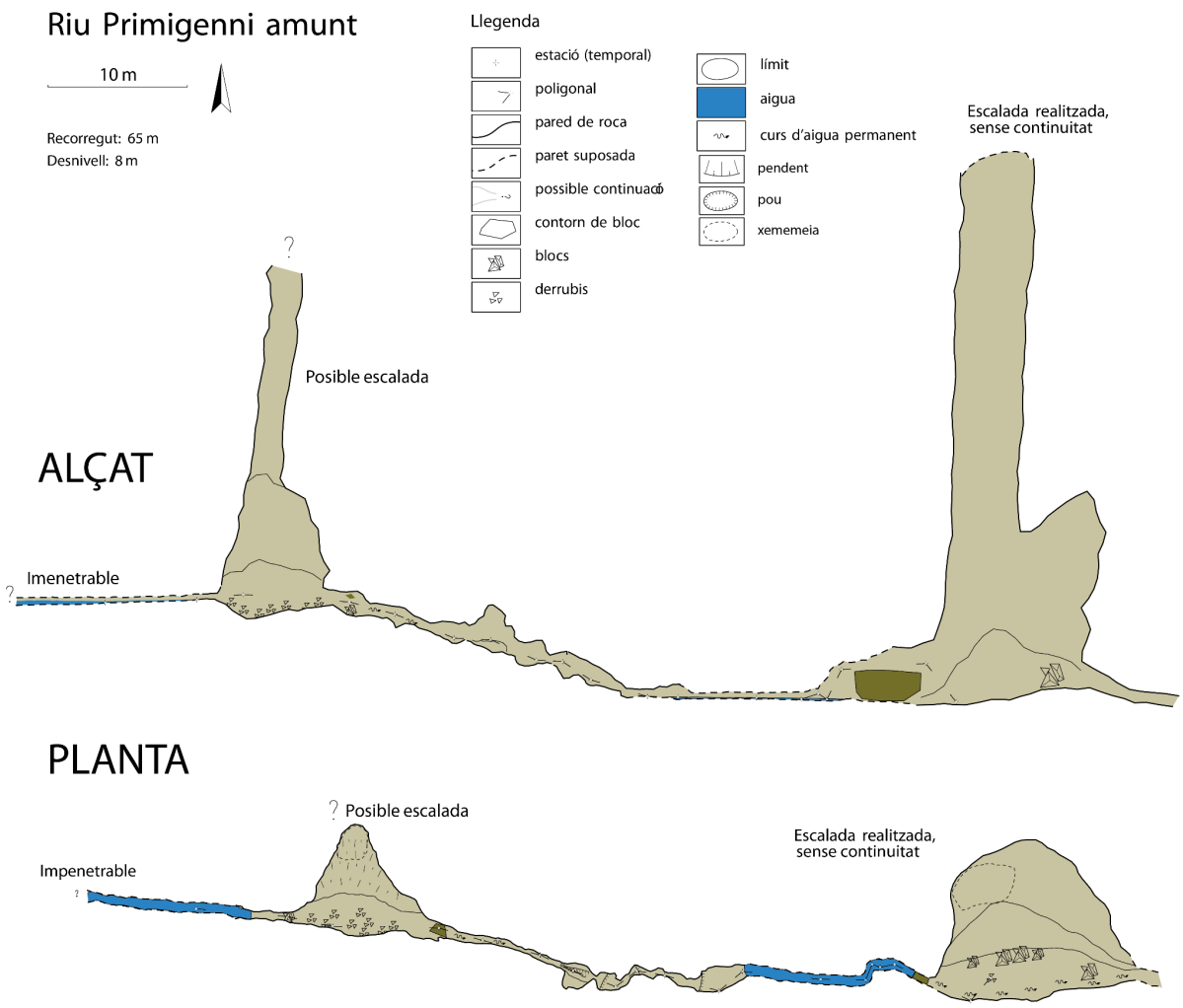

Figure 11. Topography of the Primigeni river upstream.

Exploration in the *Crunxi* and *Riuet Zig-Zag* line

Before the August camp, two speleologists ventured into the S1 with the goal of completing the pending climb at the exploration tip of the *Riuet Zig-Zag*. The intention was to reach a gallery or find a passage that would allow them to overcome the narrow river upstream.

It was late spring, with little snow remaining in the higher areas. During the approach, it began to rain, so it was anticipated that the river's flow would be somewhat more active than usual. However, the surprise was immense upon reaching the *Great Canyon*. The roar of the water was deafening: the *Primigeni* river was carrying a much higher flow than expected. Without thinking too much, we decided to ascend the great waterfall of the river, accessing the canyon in a hurry to try to get as little wet as possible, although it wasn't an easy task. Once at the top, we started the traverse along the *Crunxi* and *Riuet Zig-Zag* ramp. Here, we were also surprised by the situation: the small stream no longer seemed so "small," and the climb was quite soaked. Despite the poor conditions and carrying all the material, we didn't want to give up, so we started the climb, trying to avoid getting dripped on as much as possible.

We completed three pitches of about 15 meters each, crossing sections of poor-quality rock and some traverses. When we finished this climb, we encountered a ramp of about 15 more meters, which we climbed freely, except for two artificial steps that led us into a new chamber. This chamber had a very high ceiling, with shapes similar to those of a cathedral. The rock was less water-eroded, more chaotic, with more collapses, giving the impression that we were close to the surface. Here, we found another small shaft that was left for a future climb.

Figure 12. Exploration in the *Crunxi* and *Riuet Zig-Zag* line. Photos: Lluís Almela.

From the same chamber, among the blocks, we found the option to descend with a rope to a lower level. We descended, and to our surprise, the dimensions of the chamber were much larger. Through narrow meanders, we began exploring the area, which resembled a Gruyère cheese, with many alternative passages. Climbing down and checking the area gave us the feeling that we were above the *Riuet Zig-Zag*. We decided to leave the topography for another effort, as we had already spent many hours exploring, and there was still a long way out and a descent back to the refuge.

This area is particularly interesting because its direction lies outside the known system, trending towards the west. However, the main issue is that it seems to head towards the outside, and on the surface, the terrain is heavily collapsed with blocks and stones, which greatly hinders the possibility of successfully completing this exploration. What is absolutely necessary, however, is to finish the topography of the area and plot it on the polygonal survey to accurately pinpoint its location on the surface. This will allow a better assessment of its significance and the possibilities for further exploration in the future. Once at home, we draw a schematic topography of the explored area, highlighting a route with a notable ascending slope.

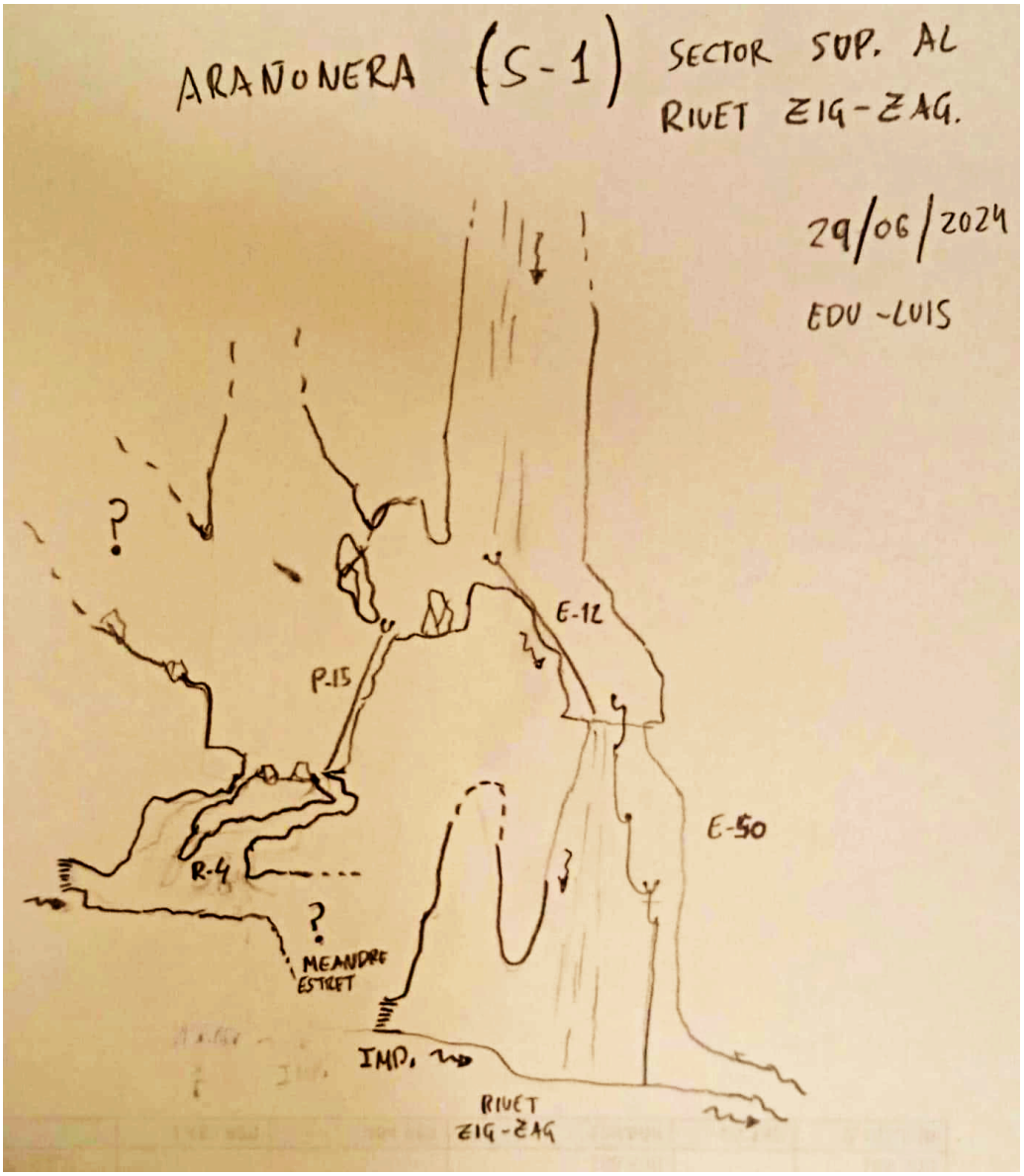

Figure 13. Scheme of the upper sector of the *Riuet Zig-Zag*.

Exploration of hanging entrances on the northern face of the Ripera ridge

The hanging entrances on the northern face of the Ripera ridge were known and spotted a long time ago. They are visible from afar in this remote area of the Sierra del Tendeñera, but they had never been investigated due to the difficulty of access and the distance separating them from other points of interest. Their dimensions are spectacular and very striking, which makes it seem like the right time to explore and verify their potential.

Taking advantage of the advanced camp located at the pass between Tendeñera and Ripera, during the August camp, a small group of speleologists was organized to work on the C10, while another group would focus on exploring the hanging entrances.

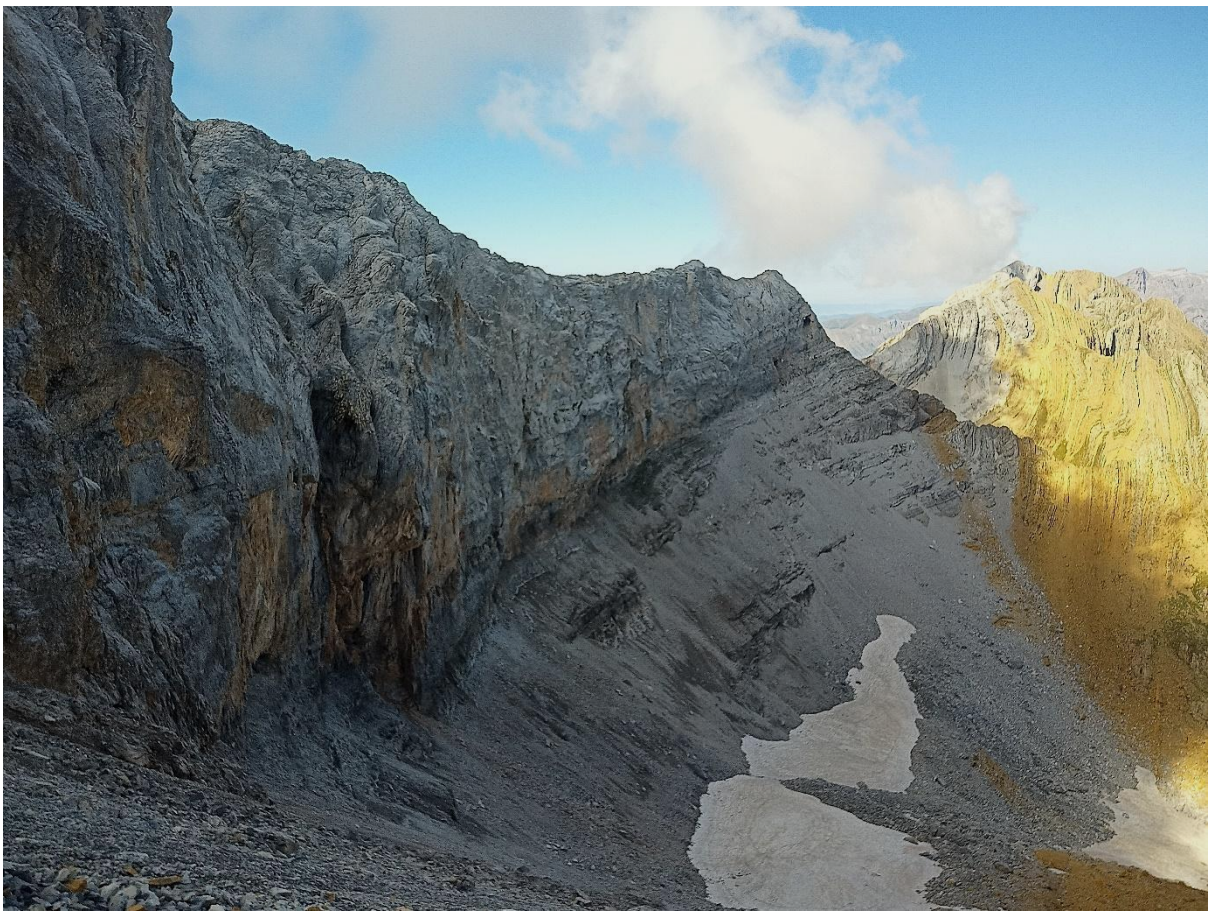

Figure 14. Northern face of the Ripera ridge. Photo: Ana Isabel.

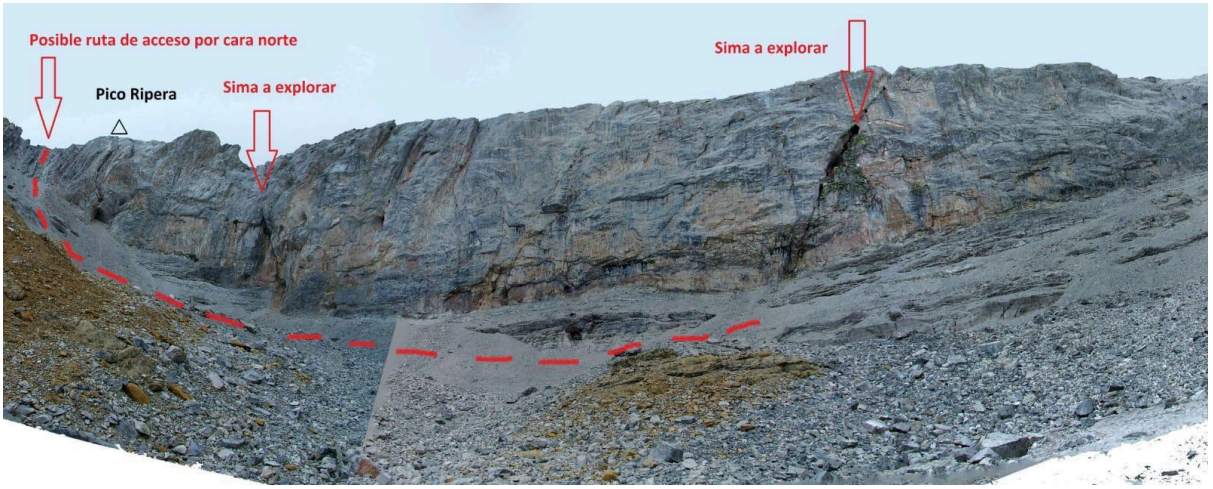

Figure 15. Location of the caves spotted on the Ripera ridge.

Two options are being considered to access the hanging entrances: one is through artificial climbing from the base of the cirque, where the large vertical walls on the northern face of the Ripera Peak ridge begin; the other is from the same ridge through rappelling.

The difficulty of both accesses is unknown, as several factors are uncertain, such as the narrowness and exposure of the ridge, the quality of the rock — which, due to the alpine terrain, tends to be very brittle — as well as the feasibility of reaching the entrances from

above. Additionally, there is uncertainty about the difficulty of locating the exact point to start the rappel, and how to overcome the overhangs on the wall and other additional challenges.

Figure 16. A spotted cave from the Ripera ridge. Photo: Ana Isabel.

GRALLERA DE LA CRESTA DEL RIPERA Nº1

Finally, two speleologists decide to attempt access from below via artificial climbing. They head to the base of the cirque, where they must climb Ripera peak and then descend into the cirque through very vertical alpine ravines with loose rock. Once in the cirque, they need to traverse a steep scree slope until they reach the base of the first large hanging entrance.

The choughs (*Pyrrhocorax graculus*) fly in large groups around the two entrances, which is a good sign. From below, it is estimated that there are about 50 meters to reach the entrance, and a line that could possibly be climbed free, saving a lot of time on artificial climbing. One of the speleologists begins to climb while the other belays. Some protection points are placed to secure the ascent, but the rock is not good. The climber clears the terrain as he advances, and about 20 meters up, suddenly a large rockfall is triggered. A large amount of rocks falls near the belayer, bouncing off the rope deployed on the ground. Fortunately, it is just a scare, but the new rope is damaged in one spot. Due to the danger, it is decided to abandon free climbing. Once back on the ground, artificial climbing is started. However, after 8 meters of height, the drill stops working. Due to the breakdown, the attack is over.

The rest of the day is spent exploring the entire cirque and attempting to access the ridges from the west side. As they progress, they find very exposed passages that allow them to prospect and verify the lack of continuity of some other visible entrances. By chance, they come across a cavity that had been explored in 1982 by the SIE, during one of the first exploration campaigns in the Sierra del Tendeñera. It is a modest cavity known as the *Túnel de las Blancas*, which crosses the Ripera ridge. This discovery will be relevant for understanding how the cavities are distributed in this area of the mountain range.

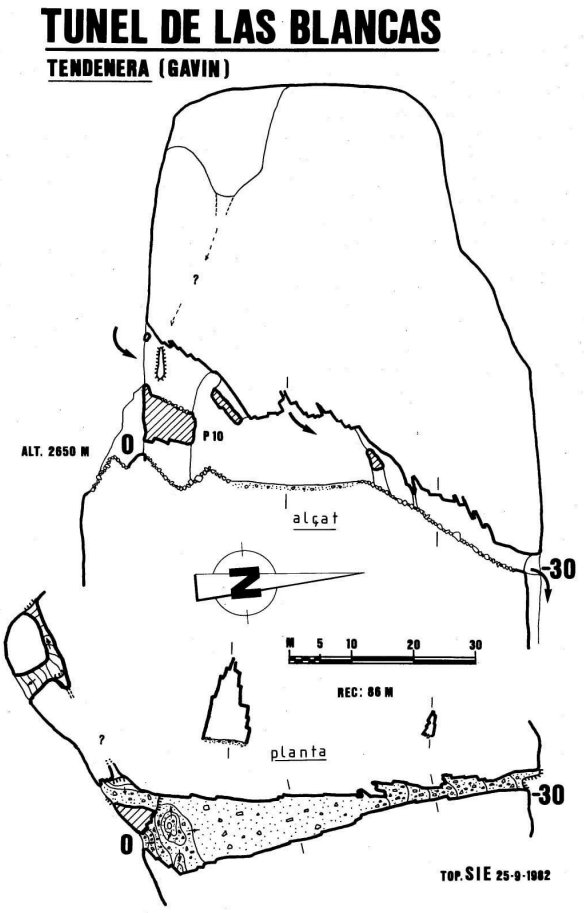

Figure 17. Topography of the *Túnel de las Blancas* (SIE, 1982).

A week later, with the replacement drill and the arrival of a new member to the camp, access is made again to the base of the entrance, and the remaining 50 meters are climbed in artificial style until reaching the entrance. From inside the cavity, several steps formed by water erosion are overcome until reaching a small room. From this point, two large hanging entrances in the ceiling are observed.

Upon noticing the lack of continuity in the cavity, it is concluded that it is a new tunnel formed by the erosion of water filtered from the higher part of the ridge, which has created a ravine that crosses the northern face of the same ridge. This process has created the large hanging entrance through which access was made, so the exploration is considered finished. Topography is then carried out while descending through the cavity, recovering the rope and descending using the double rope technique.

The remainder of the day is spent locating the exact point to start the rappels from the ridge top. The two team members separate, one from the ridge and the other from the base of the cirque, marking the exact point on the ridge using signs and radio frequency. The goal is to attempt access from the ridge to the other hanging entrance the following day. The team member remaining at the base of the cirque takes advantage of the other member's climb to the ridge to locate a known cavity with possibilities for revisiting. This cavity was explored in the 2000s but was stopped due to a high water flow. It is the F1 sinkhole, which is very active at the moment due to the remaining snow in the cirque, so it is decided that it is not a good time for its revision.

Figure 18. Artificial climbing to reach the hanging entrances of the Ripera ridge. Photos: Ana Isabel.

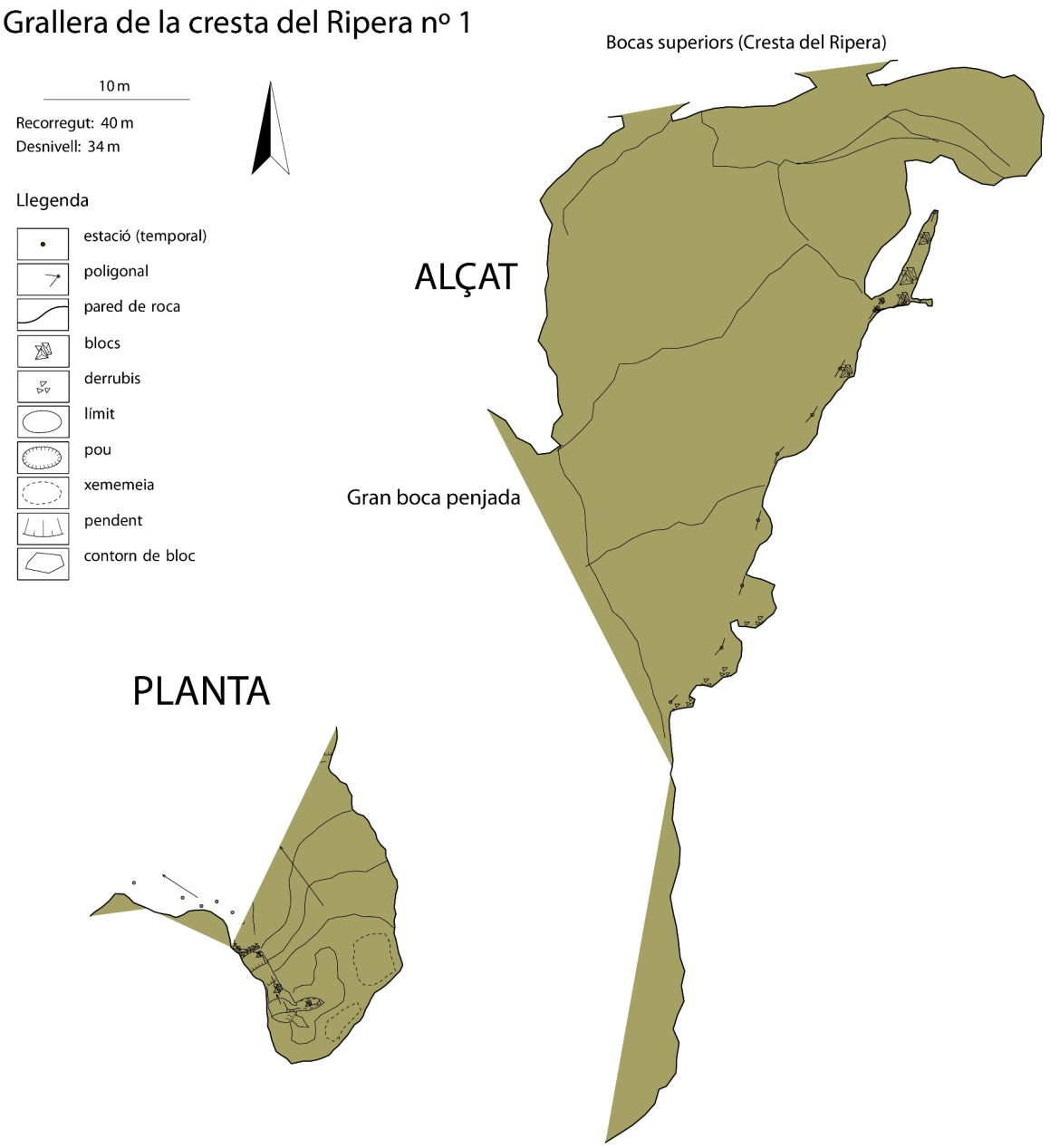

Figure 19. Topography of the *Grallera de la cresta del Ripera nº 1*.

GRALLERA DE LA CRESTA DEL RIPERA Nº2

After the experience of exploring the first hanging entrance and with the confirmation of two already known tunnels on this ridge, it is considered worth attempting access from above. If it were a third tunnel, there could be a possibility of finding the upper entrance.

Access from the ridge turns out to be better than it seemed from afar or from below. The path is one meter wide at its narrowest points, and the southern face is not as steep as expected. Additionally, the rock quality is better than initially estimated.

After several attempts at rappelling, re-installing ropes, and performing pendulums, the team almost reaches the hanging entrance. However, due to the large overhang on the left, the strategy is changed. The decision is made to ascend, disassemble, and try from the right, as this route doesn't present such a pronounced overhang and seems more viable for reaching the cavity.

As the team descends on this new side, they must overcome a large overhang, requiring the installation of four deviators to avoid hanging in the void. After performing several pendulums, they reach a small window very close to the large entrance, through which they suspect access to the main cavity is possible. However, after passing through a narrow section and performing a small free climb, they encounter another narrowing that blocks the way. Faced with this obstacle, they must exit and continue performing more pendulums until they finally reach the large entrance.

Figure 20. Rappelling from the Ripera ridge (left) and the explored cave (right). Photos: Ana Isabel.

Once inside the entrance, we noticed that the characteristics of the cave were similar to those of Grallera Nº1: large steps eroded by water, arranged in two levels at different heights. These erosions appear to have occurred in different periods, with water seeking its path through the softer limestone areas.

Much like the previous exploration, we suspected the presence of a higher entrance, suggesting that this cavity could be the third tunnel in the series. However, the rock quality was extremely decomposed, making free climbing to continue the exploration too risky.

Given these dangers, we decided to create a topographical sketch using several radial lines from the center of the cave to document our findings. Once the topography was completed, the exploration was concluded, and we proceeded to ascend back to the ridge top, retrieving the anchors and ropes used during the descent.

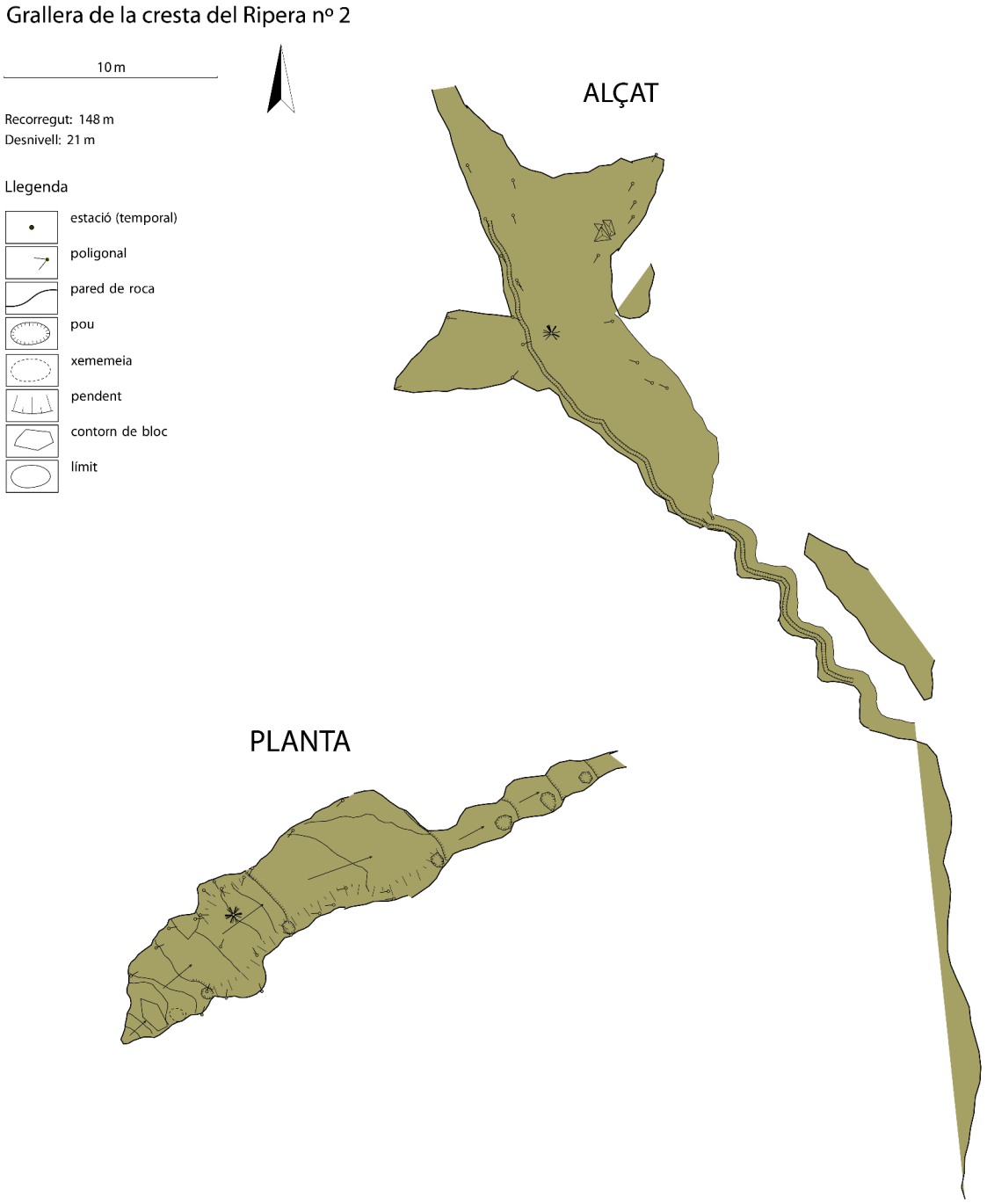

Figure 21. Topography of the Grallera de la Cresta del RIpera nº2.

Exploration and topography in the *Eclipse* line

During the August campaign, we decided to descend again through the *Foratín* (S50) towards the *Eclipse* line, with the goal of closing the remaining questions that could lead to a path to the west of the mountain range.

In the previous campaign, the obstructions in this route had been cleared, reaching a large chamber where what seemed to be a chimney and a small stream at the base were identified, which filtered through a narrow, impassable meander. The plan for this campaign was to perform a traverse from the head of the pit that leads to the chamber and attempt to climb to verify the chimney. Additionally, the opportunity would be taken to complete the topography of the exit route, fully documenting the entire passage and thus leaving the route completely mapped.

Figure 22. Traverse on the Eclipse line. Photo: Maria Prokhorova

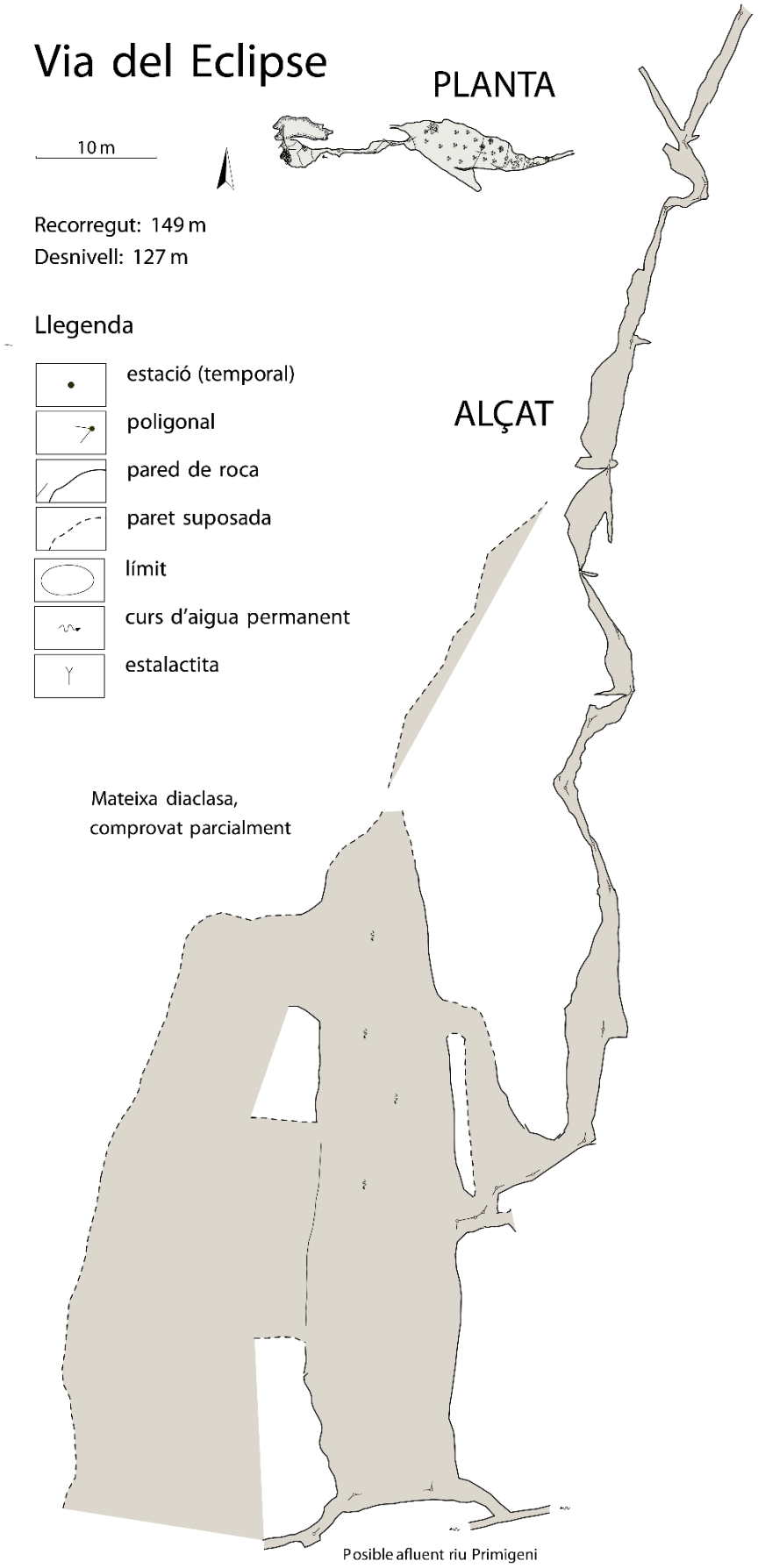

Figure 23. Topography of the *Eclipse* line.

The proposed traverse is carried out, and part of the climbing is completed. After examining the chimney, it is ruled out as a true chimney, as it turns out to be the same adjacent shaft we had come through. Next, an attempt is made to overcome the narrow meander where the water filters through, searching for a passage at its upper part. A traverse is performed from above, using pendulums and reinstallation, but without success, as the walls close in, preventing further progress.

On the way back, all the remaining topography is completed, marking the end of the route. However, the topography still needs to be plotted on the polygonal map, and it remains to be checked whether the small stream found in the final room corresponds with the tributary of the *Primigeni* river, upstream, which was mentioned during the exploration in that area.

Drone survey on the Soaso ridge: the new cave S52

During the camp at Soaso, potential new caves observed the previous day are reviewed using a drone. The area is prospected, and some already marked and explored caves are verified, but a new cave (S52) is discovered. Although expectations are low due to the lack of airflow, it is decided to investigate it.

As rope is needed to descend the first pit, it is decided to return to rest and later return with the exploration gear and the necessary rope. Once on site, the cave is equipped, and topography begins. After descending a series of two pits, the cave ends in a collapse due to a rockfall. The topography is completed, and the cave is then de-equipped.

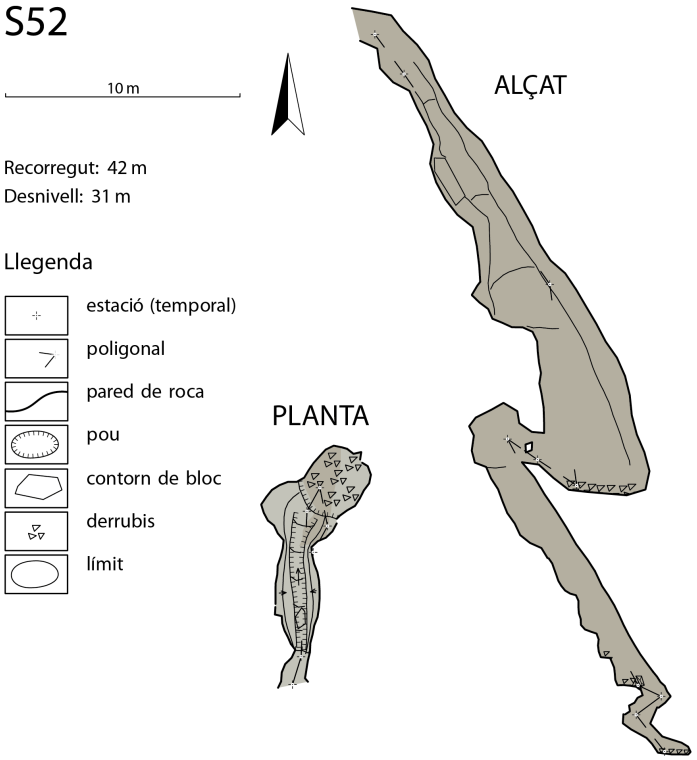

Figure 24. Topography of the S52.

Review and exploration of S25

During the August camp, two attempts were made on S25, following the same approach as in previous years: continuing to rule out the closest uncertainties regarding the potential connection of the pit with the system.

The first attempt involved artificial climbing in the chamber nearest to the possible connection, located at the westernmost part of the cave. The climb was short but very overhung. The top was quickly reached, and through free climbing using the "ramonage" technique, significant progress was made. However, the lack of airflow and the ascending direction toward the surface led us to discard this option, as it did not offer any further progress for the main objective of the exploration.

Another unresolved question was to continue the climb beyond the blockage that was cleared during the campaign two years ago in the same section of the cave. After evaluating the passage, no signs of airflow were found in that area this year, leading us to discard this option as well.

Figure 25. Artificial climb in the S25.

In this way, we thoroughly rechecked the western sector of the chamber and found a new passage with airflow, although it was blocked by stones. The decision was made to spend the rest of the day starting the process of clearing this passage to evaluate its viability. The

obstruction is a ramp, similar to the one in C10, but with a low ceiling, so a small dam was built to prevent the ramp from collapsing and blocking the passage while work was ongoing.

The next day, a team continued with the unclogging work. However, a partial blockage occurred in the area being worked on. The work area proved to be very uncomfortable due to the low ceiling and the steep inclination of the ramp, which made progress considerably more difficult.

Unblocking a blower hole

During the final days of the summer camp, a blower hole is discovered between blocks on a wall near the Soaso camp. Taking advantage of free moments and some spare days, efforts are made to try new unblocking methods and assess the viability of this work. Although the team is reduced towards the end of the campaign and some members are already quite fatigued, the work remains interesting, and the available days are maximized. However, the unblocking is not completed during this campaign.

Cleaning of the Arañonera cave system through the S1

During the last two campaigns, the *Somnis de Glòria* collector was reviewed, and the new *Groga* line was explored. To access this sector, the team used the S1 shaft, reaching the bivouac at -600 meters in the S1 gallery, from where they could access the collector and the start of the Groga route, located at -900 meters depth. During these explorations, it was necessary to re-equip many sections of the cavity. Due to the difficulty of the shaft and the limited personnel, it was not possible to remove the old ropes, which were also wet and muddy, increasing their volume and weight.

Additionally, a large amount of accumulated garbage was identified along the entire route up to the bivouac at -600 meters, remnants of past explorations that had not been removed. This highlighted the urgent need for a large-scale cleanup of the entire sector. As a result, a cleanup day was organized, open to the entire speleological community, for June, with the goal of removing all accumulated trash.

First Cleaning Attempt (April)

In April, two members of the team carried out the first cleaning attempt under winter conditions, moving a large amount of garbage from the bivouac at -600 meters to -240 meters, at the base of the S1 shafts, although no load was carried on the return trip. This first contact with the task revealed the complexity of the work and the large amount of effort it would require. Furthermore, the last spring snowfalls had covered the south face of Tendeñera with snow up to 2000 meters, an unusual phenomenon for this time of year, which forced the cleaning to be postponed until September, ensuring there was no snow left in the area. On the other hand, the opportunity was used to assess the need to re-equip some sections of the S1 shaft, which were in precarious condition to handle a massive influx of speleologists.

Figure 26. Cleaning campaign in the S1. Different obstacles to overcome in the S1 gallery during the transport of waste between -600 m and -240 m, derived from past explorations in the Arañonera system. Photos: Anastasia Yanina and David Fabregat.

Second cleaning atack (May)

In May, a team of 5 speleologists (2 members of ECMB and 3 collaborators from clubs in Castelló, Comunitat Valenciana) completed the cleaning in the sector between the bivouac at -600 m and the base of the S1 shafts. All the remaining waste was transported, leaving the entire route to the base of the S1 shafts completely clean. With this step, the final removal of all accumulated waste in the S1 was postponed until September, up to the entrance of the cave.

Re-equipping the S1 (August)

During the August campaign, a team of 3 speleologists dedicated 3 days to re-equipping the S1 shaft, improving some sections and making the cavity completely safe for the influx of more speleologists. Additionally, some previously uncomfortable sections were made more accessible, ensuring the shaft was in optimal condition for future activities.

Final Cleaning Day (September)

Finally, during a weekend in September, the last cleaning work took place. A team of 12 people, all ECMB members, along with a Russian collaborator, carried out the final removal of the waste. The result was a great success, as 15 bags, each weighing between 11 and 13 kg, were removed, totaling approximately 180 kg of waste. All the waste was evacuated by helicopter to Linás de Broto, where it was transported by vans and properly recycled.

Figure 27. Completion of the S1 cleaning campaign in September.

Waste Removed: ~180 kg

- Old ropes and anchors
- Carbide remnants and unused carbide
- Various plastics
- Stoves and gas canisters
- Kitchenware
- Food can remnants

7. Funding

The 2024 exploration campaign has been financed through (i) contributions from the speleologists participating in the campaign, (ii) the Espeleo Club Muntanyenc Barcelonès, which provided part of the necessary equipment, (iii) a grant from the Catalan Speleological Federation (FCE) designated for exploration campaigns, and (iv) the EuroSpeleo project of the European Speleological Federation (FSE), which contributed 200 meters of rope sponsored by KORDA'S and a financial grant to cover part of the costs of the 2024 campaign.

Financiamiento (€)	
Participantes	+2.960
Espeleo Club Muntanyenc Barcelonès	+2.090
Federació Catalana d'Espeleologia (FCE)	+900
Federación Europea de Espeleología (FSE)	+800
Total	6.750

Costes (€)	
Helicóptero	-2.200
Alimentación	-1.870
Material	-2.680
Total	-6.750

Helicopter transport for the August camp typically represents the largest expense of the campaign, followed by the base camp (food, gasoline, logistical material) and the purchase of technical equipment. In order to reduce costs, this year only two helicopter trips were made for the ascent, one for each camp (Soaso and the Ripera-Tendeñera pass), and the campaign closure was carried out with portage on foot. Some of the heavier and less delicate equipment was left behind to be transported by helicopter in September, along with the recovered waste during the cleaning campaign.

8. Acknowledgements

We would like to thank the collaborating organizations for their financial and logistical support (Catalan Speleological Federation (FCE), European Speleological Federation (FSE), and KORDA'S), without which the 2024 campaign would not have been possible. We also thank the Aragonese Speleological Federation (FAE) for providing the exploration permits in the Sierra de Tendeñera. The results of this year are the result of a remarkable human team, formed by speleologists from multiple clubs and nationalities. Many thanks to all the participants.

Figure 28. Panoramic view from the Soaso base camp. Photo: Xavi Garza.


ARAÑONERA 2019