

SUPPLEMENTARY MATERIAL – S3

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TOPOGRAPHICAL DESCRIPTION OF ATXURRA CAVE SYSTEM

(summarized from Arriolabengoa et al. 2020; Garate et al. 2020a; Medina-Alcaide 2020; Rios-Garaizar et al. 2020)

The cave has two horizontal levels; the lower one is called Armiña, and the upper one is called Atxurra. Both are part of the same endokarstic system; the total topographical development of the cave system is 1085 meters (Fig. 1).

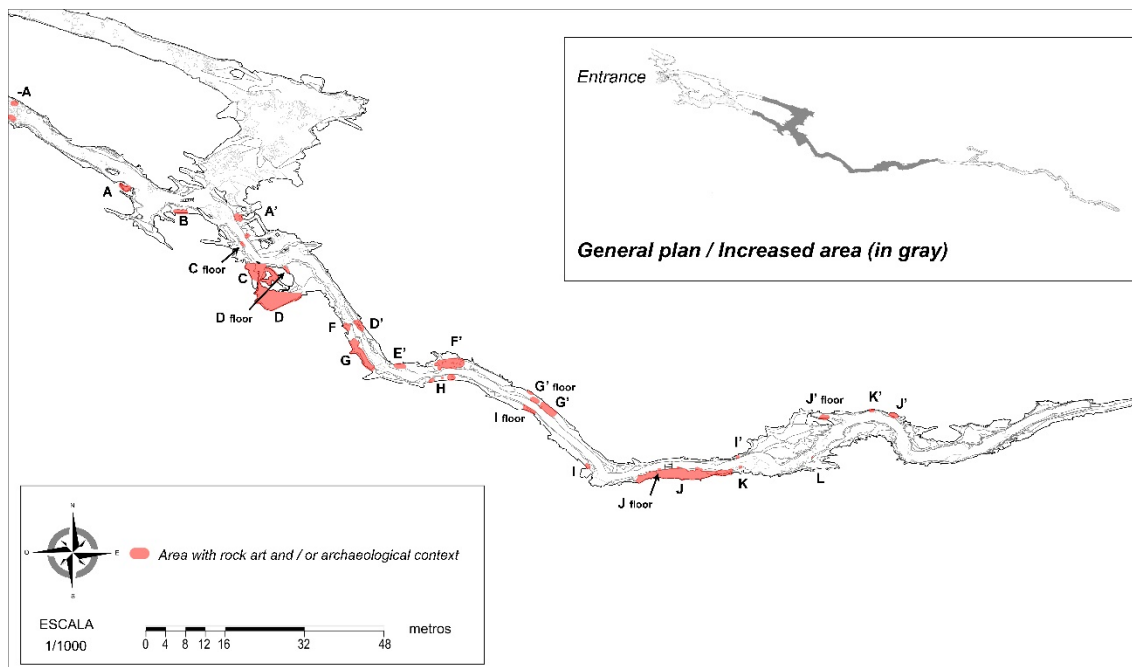


Fig. 1: Topographic plan of Atxurra cave showing the different areas with rock art and / or archaeological context. Modified from Gim Geomatics S.L.

Upper level, Atxurra

The original and the ancient access point to the cave system is situated to the west of the upper level, has a triangular shape, dimensions of 2 by 1.5 meters, and faces the southeast. There, a reduce vestibule (8.30 meters long by 2.46 meters wide) can be found; archaeological remains show at least 2 meters of sedimentary deposit developed during at least the last Pleistocene (from Gravettian to Holocene frequentations). The Upper Magdalenian units are located between 60 and 100 cm deep the current surface level, and covered by flowstone formations. After crossing this space and going through a small window, we reach the inner sector of the cave. At this point, 17 meters deep from the entrance, there is a very pronounced ramp which has a length of 15.03 meters by an average wide of 1 meter and descends vertically 10 meters, connecting with the lower level of the cave (Armiña). Further on, the passage of the upper-level continues with low, irregular ceilings that lose height until it reaches a several-metre-long tunnel that has to be crawled through. The current ground level there is formed by an inactive flowstone with a 15-30 cm wide (tested by a sounding) and dated in late Holocene. We have found thin fluviokarstic sediments with some scattered charcoal below them and thus demonstrating that this passage was easier to transit in the period during which the inner part of the cave was decorated. The flowstone ends after this crawlway, and subsequently, there is a large passage with the floor composed of fine clastic sediments. There are also deposits of bat guano produced mainly by *Rhinolophus Ferrumequinum* and *Rhinolophus Euryale*.

The next part of the floor of the passage is characterized by dens of cave bears, and before reaching the second connection with the lower cave level -Armiña-, the roof has partially

collapsed along bedding partings. Here, there is a section of the upper level passage (called **sector -A**), 10 meters long by 3 meters wide, at most, and an average height of 2.4 meters. It is located about 43 meters before the first decorated sector (Sector A). The walls and ceilings are made up of stratified limestone intercalated with small deposits of flint. Some of these might show signs of having been mined during unknown time periods. There is no cave art in the sector.

The connexion between both cave levels is located at a distance of 203 meters from the entrance and is formed by a collapse of the intermediate rock, partly due to the fact that this area is crossed by the stratigraphic limestone with siliceous nodules, causing a rockfall from the stratigraphic bedding. The decorated zone also begins here (**sector A**), 10 meters before the union between Armiña and Atxurra with a first depiction hidden in a small phreatic-tunnel located in the lower part of the right wall. It is part of a small network of channels formed by hydraulic erosion. It has an access of 1x0.5 meters that gives rise to a reduced space of about 1.2x2 meters.

The wall is very porous in its entire surface except in the central area of the niche, at medium height, where the polishing of the bears has probably smoothed the surface and that is where the decorated panel is located -it contains a badly made depiction of an indeterminable zoomorphic, perhaps a cervid.

Lower level, Armiña

Nowadays, accessing the system is done by using the lower level's artificial entrance (Armiña). This level is formed by a large passage with a relatively horizontal floor (except for the last part, where we can find a series of bear dens), which is stable for its extension of about 200 meters. In its final stretch, it connects with the upper level (Atxurra).

The general morphology of the passage is almost the same throughout the cave level -a large passage with regular dimensions of (4 by 4 meters)-, but there are differences at two points:

One is at the entrance, where there are at least two colluvial cones of matrix-supported heterogeneous clastic sediments filling the passage from the outside. The current entrance of Armiña has similar morphologies but was opened by roadworks in 1882. Close to this point, there is evidence of a **sporadic human occupation** dated in the Upper Magdalenian cultural period, suggesting that this entrance was isolated from the outdoor, with humans entering from the upper level's entrance through the endokarst. The set is made up of a small fire, an ochre stain and a set of lithic tools, in addition to a very few remains of fauna. The unit, containing the archaeological remains is located 30/40 cm deeper than the current surface, covered by flowstones and sterile fluviokarstic thin sediments, without allochthonous sediments (there is also a modern debris).

The other different part starts in a crawlway located in the final sector of the lower-level, there is a channel-shaped erosion in the flowstone that covers the floor, revealing a centimetric allochthonous pebble-supported deposit below this.

Upper level, decorated zone

The area with rock art is located in the upper level of the cave system, between 186 and 365 meters deep. The roof is located between 6 and 10 meters above the floor, and where the vadose speleogenesis has not overprinted earlier forms, it is characterized by a ceiling channel. The passage is 2 – 4 m wide, and is covered by horizontally developed decimetric to metric notches. On both sides of the normal route and at a variable height of 2 to 6 meters, small side ledges can be found. It is on these ledges (but also in some zones at the floor level) where all GUs and the IAC remains on the surface are concentrated.

Sector B: The sector is comprised of a ledge 4.7 meters long by 0.8 meters wide that rises 4 meters on the south wall of the upper passage. It contains a section 1.9 meters long and 0.5 meters wide, where some anatomic prints have been found, made by pressing the heels (surely) or the elbows against the clay. The support is patinated, which could probe its antiquity, but its anthropic attribution is not certain. There is no rock art in the sector.

Sector A’: This is a 2.1-meter-long and 1.7-meter-wide ledge that is raised 2.4 meters above the ground. It is located 216 meters from the natural entrance of Atxurra, very close to the chaotic downward-tumbling pile of blocks that connects to the end part of the lower floor (Armiña). It contains several scattered charcoals (some of them of great size) very well preserved in clay. Does not contain parietal art.

Sector C floor: Going to sector (Sector C), when the path to the sector C begins, there is a wall located in the lower part of the passage (with a wide of 1.94 meters and 8 meters high), where a rock art panel is located, containing a non-figurative ensemble of engraved lines.

Sector C (Alcove of the claws): If we continue 12.2 meters towards the east from sector B, we find a set of suspended spaces 5.67 meters above the right side of the passage. Two areas are distinguished in this sector: a main area of 3.4 by 2.4 meters; and an ascending passage giving access to a reduced tunnel and a small lateral room. Both spaces contain rock art.

The current access to reach the sector implies a first climb of 2 meters helped with a fix stair, but that can be made also traversing¹, in a kind pronounced slope. Once reached an intermediate ledge, the path continues ascending in a pronounced flowstone, fully exposed to a fall of almost 5 meters. Currently, this path is equipped by footholds and a security rope. Over this path, there have been found two scattered charcoals, one of them identified as Juniper wood.

The first space is opened like a ledge raised 5.67 meters above the ground. However, a stalagmite column "closes" this space, as a protection towards the abyss, forming a small room of about 8.16 square meters. Here, an eroded large flowstone, fully covered with bear claw marks, covers the W side of the room. The first panel is located here, containing a very visible ensemble of 12 engraved GUs, with goats, bison (wounded) and a horse. On the E side, after overcoming a 1.5-meter drop, there is access to another space made up of a tunnel and a small side room. Panel II is located just over the first slope, on a kind of ledge that leads to the aforementioned room (where panel I was located), containing 3 engraved bison. Panels III and IV are located in the subsequent tunnel, on both sides of the extremely small passage that leads to the final small room (here only two people squat), where the V (in an eroded flowstone similar to the support of panel I) and VI (on the ceiling of the room) panels are located. In these areas there are several small engraved bison (some of them wounded), in addition to some goat figures. The ground of this sector is also fully covered with scattered charcoal remains.

Sector D floor: Going to the next sector (Sector D), before reaching the main area of the Sector D, there is a small cornice (2.90 meters long and 1 meter wide) where a rock art panel is located, containing the remains of two engravings.

Sector D (Hall of the Bison): We find this sector by continuing east 5.7 meters; it is separated from the previous space (sector C) by a flowstone 1 meter thick, which would have already existed in the Upper Palaeolithic, seeing as how it has engraved surfaces. This assertion was confirmed by a radiometric dating of the most superficial part of the speleothem. This is a semi-circular space with a low roof, 5.5 by 1.9 meters in size, which can be accessed easily ascending by traversing to a ledge on the right side of the passage, and entering in a small diverticulum.

¹ Usual movement in caving, applying opposite forces to the two walls.

On the south and southwest limits of the room, there is a limestone wall/ceiling, which contains several planes on which the engravings were made, containing some figures of deer, horses and especially bison. Over the ground there were found several scattered wood charcoals remains, as well as a sandstone pebble with signs of abrasion, possible anthropic impacts and combustion residues has also been identified, interpreted as a portable lamp, through an interdisciplinary analysis.

Sector D’: Going to towards the deepest of the cave, there is a narrowness of the passage, forcing to ascend to a cornice 8.89 meters long by 1 meter long; or to passing it below the platform, along a floodable winding tunnel. In any case, the underpass appears to have been opened during the last century.

In the upper part, the soil is uneven, interspersing small platforms with flowstones and shafts falling over the underpass, allowing the movement over them by traversing. Over two cornices located in the left wall, there are two panels with non-figurative and undefined animal engravings.

Sector F: In the middle part of the last sector (Sector D’), but in the opposite wall and elevated 2 meters above it (and 5 meters above the floor level), there is located a small cornice (2.20 meters long by a width of 1.29 meters) containing a single engraved figure of a bison. The access to reach this sector is difficult and dangerous, with real danger of falling.

Sector G: This is a 5.3-metre-long, 1.7-metre-wide ledge positioned on the south wall of the passage, at 2.23 meters above the floor. Access is made by progressively ascending by exerting pressure on the two walls (by traversing). It contains two niches and a wall where there are various engraved figures of bison, goats, a horse, an aurochs and a figure with features of bear and reindeer. There are also some black and red stains, and in the soil, there has been found a scattered charcoal.

Sector E’: Continuing the last cornice, in the final part, it is possible to cross above the lower part of the passage, making a little jump of 1 meter to reach another cornice located in the opposite wall. It has a tunnel like form, because it is delimited by lithotomical columns and it has some red stains in the walls.

Sector F’: Continuing towards the east, 12.7 meters from the previous sector, we find a ledge that is 9.8 meters long and 1.9 meters wide, located over the left side of the passage at 2.4 meters from the floor. There are several possible ways to reach this cornice, but in all cases, they require to climb a vertical wall of 2 meters. Here, hanged over the passage there is a small calcite platform, which works like a bridge between sectors H and F’.

From this platform, to the left, there are various areas delimited by lithochemical formations, closing the space like a small-size-tunnel. Here there are several small engravings of ibex, some unfinished small bison (mainly wounded) and projectiles. Over the ground, there have been found some scattered wood-charcoals.

On the right, towards the interior of the cave, the cornice is narrower and is fully exposed to the lower part of the passage, 4.5 meters more below. Here there is a dangerous path to reach the next sector (G’), and in two points of this way, on the left wall, there have been found some non-figurative engravings.

Sector H: It is located in front of the preceding cornice and connected to it via a bridge formed by a stalagmitic platform; it is 5.7 meters long and 0.7 meters wide and is located raised 3.5 meters above the lower part of the passage. It contains three GUs placed on two panels: the first one, composed by two engraved goat figures, is placed near a big stalagmitic column. Crossing a dangerous cornice, fully exposed and currently equipped by a security rope, it is possible to

reach a small size niche, where an engraved goat can be found. Over the path to reach this sector, there have been found several scattered charcoals.

Sector G’: This is a ledge situated 14.7 meters to the east of sectors F’ and H, 3.5 meters above the floor level and with dimensions of 7 meters long and 0.7 meters wide. On the most uncomfortable and dangerous side of the cornice, in an area with very few footholds and practically hanged 3.5 meters above the ground, stands the only figure in the sector, an engraved goat. Nowadays it is somewhat damaged by carbide smoke, caused by the passage of cavers by that exposed step, but in the Upper Magdalenian it occupied a dominant position on the passage, located just above two groups of engravings (G’ floor and I floor).

On the left side of the figure, there is a more comfortable shelf to be in, where a flint sheet and several wood-charcoals have been located.

Sector G and I’ floor: Under the last sector (G’), in the current cave floor level, where the passage measures 1.68 wide by 6.22 meters high, there are located rock art panels in the both walls of the passage. The first contains at least one bison and other undefined animal figures, and in front of it, the other wall contains several undefined animals with an outstanding hairy horse. All GUs are very damaged by the graffiti of the early twentieth century because of their unusual location (in the lower part of the passage, the most affected areas in the cave).

Sector I: Elevated 3 meters above the cave floor level, there is located a small cornice which contains a single non-figurative engraved line.

Sector J (Ledge of the Horses): This cornice is located 46.1 meters from the preceding sector and 3.39 meters high on the south wall of the main passage; its dimensions are 12 by 1.2 meters. It contains two different large panels with rock art. The floor is full of archaeological remains of all kinds (hundreds of charcoals remains and more lithic tools, chips and fragments were recovered). There are also some remains of hearths made on the floor, just below the most outstanding figures of the second panel.

The access to reach the panel is made by the side furthest from the entrance, because the slope there is less-steep.

The first panel that exists as we enter the deepest part of the cave contains a black painted bison, partially covered in calcite, visible from the lower part of the passage.

The second one is a 12 meters fully decorated wall, although the conservation of the motifs, as well as the nature of the support, is not kept uniform. Starting from the bottom, but where the ledge is accessed; it begins with a small niche in which a few small figures (a bison and ibex) are distinguished. Later, on some pendant-type formations, two disfigured goats were drawn, but in a kind of symmetry with respect to a vertical axis. On the lower side there are more engravings, among which a hind with striated zones in the head and chest zone stands out. Continuing along that plane, we will observe a deer, a hind-head and a bison, in addition to other undefined GUs, to reach the central point of the ledge, where a niche defines a space where at least two bison are observed, one of which (the smallest), stands out for containing around thirty projectiles inside. Beneath are a schematic horse head and two undefined figures, as well as a multitude of other lines that are difficult to discern. On the exposed face of the shelf, above these last GUs stands a pendant with 12 ibex and an undefined figure, two of which are in frontal perspective. Subsequently, the last sector is accessed, where an intense superposition of figures is observed, most of which are bison, among which stands out for its size a bison full of fur and wounded with a multitude of projectiles, one of which has the shape of an arrow. Beneath them we can distinguish a hind, a horse, an indeterminate figure and a pretty goat. In the upper part, two splendid horses stand out, in addition to an indefinite figure

with a long neck and facing upwards. The panel ends with a beautiful bison, wounded, and an undefined figure at its bottom, probably another bison facing in the same direction as the previous one.

Sector J floor: Under the last sector (J), at the cave floor level, where the galleries measures 1.58 meters wide by 6.62 meters high, there are three panels with non-figurative lines located in the same wall which supports the cornice of sector J.

Sector I': This is a small niche suspended 1.5 meters above the floor on the north wall of the main passage, which measures 1.4 by 1 metre and is located 4.4 meters from the previous sector. Here, on a clay bench, over a patinated surface, there is the print of a hand, of unknown chronology.

Sector K: This is a kind of ledge, 1.3 meters long and 0.6 meters wide, which is located opposite the preceding sector, one metre off the floor; it contains a small niche that is 0.3 meters wide and 0.4 meters deep with a print of a finger over a patinated argillaceous surface.

Sector L: This is a stretch of passage that is 4.3 meters wide and 15 meters tall (from here you can see a kind of upper level that is inaccessible from the current floor level), the surface of which is covered with many pebbles. There is also evidence for a small seasonal flow of water that precipitates in a narrow vertical sinkhole, found on the north wall of the passage. On the right-side wall, there is a small stretch of floor whose patina tells us that it has barely been altered; here a finger print has been found.

Sector J' floor: Before reaching the next sectors (Sector K' and J'), there is a small diverticulum in the left wall of the passage, close to the floor level. It measures 5 meters long by 0.98 meters wide and 1.23 meters high. Here are located two small and unfinished engraved horses.

Sector K': Under the next sector (Sector J'), at the floor level, where the passage measures 2.78 meters wide and 4.25 meters high, is located a small panel with non-figurative GU. This is the last found GU in the cave.

Sector J': This is a side ledge located on the north wall of the main passage 2.1 meters from the floor; it measures 2.3 meters long and 0.6 meters wide and is found 29.8 meters to the east of Sector J. Access is impossible without the help of another person or a ladder. It is a very small shelf containing two charcoals. We do not know if these fragments fell from a torch located in the passage and were deposited on the shelf, or if this shelf was really frequented, but in any case, it does not contain or conserve rock art

Thirty meters deeper, but in the middle section of the upper level, there is a vertical speleothem formation, covering almost the entire passage. This has been partially broken at a height of 3 meters by cavers to allow further exploration of the cave deeper into the mountain, through a narrow passage. No rock art (or other archaeological remains) has been found in the cave portion (with extends approximately 600 meters) beyond this gravitationally-formed speleothem.

MEASUREMENT OF COSTS AND ESTIMATION OF LEAST-COST PATHS TO STUDY THE PREHISTORIC HUMAN TRANSIT IN ATXURRA CAVE

Geomorphological and archaeological research concluded that the current artificial entrance of Armiña cave-level (opened by roadworks in 1882) was closed (or was very difficult to access for humans) during the Upper Magdalenian (when the cave art was made), so the only known way to access to the deep parts of the cave was the entrance of the upper cave-level of Atxurra, where some occupation layers of Upper Magdalenian are known.

However, there are several ways to reach the deep parts of the upper level (where there are placed the GUs):

- Going through the upper level.
- Descending to the lower level, transiting it to the end, and ascending again to the upper level in its final part.

Geomorphological study has pointed that the crawlway located in the middle part of the upper level, going through decorated areas, was easier during the Upper Palaeolithic, because the 15-30 cm of Upper Holocene litochemical deposits didn't exist.

In addition, the sporadic occupation detected in the Armiña cave (lower level), has been dated to the same time estimated for the rock art, and as it does not seem to have had a functional motivation (being located in a deep zone of total darkness), some kind of relation with the GUs located in the deep zone of the upper level cannot be discarded.

So, we have made the cost analysis (including the estimation of LCP) of several possibilities:

- From Atxurra Habitat site to the GUs and the IAC.
- From Atxurra Habitat site to the ephemeral occupation of Armiña.
- From ephemeral occupation of Armiña to the GUs and the IAC.

However, as the galleries overlap in the entrance area, we first had to sectorize the analysis of this part (Fig. 2).

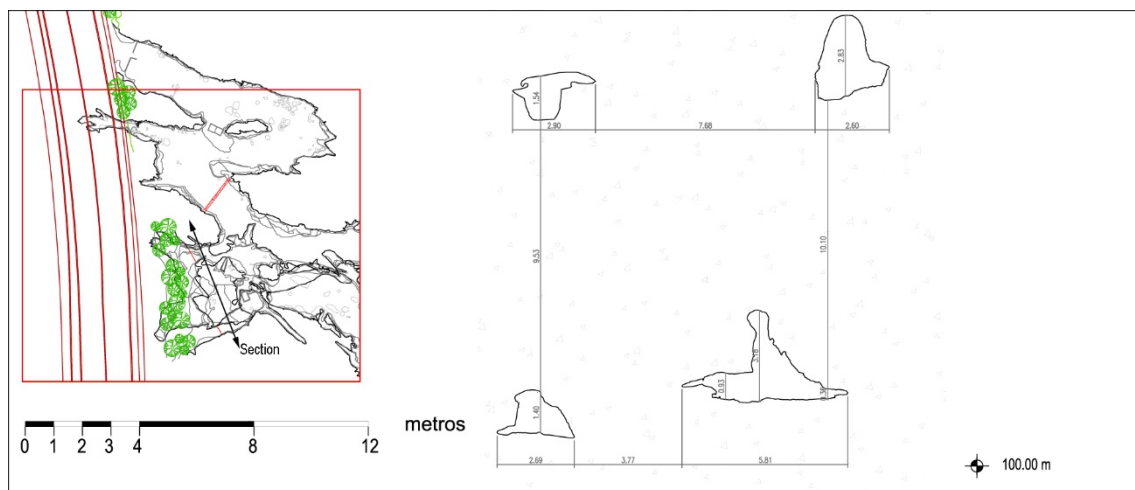


Fig. 2: Entrance areas of the cave, showing the overlapping between two levels: Atxurra cave (in the upper part), and Armiña cave (in the lower) (Gim Geomatics, SL).

For it, and since there is a vertical shaft between both cave levels close to the entrance of Atxurra cave (in the subsequent hall to the vestibule), which was possibly used by humans to descend to the zone of the ephemeral occupation of Armiña, we have estimated the cost and the

LCP between the habitat site of Atxurra and the start of these shaft, and from there, the paths to Armiña and to the inner part of Atxurra, in sectorised analysis (Fig. 3).

To establish a starting point and destination points in the areas of habitat and ephemeral occupation of Armiña, we have traced centroid points in those sites, to use as shapefiles in our script.

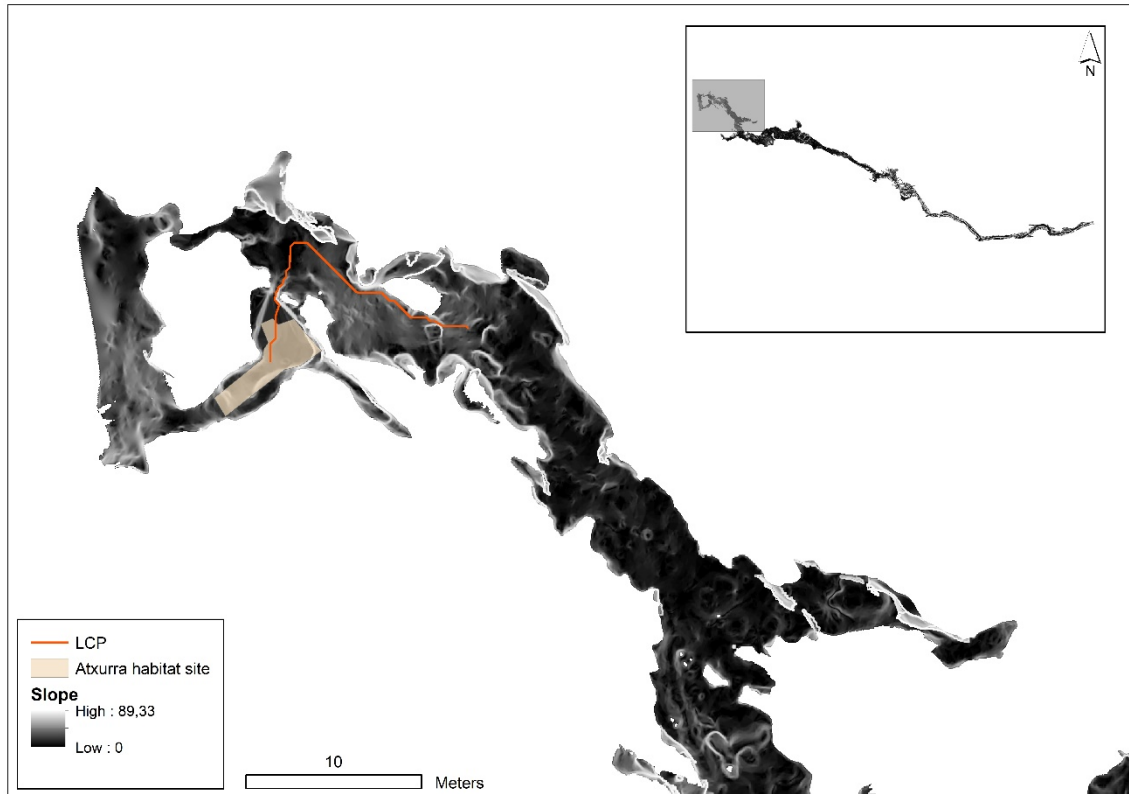


Fig. 3: Sectoring analysis in the outer parts of the Atxurra cave. LCP between the habitat site in the entrance and the start of the shaft which connects with the lower cave level (Armiña). Later, we have used this destination point (the start of the shaft), to analyse the several options to reach: the ephemeral occupation of the lower level, the rock art and the archaeological evidences found inside the cave.

DESCRIPTION OF THE OBTAINED LCP

The results show, as the geomorphological research previously pointed, that the optimal path to reach the decorated zones in the Upper Magdalenian was through the upper cave level (Fig. 4).

The estimated LCP coincides mainly with the one used today to reach the decorated sectors. Geomorphological study pointed that there are not great changes in the main part of the cave since when it was frequented and decorated in the Upper Magdalenian, so it is interesting to see that the path currently used to reach the panels (in our opinion the optimal) coincides with those estimated by GIS using our cost algorithms. However, in two cases we have some differences:

- The estimated LCP to reach sector H is placed few meters deeper than nowadays, using a fissure with a pronounced slope. Further on, the path continues through a very narrow and exposed cornice.
- The estimated LCP to reach sector G', goes from the sector F', using the cornice. However, nowadays, we prefer ascending from the same wall containing the GUs of sector G' floor. Indeed, there are many footholds that facilitate the climb, and it seems that this could have been the path they used in the Upper Magdalenian, since where this climb ends; flint sheet and scattered remains of charcoals were found, in any case, this is not a definitive argument, because over the LCP estimated by GIS there are also some non-figurative engraved lines.

It is striking that the estimated LCP to reach IAC remains coincides also mainly with the one to reach GUs. It seems to confirm that the estimated LCP coincides also by the paleo-paths used in the Upper Magdalenian to access to the decorated sectors (Fig. 5).

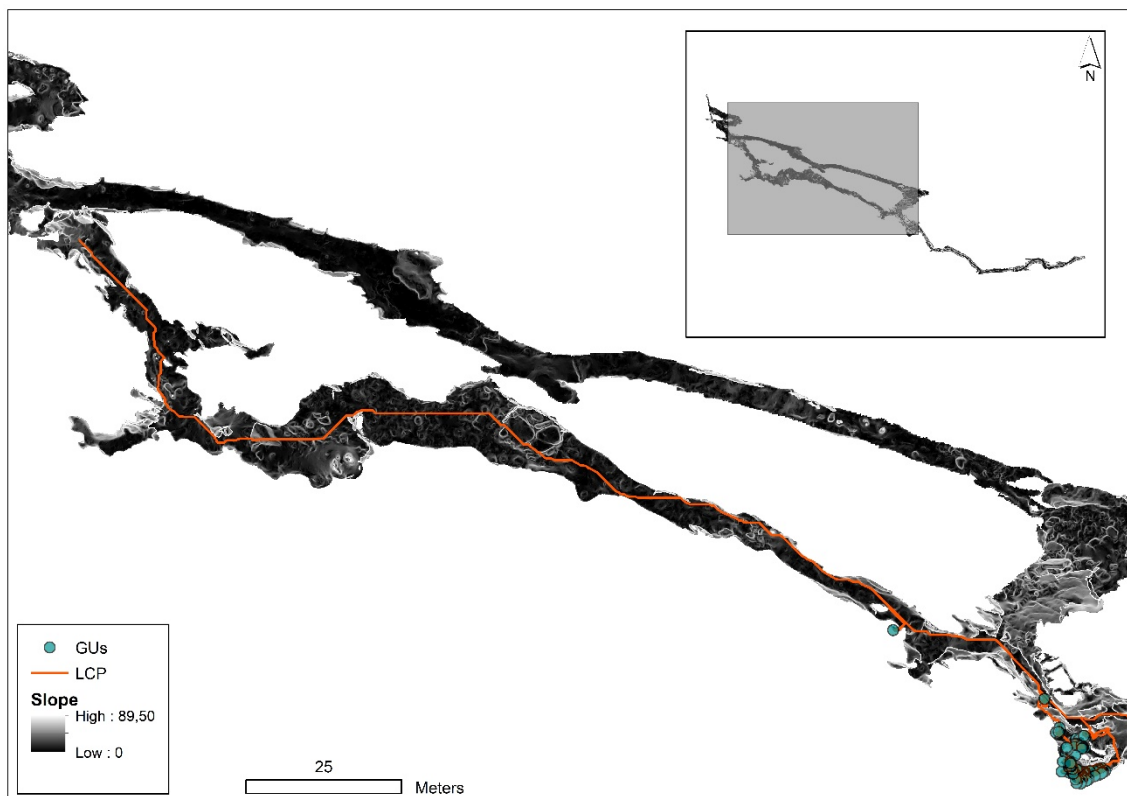


Fig. 4: Estimated LCP to reach GUs goes through the upper level.

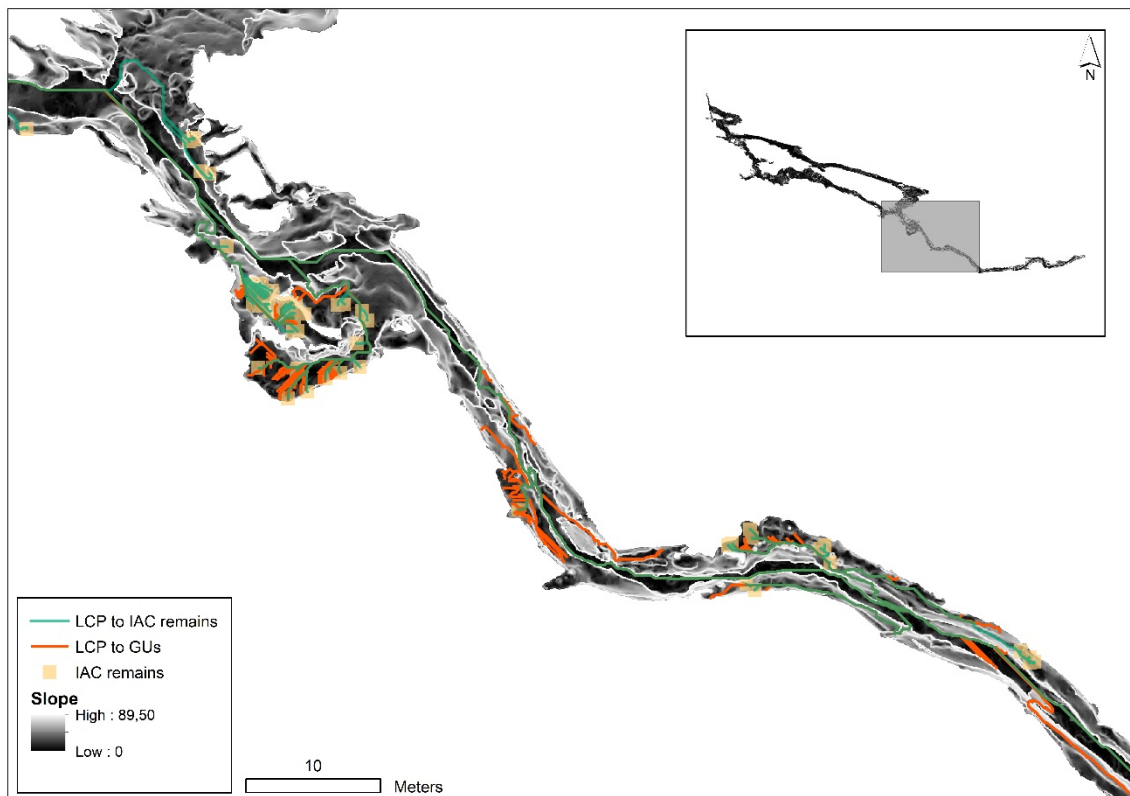


Fig. 5: Estimated LCP to reach IAC coincides mainly with the one to reach GUs.

However, to reach the ephemeral occupation of Armiña (in the lower level), the most optimal path goes through the vertical shaft close to the entrance, as pointed by the archaeological study carried out there (Fig. 6).

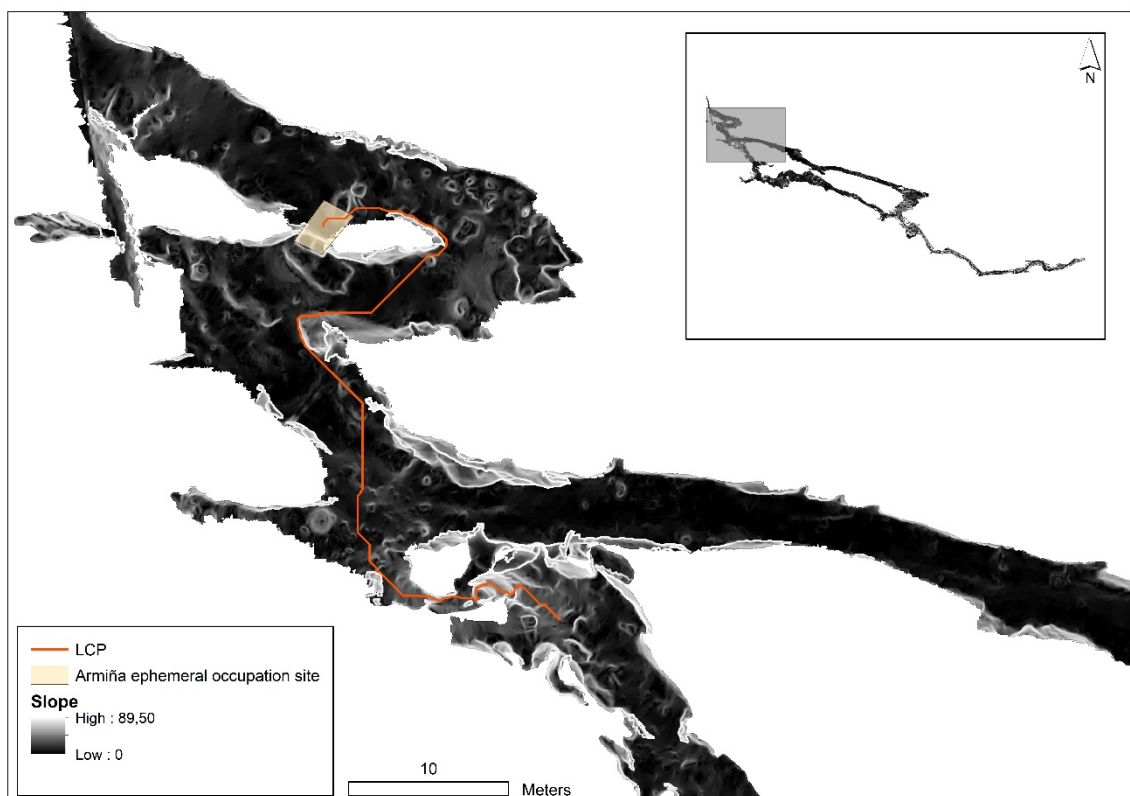


Fig. 6: Estimated LCP to reach the sporadic occupation site of Armiña goes through the shaft located near the entrance of habitat site the Atxurra.

If we estimated the LCP from the ephemeral occupation site to GUs and IAC, it goes through the lower level to its end (without ascending to the upper level), and it ascends to the decorated sectors from there (Fig. 7). Here, there is a big chamber with big blocks fallen from the ceiling, which can be used to ascend progressively to the upper level.

It is interesting, because nowadays, as the most used entrance is Armiña (motivated by its location near the road between Lekeitio and Markina), the most used path to access to the decorated zones it is the same (go through the lower level, and ascend using the fallen blocks of the final big chamber to reach the decorated zone).

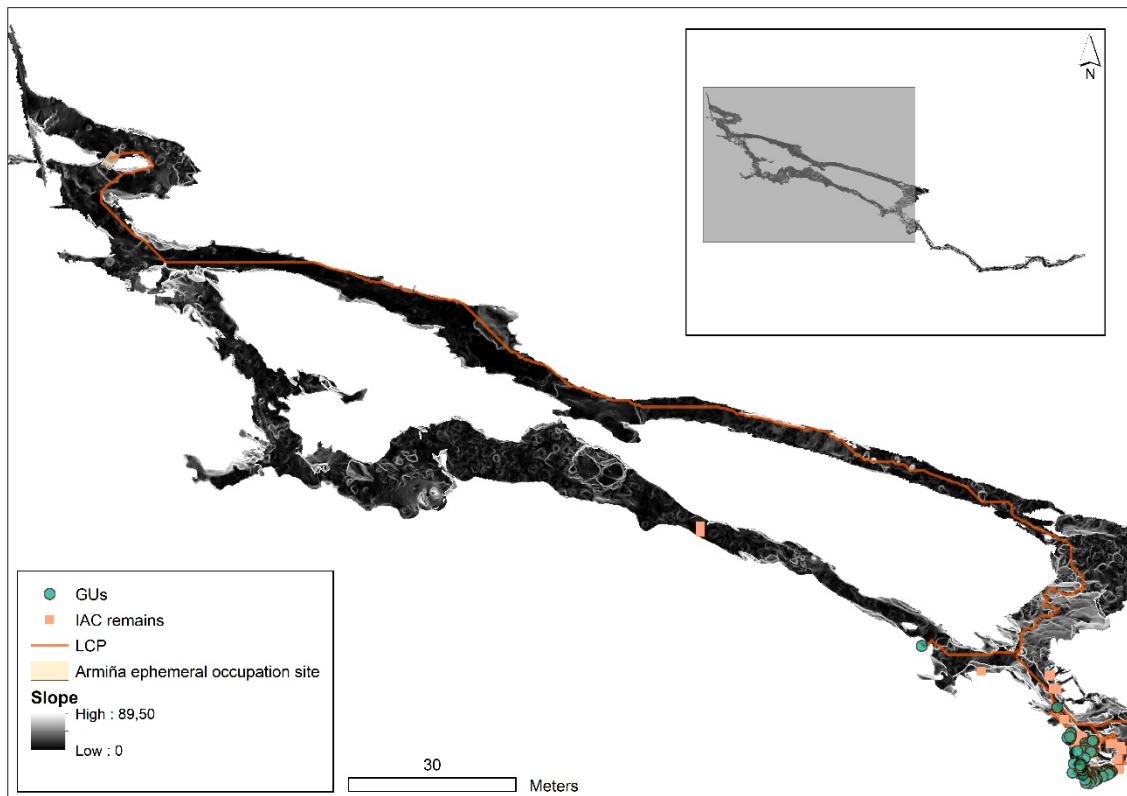


Fig. 7: Estimated LCP to reach the GUs from the sporadic occupation site of Armiña goes through the lower level until its end, and later ascends to the upper level using the fallen blocks to reach the decorated zones.

TESTING OF THE METHOD IN THE CAVE AITZBITARTE IV

The method was also tested in the cave Aitzbitarte IV. For it, the cost from a centroid point of the entrance hall to the different GUs of the cave was calculated with the python script for ArcGIS®.

The archaeological sequence excavated in the entrance revealed post-Palaeolithic evidence in the superficial layers, an Azilian level, and levels attributed to the Azilian-late upper Magdalenian, late upper Magdalenian, middle-upper Magdalenian, Upper Solutrean and an indeterminate Upper Palaeolithic level, possibly Aurignacian.

The cave contains two main groups of GUs, perhaps independent chronologically. The firsts were found in 2012, consisted of a series of shapeless stains of red pigment, possibly remains of some figurative representations of animals, now lost. They are located mainly in the final hall of the main gallery of the cave. The second group was discovered in 2017 by speleologists from the Felix Ugarte Elkarte group and consists in a series of animal figures engraved and modelled in clay on the walls and ceilings, with middle Magdalenian chronology. They are located in a high-level series of narrow passages at the top of a chimney (Fig. 8) (Garate et al. 2020b).

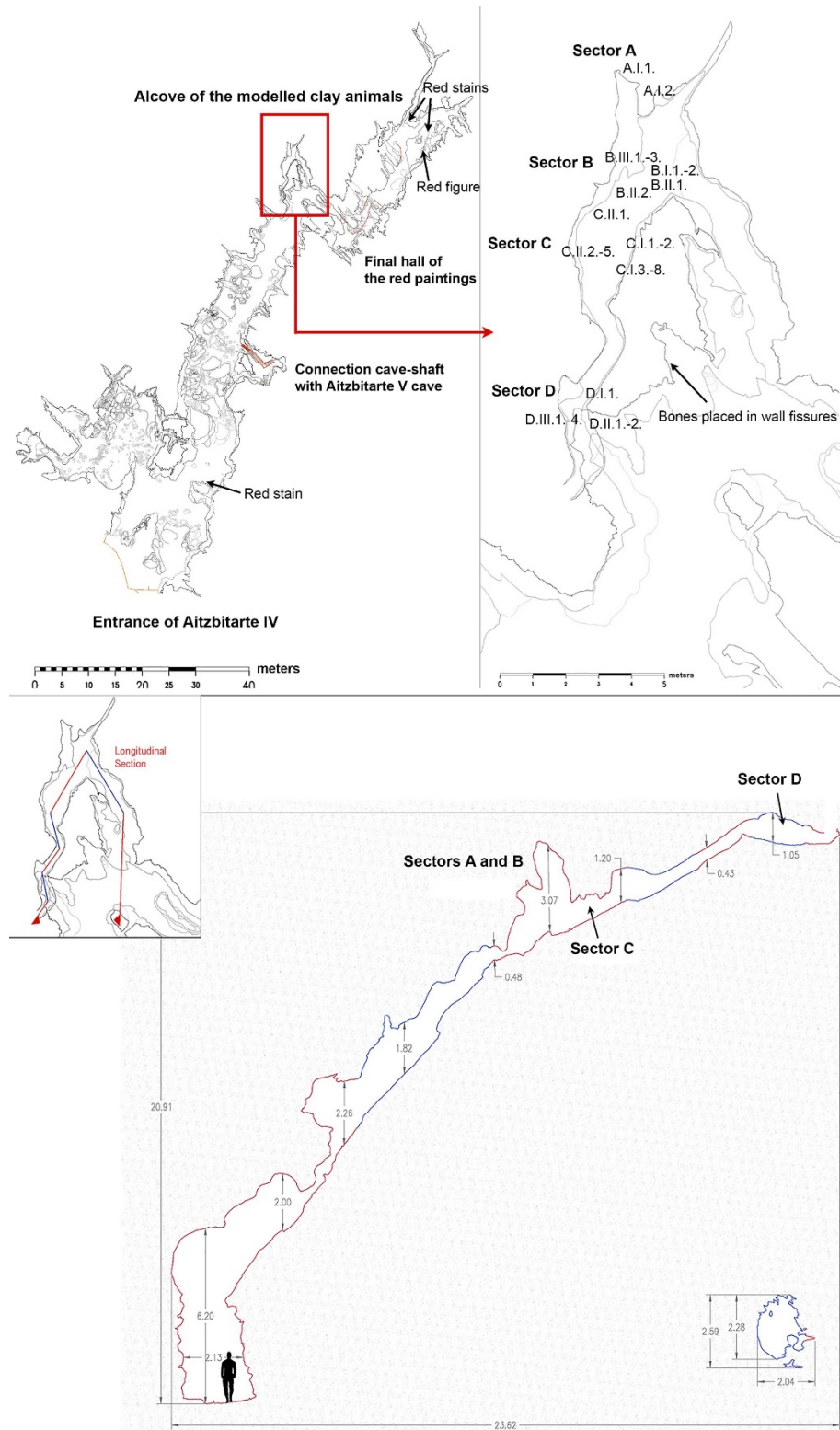


Fig. 8: Location of the parietal motifs in Aitzbitarte IV on a plan and elevation of the cave (Gim-Geomatics).

The cost of access to the last room in the chimney sector (where the modelled animals are located) and access to the last room of the cave (where some red stains are located, with a probably lost animal depiction) was compared. The first is an extremely complicated access through a subvertical chimney of about 20 meters. The second, despite being located further

inside the cave, presents a considerably easier access, since there are only a few specific narrow passages and ramps.

The method was satisfactory for calculating the cumulative costs of accessibility to these sectors (Figs. 9). Cumulative costs, as well as path length and estimated needed time to reach sectors were obtained (Table 1). As expected, the chimneys sector obtained very high value of cumulated cost (452.10), compared with those of the final hall sector (11.76).

| Sectors | GUs | IAC | LCP length (in meters) | Cost | Needed time (in minutes) |
|-------------------|-----|-----|------------------------|--------|--------------------------|
| Chimney sector | 30 | 2 | 132.06 | 452.10 | 17.49 |
| Final hall sector | 3 | | 131.92 | 11.76 | 10.54 |

Table 1: Comparison of the accessibility (measured in cumulated cost value), the length of Least Cost Paths and the estimated needed time to reach two sectors in the inner part of Aitzbitarte IV cave during the Upper Palaeolithic with the number of GUs and IAC remains they contain.

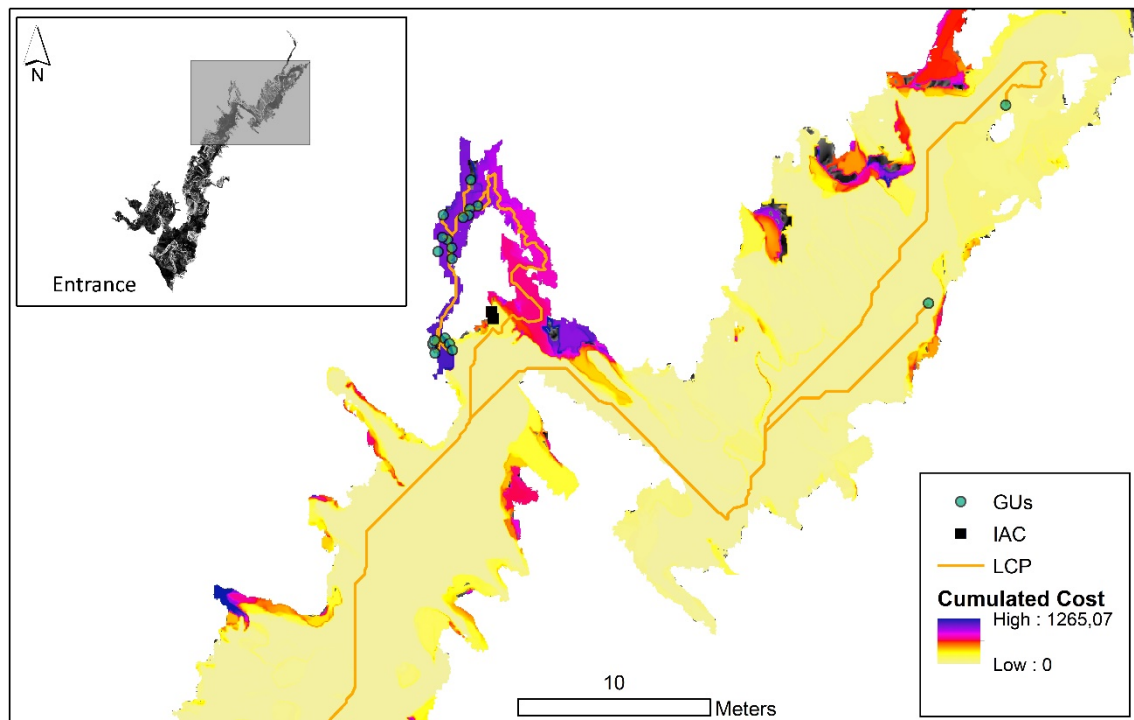


Fig. 9: Cumulated cost map and the Least Cost Paths to reach de GUs in Aitzbitarte IV. Note that the two IAC remains (two bones placed in the fissure of the wall) are located around the estimated LCPs to Gus placed on the top of the chimney (the alcove of the modelled clay animals).

Regarding to the LCP estimated by GIS, it was interesting to observe that the path to the chimney sector, uses a fracture located in the left side of the passage, to climb progressively. In this fracture there are placed two bones in the fissures of the wall, perhaps suggesting that the selected path by the Magdalenian societies was there (Figs. 9 and 10). In any case, there was not possible the direct dating of the bones, so these are only suggestions difficult to prove.

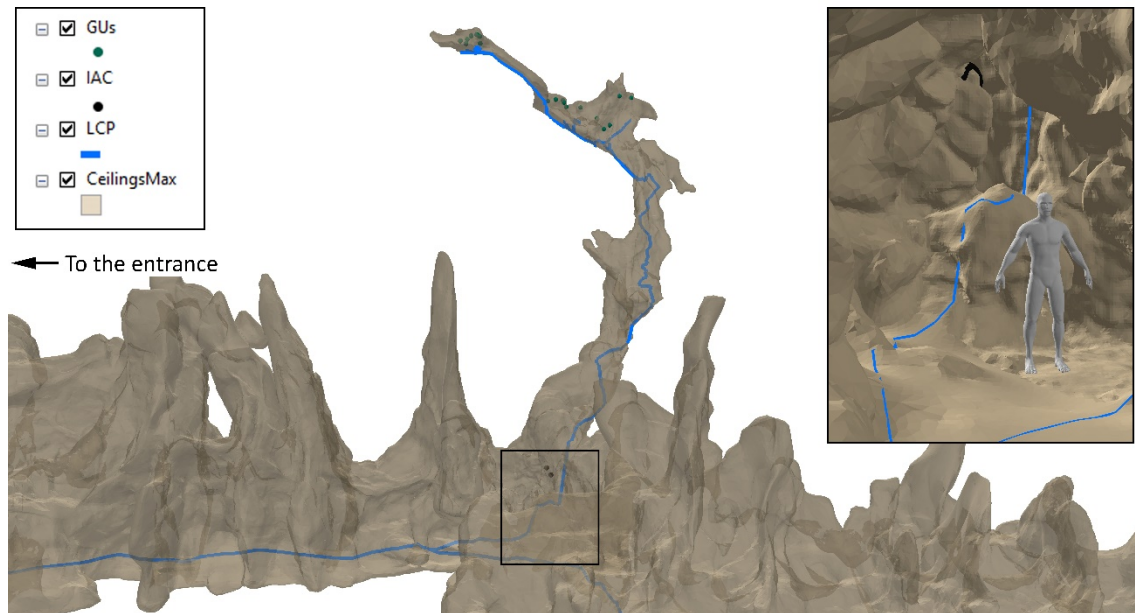


Fig. 10: Image obtained from ArcScene™, showing the LCP (in blue) to reach the top chimney with the modelled figures in clay. In the lower part, two small points are visible showing the position of the bones placed in the fissures of the wall, just above the path selected by GIS.