
La Lluera I Cave (San Juan De Priorio, Oviedo, Asturias, Spain): Art and GIS of the More Figurative Areas or “Niche Areas” of a Sanctuary

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Abstract: Since the beginning of the rock art until today, the study of prehistoric art has been done with different tools (drawings, photos, tracings, etc.). The study of the engravings in La Lluera I cave is a good example. Today, everything can be integrated into the appropriate tool: GIS. The engravings are the peculiarity to destroy a portion of the surface rock leaving a hole made with an object or even by hand. This hollow drawn in 3D is the sketch. It is known as sketch to the delineation that is formed with the design or plant of anything. The present study focuses on the more figurative areas or "zones niche" the cave of Lluera I: the niche (379 sketches), the entry's horse (22 sketches) and the bison's area (111 sketches). The creation of a 3D GIS of the sketches has been, thanks to the technical advantages posed by GIS, a revision to the art of these three areas, and a face wink to the future: GIS, thanks to augmented reality and interactivity, may be the best didactic support for a virtual visit.

Keywords: La Lluera I Cave, Solutrean, Geographic Information Systems, Paleolithic Art

1. Introduction

When reviewing, albeit briefly, the historiography of the Paleolithic cave art we realize the different and varied theories that have been developed to attempt to give answer to the big question of motivation which pushed to its realization, but, also, have been numerous and sometimes sophisticated, the tools that have been developed for their study, more and more complex and detailed. First Prehistorians were or collaborated with great artists: Paul Ratier, french painter, is the pioneer [14]; H. Breuil, in the beginning of the 20th century in their research on the prehistoric art of the Cantabrian Region [1-2]; Juan Cabré and Benitez Mellado, also in the beginning of the 20th century, helping with his drawings to Hernández Pacheco studies about the Candamo cave [4]; etc. It is also, when start to publish the first photographs of rock art [1]. Not only that, but in certain publications made copies on vellum superimposed photographs, looking for simulating the game overlays and show the three-dimensionality of prehistoric art [1].

2. Main Body

Years later, in 1979, La Lluera I cave was discovered by "Polyphemus" Speleological group [7]. The study of the rock art is not exempt from drawings, photos and even tracings [5-6]. The tracings were taken from a laser scanner which is superimposed a mosaic of photos. The aim was, as it is clear in the copies published, not only dealing with the study of the art of La Lluera I cave, but also to create a catalogue of artistic manifestations. However, if these works are for us an obliged reference tool, it is not less true that its accuracy is not adequate when it comes to be able to differentiate between bidimensionality and tridimensionality.

It is, at the beginning of these studies, when measuring the depth of the sketches of a elementary way. Its depth varies between 1 and 15 millimeters [5-6]. Probably, we are not only before the set of engravings of the deeper rock art, but that their sketches exhibit the greatest variety of parameters known depth in all the Cantabrian Region. Proof of this is the niche's aurochs that can be considered as a genuine low-relief.

Due to the proximity of the Nalón river and the successive floods that suffers the cave at different times until you get to be stucked totally by sediment arrives to shuffle the hypothesis that the erosive processes of unplugging and draining of the cave have been able to enlarge the lines of the parietal engravings. Today, based on the sedimentological studies and, above all, both in the deposit's stratigraphy as the wall, we can discard any explanation that is not the intention of the recorder as interpretation for the greater or lesser intensity of the scratched. Precisely, our studies are based on, among other elements, in the depth of the engravings.

Geographic Information Systems (GIS) are tools that can manage and analyze georeferenced information, with a view to the resolution of problems of territorial and environmental database [16].

The graphic entities of these programs are the point, line and polygon, given that it is mathematical software and their graphic entities are the representation of reality more accurately, until recent times have not been applied to the study of rock art.

Based on the mathematics was the graphical representation of each sketch in 3D. Each sketch, based in photogrammetry and in a strong field work, he was taken to the 3D GIS, going from the mathematical to the drawing. Within the rock art, the engravings belong to the subtractive depletion techniques. The subtractive depletion techniques allude to all those in the artistic work that it is inevitable the elimination or destruction of part of the bracket, which include the engravings, reliefs, and sculptures. The engravings are the peculiarity to destroy a portion of the surface rock leaving a hole made with an object or even with the hand [15]. This hollow drawn in 3D is the sketch. The Royal Academy of the Spanish Language defines sketch, in its primary sense, as "*la delineación con que se forma el diseño o planta de cualquier cosa*" [13]. In Art, sketch is "*la línea, raya o rasgo dibujada en una superficie*". In Graphic Design, sketch is "*la línea*

cuyas proporciones de largo y ancho se han invertido considerablemente dando como resultado una expresión gráfica de mayor vitalidad" [3].

3. Results and Discussion

The present study focuses on the more figurative areas or "niche" areas of La Lluera I cave: the niche (379 sketches), the entry's horse (22 sketches) and the bison's area (111 sketches). Thanks to the creation 3D GIS of the sketches about these three areas has been achieved:

The graphical representation of each sketch or recorded in 3D. This allows us to observe and take the data of its length, width and depth; see direction taken by the artist in making each sketch: up down, right to left, left to right; etc. All we used to test, not only that we are talking about a three dimensional art, but that the artist tries with the depth sketches get a clear view from any point of view, in addition to take into account artistic criteria, thematic, etc.

Inside of the analysis of the sketches, has been able to determine its maximum depth (Figure 1). In the bison's area, the depth sketches is less than 2 mm -7.2% (Figure 1(1)), the depth sketches is between 2 and 2.99 mm - 27.1% (Figure 1(2)), the depth sketches is between the 3 and the 5.99 mm - 48.6% (Figure 1(3)), the depth sketches is between the 6 and the 7.99 mm - 9.1 % (Figure 1(5)), 2.7% the depth sketches between the 8 and the 9.99 mm - 2.7% (Figure 1(5)) and is only 4.5% is between the 10 and the 14.6 mm (Figure 1(6)). This tells us that is they mated perfectly to the wall's orography looking for creating a real low relief and they adapted the depth of each sketch to the end result of the display. The artist adequate depth in every sketch of this area to get a clear view from any point of view, what leads us to think, and is what we propose as a working hypothesis, that we have a three-dimensional art.

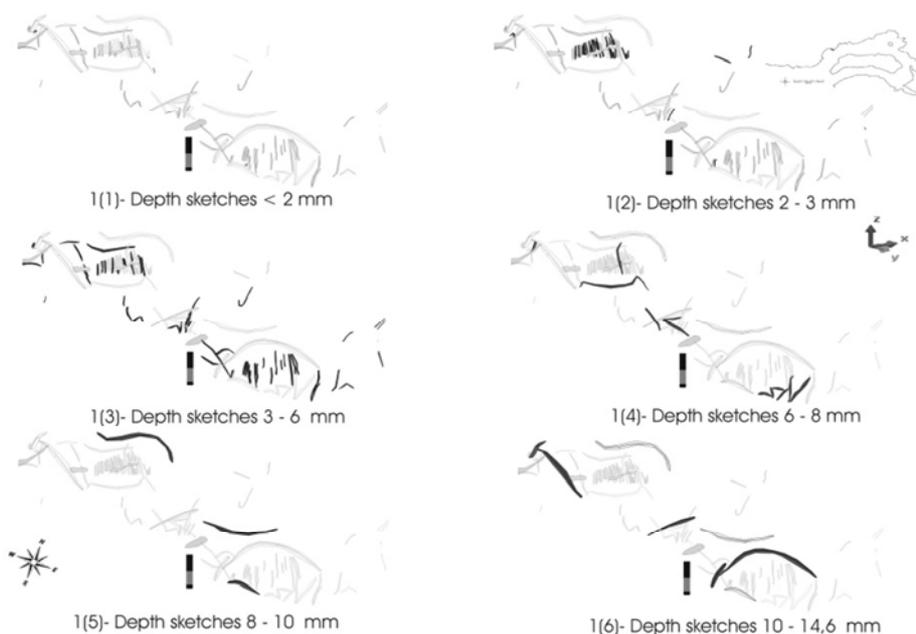


Figure 1. The bison's area- Depth sketches (black). Scale: 10 cm.

Encode all the information for each sketch, and artistic manifestation: measures, the direction taken by the artist in making each sketch, etc.

Create a catalog of the artistic manifestations of these three areas (Figure 2).

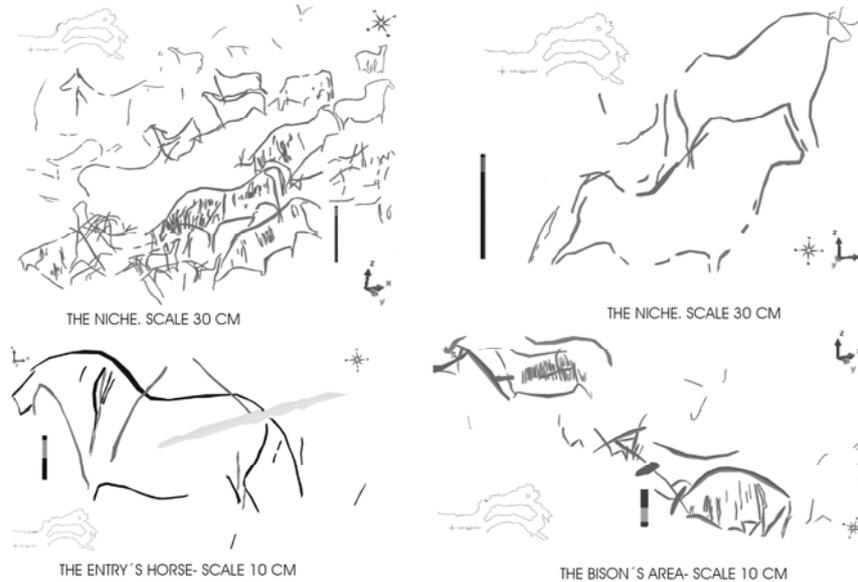


Figure 2. Catalog of the "niche areas".

Be able to display immediately and in 3D all kinds of analysis and consultations. One of the conclusions that we believe have arrived and that seems to us more interesting is that the artist based on the planning, although without denying the improvisation's degree in the whole art's work, use sketches in dry skin to mode of visual support to make

certain figures. The use of sketches trimmed to mark the silhouettes of figures is not something new in the analysis of prehistoric art but that already some authors were repaired in this, although now and that is what we present as a novelty, we can reaffirm this hypothesis and elevating them to the conclusion's category.

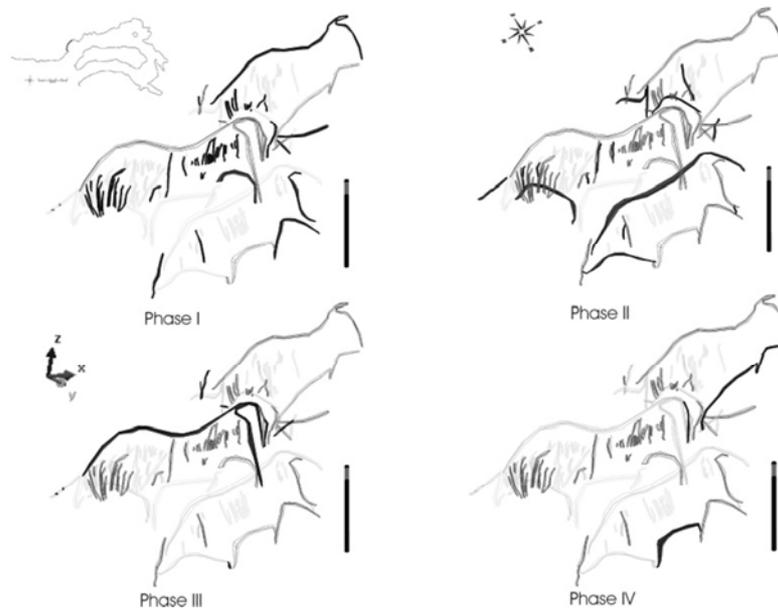


Figure 3. Elaboration's phases (black): the niche (aurochs). Scale: 30 cm.

The stratigraphy and its archaeological record [9-11], the set of superpositions and the chronological hypotheses allows us, first of all, to place the engravings of these three areas in Solutrean period, and secondly, determine the elaboration's phases. The first conclusion, which is extracted from the study of the elaboration's phases in the the niche's area, is

that three aurochs of the niche were done simultaneously (Figure 3 and Figure 4). First of all, there was realized the aurochs of the right part, and that of the low part. Later, there was recorded the aurochs that is in the center. The execution's form and the artistic similarities make us conclude that he was the same artist who recorded three

aurochs. First, it always realizes the cervical-dorsal curve and the head's top part of the aurochs; then its hair, and finally the part goes down head and neck of the aurochs, although it is not possible to discard that, later, other artists will keep on deepening the depth of its engravings. The aurochs measure more than 50 cm long and its deepest engravings go from the 15 to 22 millimeters. Now then, given the artist's skill, and the measurements about which we speak, only we can only conclude that we are before an authentic low relief realized with sketches in dry skin as visual support. Secondly, the analysis of the elaboration's phases of the bison's area they point to which three hinds of the top part were done simultaneously (Figure 5). They started by realizing the big hind and its hair, later the opposite small hind and the interior

hind. On the other hand, in the low part we conclude something much seemed, that is to say, hind, hair and bison were done simultaneously, and in this execution order. Earlier and later, there were realized several signs and lines which elaboration's phase does not appear to us very clear. If to this we add the information contributed previously about the depth of the engravings we can extract the conclusion that points to that the visual game has been achieved by the artist's mastery. We believe that before this information it is possible to aim, first of all, that these engravings were executed by the same artist and, secondly, that the achievement of these figures in the context and composition in which they are needed the sketches use in dry skin as support.

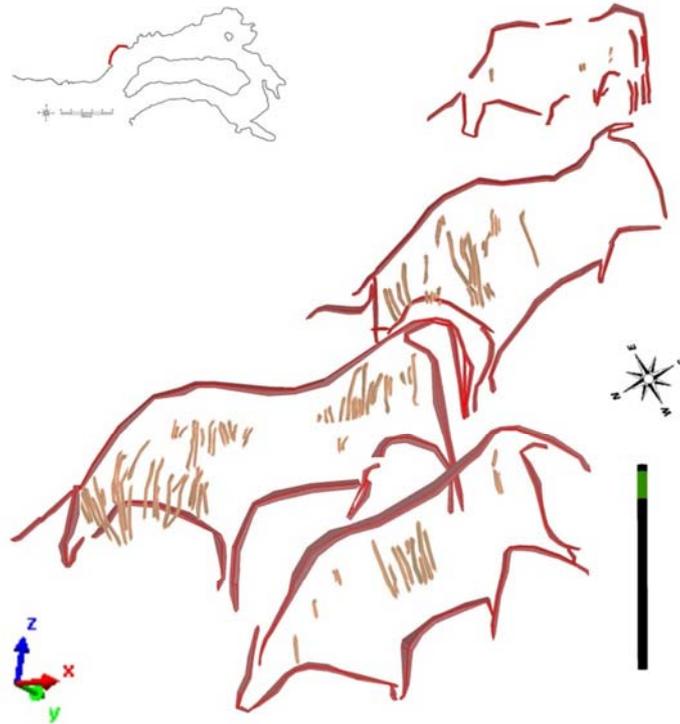


Figure 4. The niche (aurochs). Scale: 30 cm.

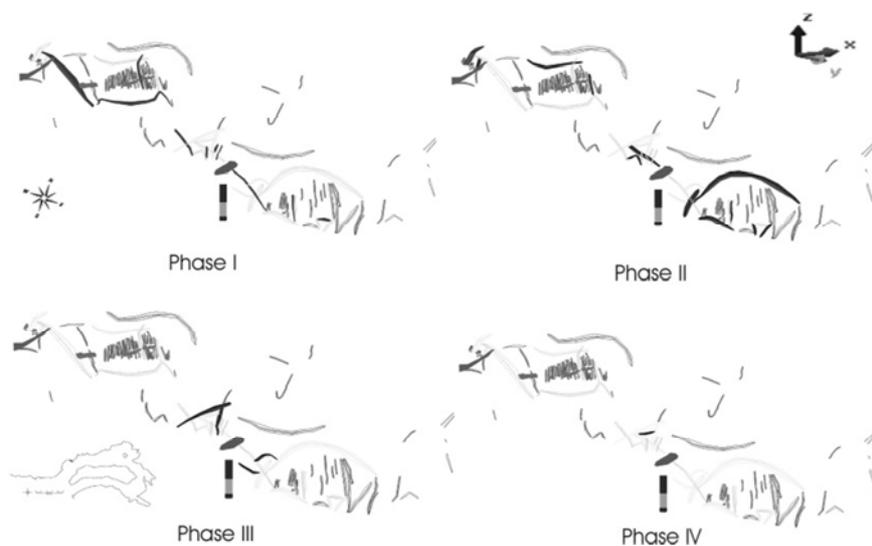


Figure 5. Elaboration's phases (black): the bison's area. Scale: 10 cm.

The vast majority of sketches were made with a fresh distal extremity. Burins were used - archaeological record from La Lluera I- [9], splinters (medium format)-archaeological record from La Lluera II [8], and remains minerals, specifically goethite with its distal extremity ready to record- archaeological record from La Lluera I [12]. In the bison's area (Figure 6), a 78.39 % of the sketches are in the perfect V's form (Figure 6(1)), a 12.61 % are a vast majority in V, a minority in U (Figure 6(2)), a 7.2 % are a vast majority in U, a minority in V (Figure 6(3)), and only a 1.2 % in U (Figure 6(4)). It is understood within the category of the sketches made in V, all the sketches that have been made as a V perfect. While for the category of the sketches made in U,

is included here those sketches at the base of which has produced some type of wear. These studies have been made: based in the photogrammetry (through software Polyworks), the field check, the drawing of each sketch in 3D and its study through 3D GIS. The vast majority of sketches have been made with a fresh distal extremity (Figure 6(1)) and (Figure 6(2)), although in the latter case (Figure 6(2)) the fresh extremity suffered some type of wear. On the other hand, in a minority of the sketches, to emphasize certain figures or signs, wore down the burins (Figure 6(3)). To make it very visible the hind deepened the sketches until leaving the burins and the sketch in U (Figure 6(4)).

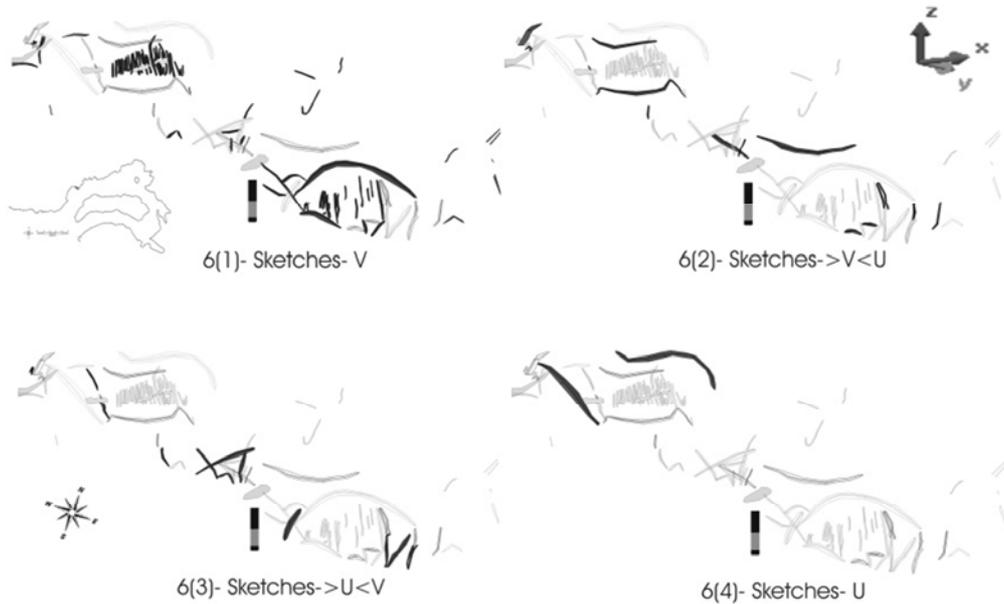


Figure 6. Sketches have been made: in V, >V<U, >U<V, U (black): the bison's area. Scale: 10 cm.

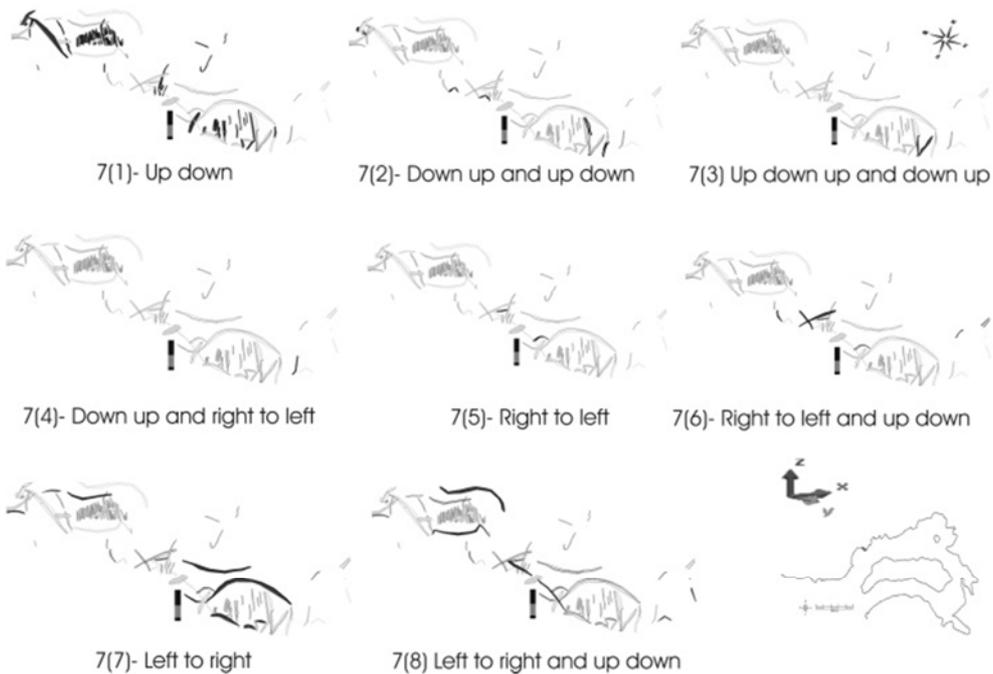


Figure 7. Direction taken by the artist in making each sketch (black): the bison's area. Scale: 10 cm.

Inside of the analysis of the sketches, has been able to determine the direction of their realization (Figure 7). In the bison's área: 72% are made up down (Figure 7(1)), 5.4% down up and up down (Figure 7(2)), 0.9% up down and down up (Figure 7(3)), 0.9% down up and right to left (Figure 7(4)), 1.8% right to left (Figure 7(5)), 4.5% right to left and up down (Figure 7(6)), 7.2% left to right (Figure 7(7)) and 6.3% left to right and up down (Figure 7(8)). All this leads us to conclude, firstly, that the majority of sketches are done up down or sometime take this direction. Secondly, the artist adapts to the orography and the way of making each sketch into the wall, always looking for the way to easier and more comfortable to run it. Thirdly, cannot be said categorically that these sketches have been made by a right-handed or left-handed artist.

Using the 3D GIS, and with the arrival of Google Glass or Gear VR Samsung Glasses, if you develop a simple application and is placed on line, could be achieved the viewing of the elaboration's phase superimposed on the walls of these 3 areas. The development of the augmented reality, not only allows you to view in 3D and in real-time digital cartography or GIS, but it also offers the possibility to carry out visits to any historical monument in an attractive way, understandable and custom [17]. The range of possibilities for selection and display are the same as the ones that you have on your computer. It would be, therefore, a didactic support unbeatable for the public visit La Lluera I cave.

4. Conclusions

Finally, being fully aware of the closeness of the Nalón river, and there were successive flooding of the cave in different historical periods, given the magnitude of the data provided and exposed lines back, the overall conclusion being removed it is that erosive processes did not influence significantly in the depth of the engravings. In addition, thanks to the study by GIS of the areas analyzed, has proven that the depth of the sketches and the elaboration's phases are a key to explain key not only implementation but also intentionality and the plasticity of the art of this important solutrean sanctuary.



Figure 8. A hind (the niche).

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