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Research Article

Animals hidden in plain sight: stereoscopic recording of Palaeolithic rock art at La Pasiega cave, Cantabria

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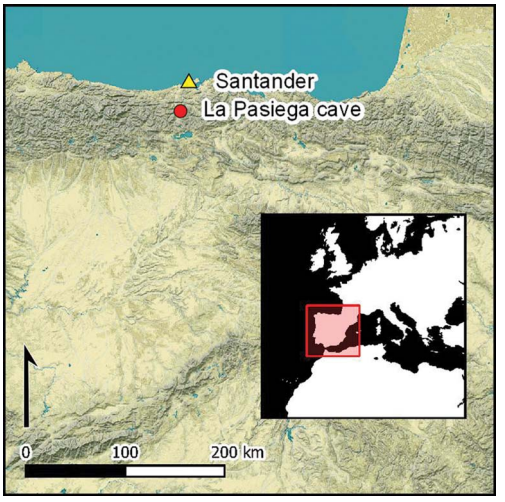

Cantabrian cave art is familiar from photographs reproduced in textbooks, but these two-dimensional images do not capture the irregularities of the rock surfaces on which animals and other designs were painted or engraved. Here, the authors use stereoscopic photography to review the parietal art of La Pasiega cave. By documenting the uneven surfaces of the cave's walls alongside painted and engraved marks, they identify new animal figures and reinterpret others, previously thought to be partial representations, as complete. The results show the positioning of animal figures to make use of concave/convex surfaces and rock edges to define the outlines of animals, reinforcing the need to record and interpret cave art three-dimensionally.

Keywords: Iberia, Palaeolithic cave art, stereoscopic photography, decorrelation stretch analysis

Introduction

Cantabria in northern Spain has more than 100 examples of caves with parietal art dating from the Early Upper Palaeolithic through to the Last Upper Palaeolithic period (González Sáinz 2004; Ontañon *et al.* 2019). Recent studies have now extended the known chronology of cave art in this region back to the Middle Palaeolithic (Hoffmann *et al.* 2018, but see Slimak *et al.* 2018 and reply by Hoffmann *et al.* 2020). The Cantabrian artistic corpus includes zoomorphic and anthropomorphic figures, negative and positive hands and a variety of signs, dots, finger marks and isolated strokes. In addition, there are many examples in this karst region for the intentional incorporation of rock formations into artistic expressions. These

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include 'masks' incorporating anatomical parts (e.g. eyes or nostrils) painted in black charcoal on rock protrusions at Castillo, La Garma and Altamira; the bird of La Pasiega (Gallery B), where a natural protuberance of the wall was modified by adding an eye, feet and beak in red pigment; and the modification of a stalagmite formation at Castillo to form a bison (Groenen & Clottes 2016). This practice is also evident at Altamira, where a group of painted and engraved bison make use of geological formations on the cave ceiling (Aranburu & Iriarte 2017).

It is only in the past few decades that scholars have considered the incorporation of such natural rock formations into cave art (Lorblanchet 1993; Saura *et al.* 1998; Sauvet & Tosello 1998; Múzquiz & Saura 2002; Brot 2010; Ogawa 2010; Fritz *et al.* 2016; Groenen & Clottes 2016; Sakamoto *et al.* 2020). Previously, from the beginning of the study of Palaeolithic cave art, references to this phenomenon were unusual and did not extend beyond an aesthetic perspective (Breuil 1952: 59). Scholars became more interested in this subject from the 1980s, but still only occasional references are found in the literature (Aujoulat 1987; Clottes & Lewis-Williams 1996), with only one systematic study, of six caves in France, published (Lejeune 1985). This sustained lack of investigation into the use of the topographical features of cave walls and ceilings into artistic expressions in order to create three-dimensional features is the inspiration for the current research.

Traditionally, Palaeolithic parietal art has been documented using sketches, direct or indirect tracings and photographs. All these methods, however, are two-dimensional. To study the three-dimensionality of cave art, we needed a recording method that can capture the shape of the rock surface. To the best of our knowledge, stereo photography has only been used on two occasions to document cave art: the Tuc d'Audoubert clay bison and the Pestillac engravings (Bahn 2016). Although the results obtained were promising, these applications of stereo photography during the early and middle twentieth centuries experienced difficulties relating to lighting systems, the use of photographic film and the need for 3D viewers. For these reasons, scholars abandoned the use of this recording technique.

More recently, photographic techniques and 3D-viewing systems have become more accessible. Digital photographic processes are more straightforward to implement than film photography and photogrammetry is increasingly used to record and study rock art (e.g. Lerma García *et al.* 2012; Ontañon *et al.* 2014, 2019; Fritz *et al.* 2016; Ruiz *et al.* 2016; Garate *et al.* 2020; Rivero *et al.* 2021). This 3D recording of cave art captures more detail than traditional photography, but the images are still predominantly viewed two-dimensionally on a computer screen. In contrast, stereo photography permits users to view recorded surfaces three-dimensionally during laboratory work—in other words, to look at cave art as if *in situ*.

Here, we use stereo photography to record the rock art corpus of La Pasiega cave. La Pasiega, near the village of Puente Viesgo, is one of four decorated caves of the karstic Monte Castillo (along with El Castillo, Las Chimeneas and Las Monedas), which in turn form part of a UNESCO World Heritage Site ('Cave of Altamira and Palaeolithic Cave Art of Northern Spain'). La Pasiega cave was discovered in 1911 and has been studied by numerous scholars (e.g. Breuil *et al.* 1913; González Echegaray & Ripoll 1953/54; Ripoll 1956; González-Echegaray 1964; Glory 1965; González Echegaray & Moure 1971; Balbín Berhmann & González Sainz 1993, 1994, 1995, 1996; Garate *et al.* 2019; González Sainz & Balbín Berhmann 2000). La Pasiega is topographically divided

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into three sectors: the western sector (Galleries A and B), the eastern sector (Gallery C), and the central sector known as Zone D (Breuil *et al.* 1913; Balbín Berhmann & González Sainz 1993). In this article, we present the results of our systematic study in La Pasiega cave using stereo photography. We identify three previously unrecognised zoomorphic figures (two horses and an aurochs) and use three-dimensional rock forms to reinterpret three previously published figures.

Methods

For this study, we use stereo photography to capture the three-dimensional form of the rock art at La Pasiega; the method is easily replicable and produces images of the highest quality. The technique uses pairs of photographs taken 63.5mm apart, this distance corresponding to the average human interpupillary distance. The individual photographs therefore separately capture the views of the left and right eyes (French 1921; Dodgson 2004). When viewed together, the human brain perceives the images as a single three-dimensional view.

Two pairs of cold light sources (flashlights) with diffusing and polarising filters were used as a lighting system. Polarisation eliminates specular reflections and improves colour vision. Photos were captured in RAW format to include the broadest range of information and retain the highest quality. Lightroom® and Photoshop® software was used to enhance the images, and for minor operations such as adjusting exposure. The photographs were assembled in pairs for viewing using 3D glasses or visors similar to those used for virtual-reality gaming. Using these glasses, it is possible to perceive the recorded cave art three dimensionally without being present in the cave. In addition, the DStretch© plugin (Harman 2005; Le Quellec *et al.* 2013) was used for complementary image enhancement.

Results

Gallery A

Of the three galleries and Zone D at La Pasiega, Gallery A has the most images. The majority of these images are located in the final 25m of the gallery, where it narrows at the rear of the cave, and include zoomorphic figures (e.g. horse, aurochs, deer), quadrangular symbols, engraved lines and painted dots and stripes (Balbín Berhmann & González Sainz 1993, 1996; González Sainz & Balbín Berhmann 2002). Based on Leroi-Gourhan's 1965 classification, most of these images have been assigned to Style III (Upper Solutrean/Lower Magdalenian); some transitional figures have been classed as Style IV (Middle-Upper Magdalenian; Balbín Berhmann & González Sainz 1993). Our examination of the stereoscopic photographs reveals two previously unrecognised figures in Gallery A. Both are on the left side of the gallery, located between groups 17 and 18 of the Breuil *et al.* (1913) scheme (Figure 1).

The first new figure forms part of group 17. To the right side of this group (which includes the profile of a hind and the head of a possible caprid; not shown here) are some red strokes noted by Breuil *et al.* (1913: 9). These marks can now be interpreted as a new horse figure: I.A-A.17 (Figure 2). The head, mane, neck and part of the chest are painted in red. The neck and chest are faded making it difficult to perceive the animal without the use of digital image

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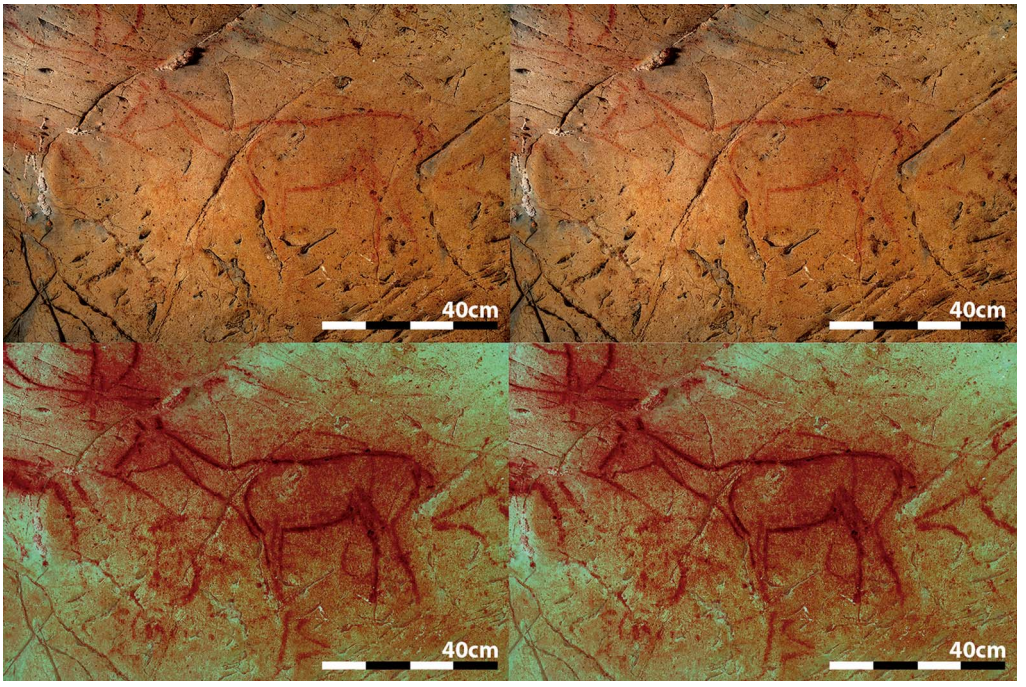

Figure 1. Top: photograph of the area between groups 17 and 18 on the left side of Gallery A; bottom: photograph processed with DStretch (images prepared by R. Asiain & P. Saura). URL for stereo pairs: https://www.flickr.com/gp/196948634@N08/y04FJr872e

enhancement. The maximum dimensions of the figure are 450 × 400mm. The lines were created with a simple stroke, possibly using a liquid pigment applied with a pad of animal fur. A calcite deposit from the wall encloses the head. The mane and neck are located over a concave depression in the cave wall; conversely, the chest is situated over an area of convex relief, enhancing this area of the animal.

The second newly identified animal figure is located immediately to the right of I.A-A.17 (Figure 2) and forms part of group 18. This group was previously documented as comprising three figures: a full profile of a deer outlined in red with well-defined antlers; a complete outline in red of a hind, showing many anatomical details, to the right; and an incomplete hind depicted with a faint red line at the bottom of the group. The newly identified figure, II.A-A.18, is located in front of and below the red doe figure in the centre of the group. Previously, this image had been tentatively identified as the badly faded hindquarters of an animal (Breuil *et al.* 1913: 9–10). In this study, we identify this figure as a horse image (Figure 2). Painted in red, the preserved area measures a maximum of 460 × 300mm, depicting the head with the corner of the mouth, an eye, ear and the beginning of the cervico-dorsal line. The horse is depicted using variably spaced dots; on the cervico-dorsal line, the points are more widely spaced, while for the head, they are closely spaced forming a continuous line. The figure makes use of natural features of the cave wall. Cracks in the rock are incorporated into the outlines of the head and chest and the cervical-dorsal line adapts to a concave area.

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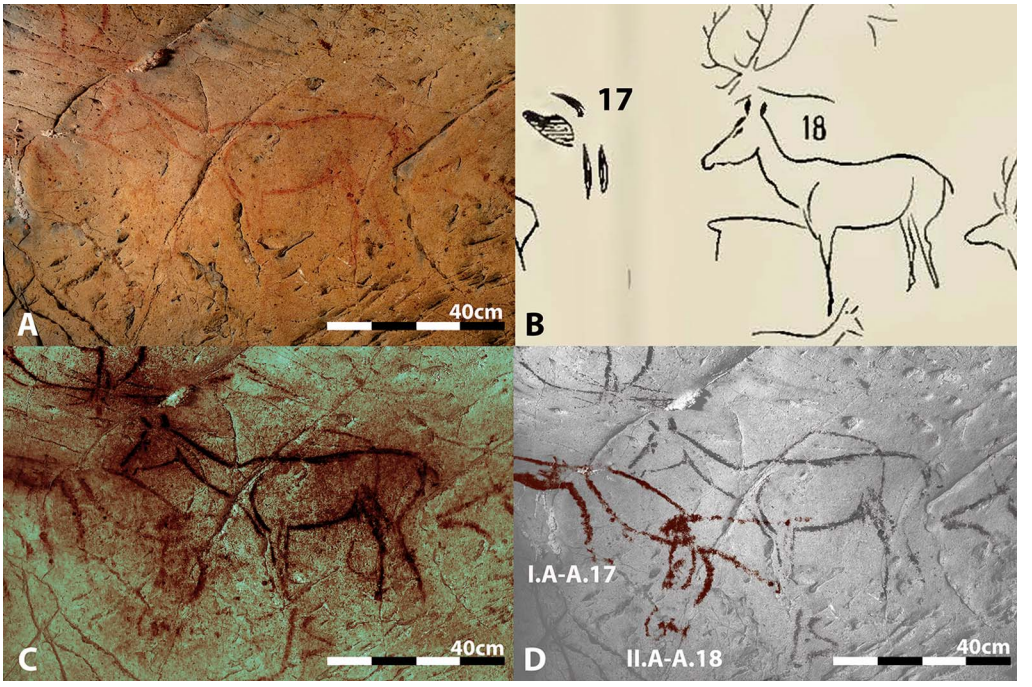

Figure 2. A) area between groups 17 and 18, Gallery A; B) tracing of the same area after Breuil et al. *1913; C) the same area processed using DStretch; D) tracing of the same area based on image processed with DStretch (images prepared by R. Asiain & P. Saura).*

Still in Gallery A, we have also reinterpreted two well-known figures. The first of these two figures, located in group 5, was previously described by Breuil *et al.* (1913) as an incomplete horse. In this study, we have reinterpreted this image (here labelled, III.A-A.5) as a complete horse figure by taking into consideration the shape of the cave wall (Figures 3 & 4). The anatomical components of this figure that have been previously described are the head and mane (Breuil *et al.* 1913: 8; González Sainz & Balbín Berhmann 2002). The head is outlined in red using a simple line and the mane depicted with dots. Here, we argue that the cervico-dorsal line, hindquarters and foreleg are suggested by natural lines and edges in the rock surface, with the belly located on an area of convex relief. In this way, these natural formations are combined with the painted components to create a complete animal figure.

The second figure in Gallery A that we have reinterpreted is also in Breuil *et al.*'s (1913) group 5. This figure had previously been interpreted as an incomplete image of a deer (Breuil *et al.* 1913: 8; González Sainz & Balbín Berhmann 2002). Taking into account the natural formations of the cave wall, we reinterpret this as an almost complete deer figure (IV.A-A.6; Figure 4). Painted in dark red, the anatomical parts depicted are the snout, cervico-dorsal line and long curved antlers. The maximum length from the snout to the cervico-dorsal line is approximately 415mm. Here, we suggest that the hindquarters and hind leg of this deer figure are defined by holes and cracks in the rock surface of the cave wall, as are the mandibular area and front part of the neck. Thus, except for the head, natural formations were used to evoke the rest of the deer's figure.

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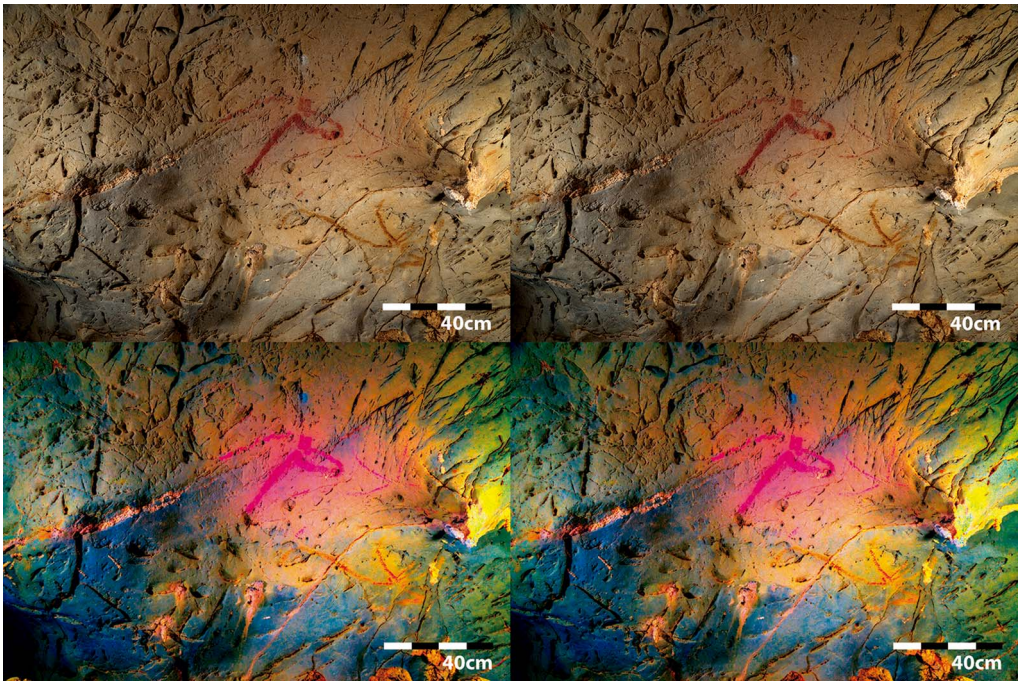

Figure 3. Top: photograph of group 5 on the left side of Gallery A; bottom: photograph processed with DStretch (images prepared by R. Asiain & P. Saura). URL for stereo pairs: https://www.flickr.com/gp/196948634@N08/y04FJr872e

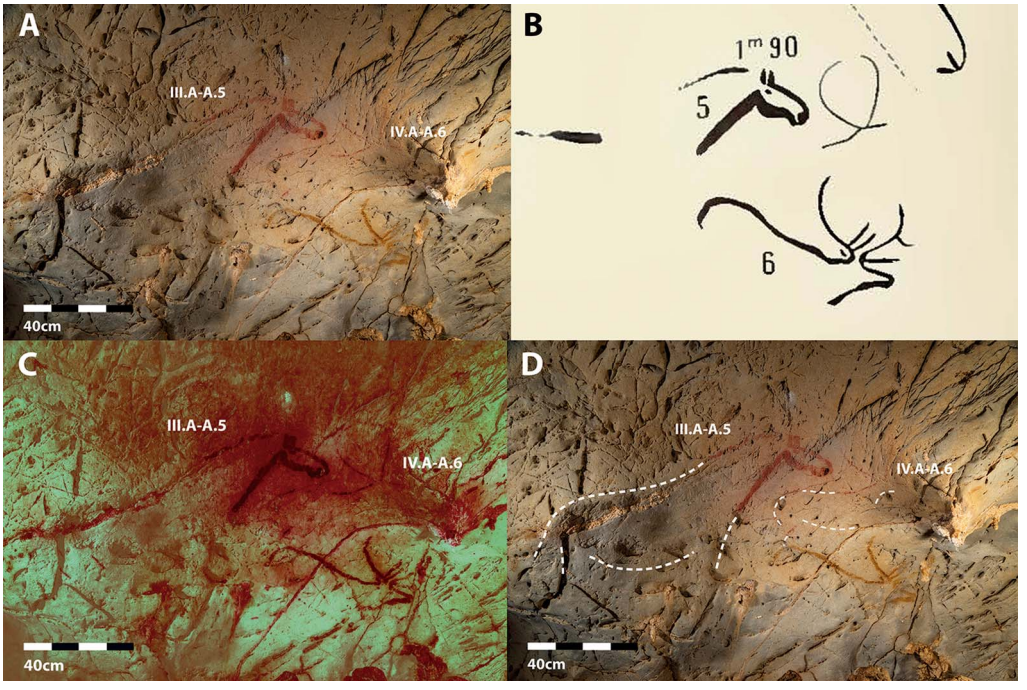

Figure 4. A) Group 5 Gallery A; B) tracing of group 5 after Breuil et al. *1913; C) Group 5 processed using DStretch; D) tracing of group 5 by authors (images prepared by R. Asiain & P. Saura).*

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Gallery B

Gallery B contains approximately 200 images, including anthropomorphic and zoomorphic figures of horse, deer, aurochs and bison, as well as various non-figurative dots, stripes and other marks. The images in this gallery are divided into two zones: Gallery B Anterior Zone (panels B.1 to B.8) and Gallery B Posterior Zone (panels B.9 to B.12; Balbín Berhmann & González Sainz 1993). Panel B.2 is located close to the original entrance of the (currently sealed) gallery and features two images of large bovines associated with a non-figurative depiction and various incised figures. Based on stylistic grounds, panel B.2 has been assigned to the early Style IV (Middle Magdalenian; Leroi-Gourhan 1965, 1983; Balbín Berhmann & González Sainz 1993, 1995, 1996; González Sainz & Balbín Berhmann 2000, 2002). We have identified a previously unrecognised figure in group 54 of panel B.2. Group 54 includes a large bison positioned on a red painted line, previously interpreted as a possible 'ground line' (Breuil *et al.* 1913: 17–18). Here, we reinterpret this ground line as a new figure, depicting a large bovid, possibly an aurochs (V.B-B.54; Figure 5).

The maximum dimensions of the figure are 1650 × 700mm. The anatomical elements depicted are the lyre-shaped horns, head, cervico-dorsal line, hindquarters, tail, the start of the hind leg, belly, foreleg and chest. The outline of the animal is drawn with a delicate stroke. Some traces of red pigment that presumably filled the entire figure can still be discerned. The antlers, shoulder hump and hindquarters incorporate areas of convex rock, the dorso-lumbar

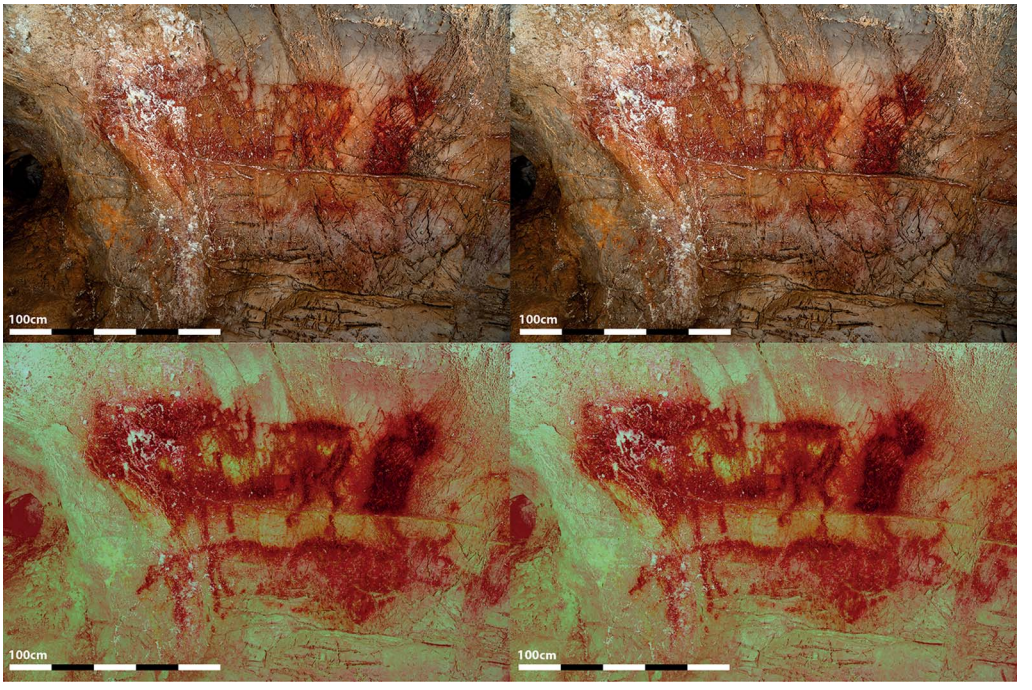

Figure 5. Top: photograph of group 54 (Panel B.2, Gallery B); bottom: photograph processed using DStretch (images prepared by R. Asiain & P. Saura). URL for stereo pairs: https://www.flickr.com/gp/196948634@N08/y04FJr872e

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line adapts to the surface of the wall, the hind leg includes a rock edge into the paint stroke, and the belly and chest incorporate the cracks in the rock surface to define these anatomical parts (Figure 6).

Zone D

In the central part of the cave complex, Zone D has fewer and more scattered images compared with the other three galleries. The images in this zone also demonstrate more technical and stylistic variety. The main corridor of Zone D leads to two 'rooms', one on top of the other. In the 1950s, two painted horse figures were discovered on the ceiling of the upper room, both assigned on stylistic grounds to the advanced Style III (Lower Magdalenian; González Echegaray & Ripoll 1953/54; González Sainz & Balbín Berhmann 2002). Here, we reinterpret the incomplete figure of horse 5 in Gallery D, showing how the natural features of the rock surface permit the identification of a complete horse figure (VI.D-D.5; Figure 7).

The horse is painted in yellow ochre, with a maximum length from head to hindquarters of 600mm. The anatomical parts previously identified are the head, mane, cervico-dorsal line and hindquarters (González Echegaray & Ripoll 1953/54: 61). Taking into consideration the shape of the rock surface, we suggest that a natural rock edge defines the belly of this horse; the natural cracks of the rock also define the foreleg (Figure 8). Without the use of paint, therefore, these anatomical elements are evoked by the natural rock surface.

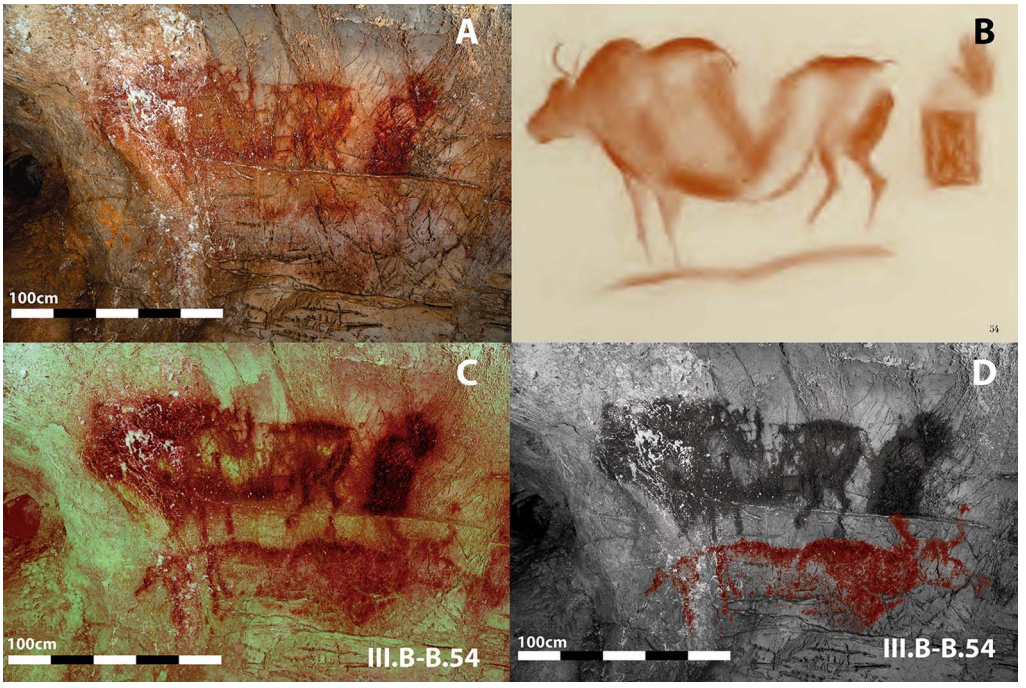

Figure 6. A) Group 54 Gallery B; B) tracing of group 54 after Breuil et al. *1913; C) Group 54 processed using DStretch; D) tracing of group 54 by authors (images prepared by R. Asiain & P. Saura).*

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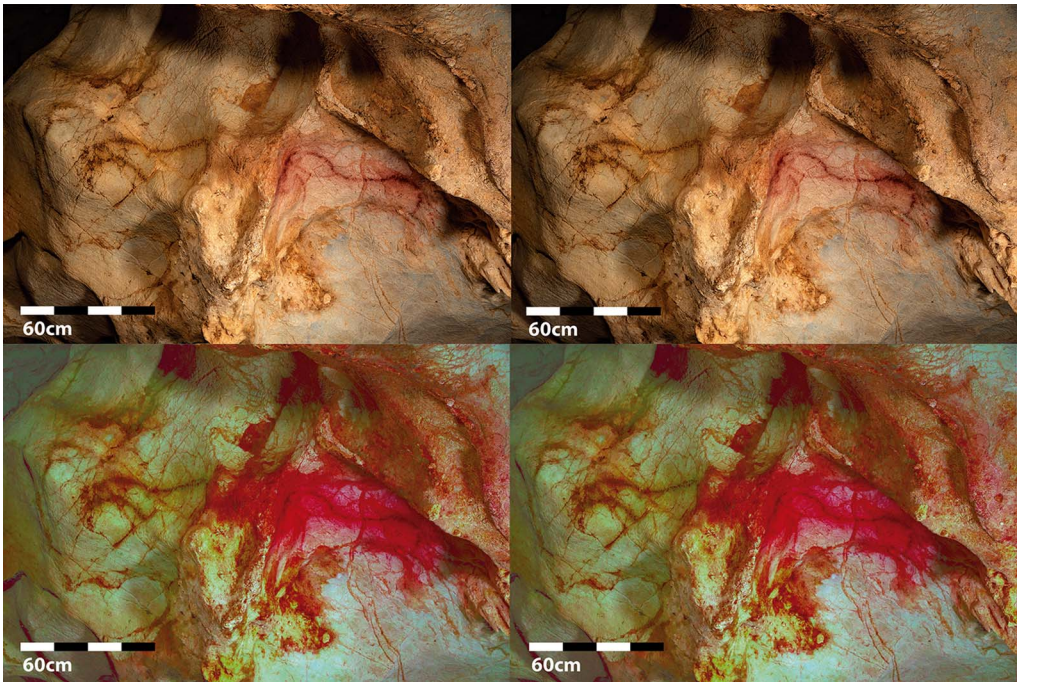

Figure 7. Top: photograph of horse 5, left (VI.D-D.5) in Gallery D; bottom: photograph processed using DStretch (images prepared by R. Asiain & P. Saura). URL for stereo pairs: https://www.flickr.com/gp/196948634@N08/y04FJr872e

New figures, new perspectives

In Gallery A, five animal species are represented. As is usual in Cantabrian art, horse and deer stand out (De las Heras 1994; Garate 2007). This association of deer with other animals, such as horses, is also characteristic of nearby caves such as Arenaza, Covalanas or El Pendo (González Sainz 2004). The two new horse figures (I.A-A.17 and II.A-A.18) identified in Gallery A reinforce this thematic association via proximity to the deer figures of groups 17 and 18. The newly identified horse (I.A-A.17), is depicted with a simple red line. Among the horse figures in Gallery A, lines predominate over detail (De las Heras Martín 1994: 289). This type of painted line, thin or thick, is one of the most widely used techniques in this gallery. The depiction of I.A-A.17 shows some stylistic and technical similarities with the horse figures of groups 30 and 34 (Figure 9). The group 34 horse has a narrow neck and a mane depicted with a curved line; these stylistic features are also found in I.A-A.17. Further, I.A-A.17 and the other two horse figures from groups 30 and 34 all incorporate natural rock formations of the cave walls into the painted images. In all three figures, the neck and mane are adapted to areas of concave relief and the chest area located on convex relief.

In Gallery A, some of the animal figures are painted using lines of dots, sometimes so closely spaced as to create continuous lines. Three animal figures depicted in this way have been attributed to the same possible hand: the 'Maître aux Contours expressionnistes' (Groenen & Martens 2010: 16–17). Two of these three figures (horses from groups 30 and 34) are

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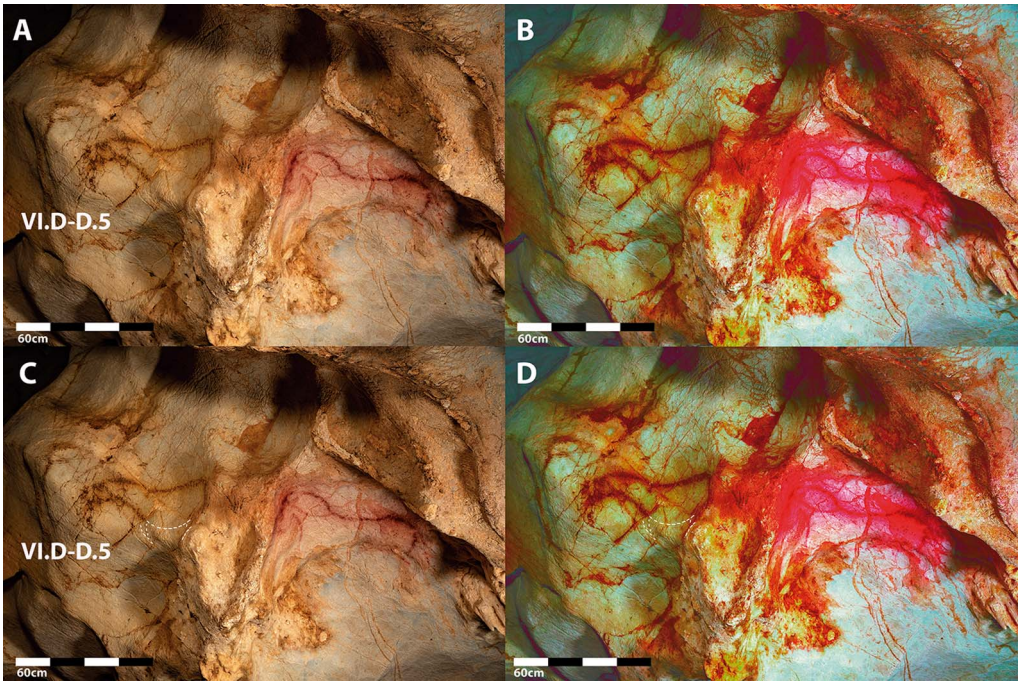

Figure 8. A) tracing of new anatomical elements of horse figure 5 (Gallery D) by authors; B) image processed using DStretch and tracing of new anatomical parts of horse figure 5 by authors (images prepared by R. Asiain & P. Saura). URL for stereo pairs: https://www.flickr.com/gp/196948634@N08/y04FJr872e

mentioned above; the third figure is the bovid 35 (Breuil *et al.* 1913: 13–14). These images share some characteristics, including the concave snout (or muzzle) profile, similar to an elk, and the mane depicted by isolated strokes. The new horse figure, II.A-A.18, features a muzzle depicted in a similar way to the more significant red horse figure in group 25 (Breuil *et al.* 1913: 11) and a mane like that in horse figure 44 (Breuil *et al.* 1913: 16), both also attributed to the 'Maître aux Contours expressionnistes'. These figures, made with dots and continuous lines, including II.A-A.18, tend to be partial depictions of animals and are characteristic of Gallery A (De las Heras Martín 1994: 291).

The incorporation of irregularities of the rock surface into the II.A-A.18 is similar to the horses 16, 34 and 44 (Breuil *et al.* 1913), all in Gallery A. In all five cases, the neck and cervical-dorsal lines are adapted to areas of concave relief. In addition, horses 25 and 44, and II.A-A.18 incorporate cracks in the cave wall using paint strokes to define the animal's chest. Based on these technical, stylistic and formal similarities with the figures made by the 'Maître aux Contours expressionnistes' in Gallery A, II.A-A.18 might also be assigned to this hand.

The final unpublished figure identified here, a possible aurochs labelled V.B-B.54, forms part of panel B.2 of Gallery B alongside two other bovid figures: bison 54 and aurochs 55. The lengths of bison 54 and aurochs 55 are 1.3m and 1.65m respectively (Figure 10). The size of the latter is equal to that of the new aurochs V.B-B.54 on the same panel. These two figures share other artistic conventions, such as the drawing of the shoulder hump, the back-lumbar line, the hindquarters and the belly. In addition, both animals are depicted from a

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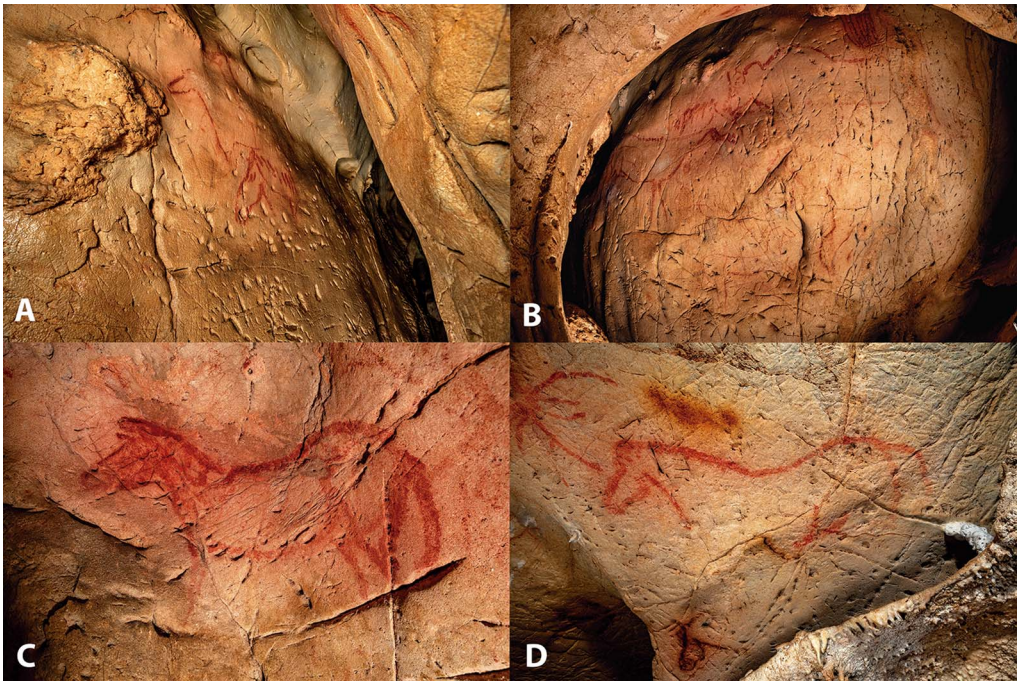

Figure 9. Depictions of horses in Gallery A: A) group 30; B) group 34; C) group 25; D) group 44 (images prepared by R. Asiain & P. Saura).

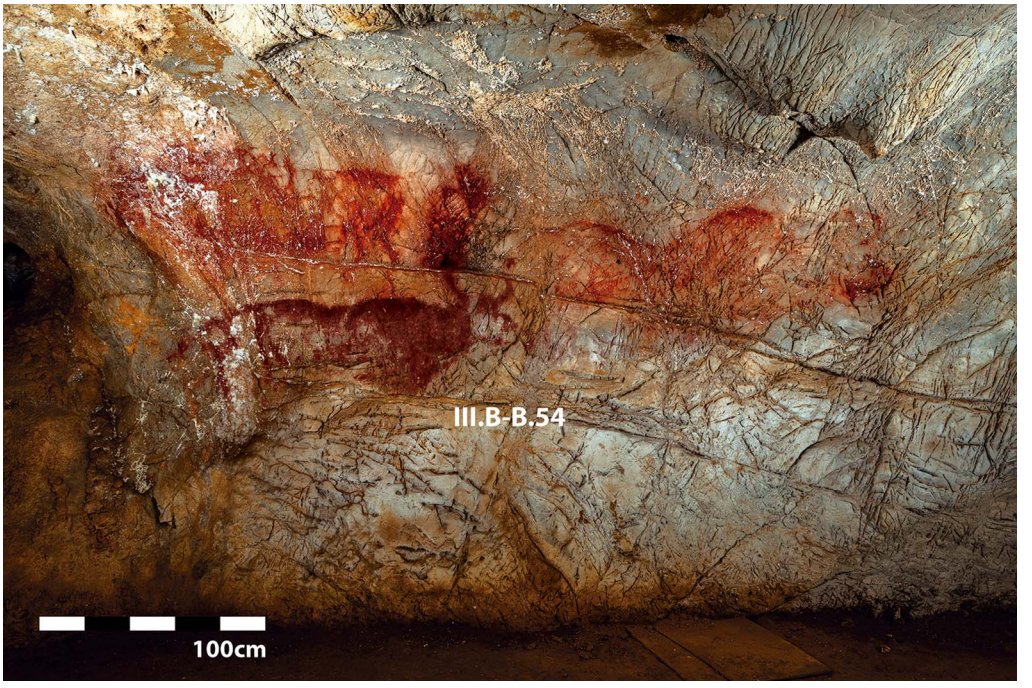

Figure 10. Panel B.2 in Gallery B showing group of animals including Figure III.B-B.54 digitally highlighted (images prepared by R. Asiain & P. Saura).

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similar perspective, represented in profile with the horns pointing forward. According to the traditional schemes of Breuil (1952) and Leroi-Gourhan (1983), this perspective is defined as 'perspective tordue' or 'perspective bi-angular droite' respectively, and associated with older phases (Style II, according to Leroi-Gourhan), contrasting with other technical characteristics typical of the Magdalenian period, such as outline engraving. With the discovery of the new aurochs figure V.B-B.54, the panel now presents a composition of four images: a sign (54) at the top of the panel, aurochs 55 facing right, bison 54 facing left, and V.B-B.54, below the bison 54, also facing left. With the addition of the new aurochs figure, the group depicted in this panel could be interpreted as a possible 'scene' or 'group portrait' (Figure 10).

The existence and interpretation of scenes in Palaeolithic parietal and portable art is much debated (Fritz & Tosello 2007; Bahn 2016; Davidson 2021). Despite the frequent depiction of groups of large mammals, few of these examples have been characterised as scenes (Guthrie 2005: 61). Panel B.2 does not correspond to the definition of a scene as a "representation of an action" (Villaverde 2021), typical of hunting scenes in Levantine art, but here we propose to consider it as a portrait of a group of mammals. According to Guthrie (2005: 61), if the animals that appear grouped more frequently in such panels are, today, social animals, these images could be interpreted in the sense of 'group portraits'. Indeed, other researchers (e.g. Davidson 2021: 18) argue that the absence of scenes in Palaeolithic art is due, in large part, to a misinterpretation of these images.

Regarding the use of natural rock formations to define or enhance animal figures, aurochs V.B-B.54 shares many similarities with aurochs 55. The horns, shoulder hump and hindquarters of both figures take advantage of areas of convex relief on the cave walls, while the chest and belly incorporate the cracks in the wall into the paint strokes. The use of the natural irregularities of cave walls to represent anatomical parts is found more widely at La Pasiega and adds to the list of other examples where the incorporation of natural characteristics of cave walls might be considered as an artistic technique on a par with painting or engraving (Lejeune 1985; Corchón 1986; Sauvet & Tosello 1998; Múzquiz & Saura 2002; Groenen & Clottes 2016). With this study (Asiain 2021), we strengthen this idea and advance its potential use as a complementary tool for stylistic interpretations.

We have also reinterpreted three other figures in Gallery A and Zone D where images have made use of natural rock formations. These figures, II.A-A.18 and III.A-A.5 in Gallery A, and VI.D-D.5 in Zone D, were previously considered incomplete; here, by taking into account the use of natural rock features, we have reinterpreted these as complete animal figures. A shared characteristic of these examples is that the anatomical elements evoked with natural formations, especially rock edges, are the hindquarters and ventral regions of the animals.

Conclusions

Using new digital stereoscopic recording methods, we have revisited the rock art of La Pasiega cave, identifying previously unrecognised animal figures and reinterpreting other figures thought previously to be incomplete. Stereoscopic photographs have allowed us to recognise correlations between images and irregularities of the rock walls of the cave, which are not perceptible in two-dimensional photographs. Further, we have shown that the identification of the use of the natural rock surface to define animal figures can complement the analysis of

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cultural processes, styles and even the possible authorship of individual images (Groenen & Martens 2010; Fritz & Tosello 2015). The incorporation of natural rock features into palaeolithic depictions clearly reflects something typical of the Ice Age parietal art (Bahn 2016: 160). Regarding that idea, several scholars have previously stated that understanding Palaeolithic cave art is impossible without consideration of the rock surfaces on which it was created (Sauvet & Tosello 1993; Groenen & Clottes 2016); here, we have used stereoscopic photography as a practical method of achieving this. La Pasiega cave provides a good example of a site where previous research relied on the description of the art based on colour, form and painting or engraving technique, with the natural rock surfaces only occasionally acknowledged. Going forward it will be essential to document both elements to ensure the full recognition and proper interpretation of such cave art. To conclude, Palaeolithic rock art should not be defined only by drawn, painted or engraved marks but also by the topographical features of the rock on which they are inscribed—the two elements cannot be separated.

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References

Aranburu, A. & E. Iriarte, 2017. El soporte rocoso del arte parietal paleolítico, in D. Gárate Maidagan & M. Unzueta (ed.) *Redescubriendo el Arte Parietal Paleolítico*. Últimas novedades sobre los métodos y las técnicas de investigación (Bilbao, 2016). *Kobie* (serie Anejos) 16, Diputación Foral de Bizkaia, Bilbao: 9–24.

Asiain, R. 2021. El aprovechamiento del soporte por parte de los artistas paleolíticos en cavidades de Asturias y Cantabria. La búsqueda de la tercera dimensión. Unpublished PhD dissertation, Universidad Complutense de Madrid.

Aujoulat, N. 1987. Le relevé des oeuvres pariétales paléolithiques: enregistrement et traitement des donnes, *Documents d'Archéologie Française* 9. Paris: Maison des Sciences de l'Homme.

Bahn, P. 2016. *Images of the Ice Age*. Oxford: Oxford University Press.

Balbín Berhmann, R. De & C. González-Sainz. 1993. Nuevas investigaciones en la cueva de La Pasiega (Puente Viesgo, Cantabria). *Boletín del Seminario de Estudios de Arte y Arqueología* 59: 9–34.

– 1994. Un nuevo conjunto de representaciones en el sector d.2 de la cueva de La Pasiega (Puente Viesgo, Cantabria). *Museo y Centro de Investigación de Altamira* 17: 269–80.

– 1995. L'ensemble rupestre paléolithique de 'La Rotonda', dans la galerie B de la grotte de La Pasiega (Puente Viesgo, Cantabria). *L'Anthropologie* 99: 296–324.

– 1996. Las pinturas y grabados paleolíticos del corredor b.7 de la cueva de La Pasiega (Cantabria), in A. Moure (ed.) *El hombre fósil 80 años después*: 271–94. Santander: Universidad de Cantabria.

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https://doi.org/10.15184/aqy.2023.122 Published online by Cambridge University Press

Breuil, H. 1952. *400 Siecles d'art pariétal*. Paris: Fourny.

Breuil, H., H. Obermaier & H. Alcalde Del Río. 1913. *La Pasiega à Puente Viesgo (Santander) (Espagne)*. Monaco: Chêne.

Brot, J. 2010. L'utilisation des reliefs naturels dans l'art pariétal paléolithique. *L'art Pleistocene Dans Le Monde (Arte Pleistoceno En El Mundo). Actes Du Congres IFRAO, Tarascon-Sur-Ariege, Septembre 2010. Symposium «Art Pléistocène En Europe»*. N° Spécial de Préhistoire, Art et Sociétés, Bulletin de La Société Préhistorique Ariège-Pyr, LXV–LXVI, 75–91.

Clottes, J. & D. Lewis-Williams. 1996. *Los Chamanes de la Prehistoria*. Barcelona: Ariel.

Corchón, M.S. 1986. *El arte mueble paleolítico cantábrico, contexto y análisis interno*. (Centro de investigación y Museo de Altamira Memoria 16). Madrid: Ministerio De Cultura.

Davidson, I. 2021. Scenes and non-scenes in rock art, in I. Davidson & A. Nowell (ed.) *Making scenes: global perspectives on scenes in rock art*: 16–31. New York: Berghan Books. https://doi.org/10.2307/j.ctv2tsxj5z.6

De Las Heras Martín, C. 1994. Estudio de la estructuración del espacio artístico en el Arte Paleolítico. La galería 'A' de la Cueva de La Pasiega. *Museo y Centro de Investigación de Altamira, Monografías* 17: 281–300.

Dodgson, N.A. 2004. Variation & extrema of human interpupillary distance. *Proceedings of SPIE - The International Society for Optical Engineering* 5291: 36–46.

French, J.W. 1921. The interocular distance. *Transactions of the Optical Society* 23(1): 44. https://doi.org/10.1088/1475-4878/23/1/304

Fritz, C. & G. Tosello. 2007. The hidden meaning of forms: methods of recording Paleolithic parietal art. *Journal of Archaeological Method and Theory* 14(1): 48–80. https://doi.org/10.1007/s10816-007-9027-3

Fritz, C., M.D. Willis & G. Tosello. 2016. Reconstructing Paleolithic cave art: the example of Marsoulas cave (France). *Journal of Archaeological Science: Reports* 10: 910–16. https://doi.org/10.1016/j.jasrep.2016.05.012

Garate, D., J. Rios-Garaizar & S. Talamo. 2019. Inserción de objetos en las paredes de la cueva de La Pasiega B (Puente Viesgo, Cantabria). *Zephyrus* 83: 187–99. https://doi.org/10.14201/zephyrus201983187199

Garate, D., O. Rivero, J. Rios-Garaizar, I. Intxaurbe & S. Salazar. 2020. Modelled clay animals in Aitzbitarte IV Cave: a unique Palaeolithic rock art site in the Cantabrian Region. *Journal of Archaeological Science: Reports* 31: 1–12. https://doi.org/10.1016/j.jasrep.2020.102270

Glory, A. 1965. L'oiseau de la Pasiega (Espagne), in *Congrès préhistorique de France, Compte rendu de la 16e session (Principauté de Monaco, 28 août – 5 septembre 1959)*: 596–607. Paris: Société Préhistorique Française.

González-Echegaray, J. 1964. Nuevos grabados y pinturas en las cuevas del Monte del Castillo. *Zephyrus* 15: 441–6.

González-Echegaray, J. & A. Moure. 1971. Representaciones rupestres inéditas en la cueva de La Pasiega (Puente Viesgo, Santander). *Trabajos de Prehistoria* 28: 401–05.

González Echegaray, J. & E. Ripoll. 1953/54. Hallazgos en la cueva de La Pasiega (Puente Viesgo, Santander). *Ampurias* 25–26: 43–65.

González Sainz, C. 2004. Arte parietal en la región cantábrica: centros y peculiaridades regionales. *Kobie Anejo* 8: 403–24.

González Sainz, C. & R. De Balbín Berhmann. 2000. Revisión de las representaciones rupestres paleolíticas de la cueva de La Pasiega en el conjunto del monte Castillo. Topografía y documentación artística, in R. Ontañón (ed.) *Actuaciones Arqueológicas en Cantabria, 1984-1999*: 69–73. Santander: Gobierno de Cantabria.

González Sainz, C., & R. De balbín berhmann. 2002. La Pasiega, in M.L. Serna, A. Valle & P. Smith (ed.) *Las cuevas con arte paleolítico en Cantabria:* 165–78. Santander: Asociación Cántabra para la Defensa del Patrimonio Subterráneo (A.C.D.P.S.), Consejería de Cultura, Turismo y Deporte del Gobierno de Cantabria.

Groenen, M. & J. Clottes. 2016. *L'art des grottes ornées du paléolithique supérieur*. Bruxelles: Académie Royale des Sciences.

Groenen, M. & D. Martens (ed.). 2010. Les peintures de la grotte de La Pasiega A (Puente Viesgo, Cantabrie) à l'épreuve de la méthode de l'attribution, in *Actes du 15e Congrès mondial de l'Union international des Sciences Préhistoriques et Protohistoriques* (UISPP, Lisbonne, 4–10

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https://doi.org/10.15184/aqy.2023.122 Published online by Cambridge University Press

Septembre 2006) (British Archaeological Reports International Series S2108): 13–21. Oxford: British Archaeological Reports.

Guthrie, R.D. 2005. *The nature of Paleolithic art*. Chicago: University of Chicago Press.

Harman, J. 2005. *Using decorrelation Stretch to enhance rock art images*. Available at: http://www.dstretch.com/AlgorithmDescription.html (accessed 20 December 2021).

Hoffmann, D.L., *et al.* 2018. U-Th dating of carbonate crusts reveals Neandertal origin of Iberian cave art. *Science* 395: 912–15. https://doi.org/10.1126/science.aap7778

– 2020. Response to White *et al.*'s reply: 'Still no archaeological evidence that Neanderthals created Iberian cave art' [*J. Hum. Evol.* (2020) 102640]. *Journal of Human Evolution* 144: 102810. https://doi.org/10.1016/j.jhevol.2020.102810

Lejeune, M. 1985. La paroi des grottes, premier 'mur' support artistique et document Archéologique. *Art et Fact* 2: 15–24.

Le Quellec, J.-L., J. Harman, C. Defrasne & F. Duquesnoy. 2013. DStretch® et l'amélioration des images numériques: applications à l'archéologie des images rupestres. *Les Cahiers de l'AARS* 16: 177–98.

Lerma García, J.L., M. Cabrelles López, S. Navarro Tarín & A.E. Seguí. 2012. Modelado fotorrealístico 3D a partir de procesos fotogramétricos: láser escáner versus imagen digital. *Cuadernos de arte rupestre* 6: 82–7.

Leroi-Gourhan, A. 1965. *Préhistoire de l'art occidental*. Paris: Mazenod.

– 1983. *Los primeros artistas de Europa*. Madrid: Encuentro.

Lorblanchet, M. 1993. Le support, in Groupe de Réflexion sur l'Art Pariétal Paléolithique (ed.) *L'art parietal paléolithique. Techniques et méthodes d'étude*: 69–80. Paris: Comité des travaux historiques et scientifiques.

Múzquiz Pérez-Seoane, M. & P. Saura. 2002. El facsímil del techo de los bisontes de Altamira, in J.A. Lasheras (ed.) *Redescubrir Altamira*: 219–42. Madrid: Turner.

Ogawa, M. 2010. Power of seeing: high quality and diversity of parietal art in Chauvet. In: Clottes J. (dir.) *L'art pléistocène dans le monde/Pleistocene art of the world/Arte pleistoceno en el mundo*, Actes du Congrès IFRAO, Tarascon-sur-Ariège, septembre 2010, Symposium « Art pléistocène en Europe ». N° spécial de *Préhistoire, Art et Sociétés, Bulletin de la Société Préhistorique Ariège-Pyrénées*, LXV–LXVI, 2010-2011, CD: 465–72.

Ontañón, R., V. Bayarri, J. Herrera & R. Gutiérrez. 2014. The conservation of prehistoric caves in Cantabria, Spain, in C. Saiz-Jimenez (ed.) *The conservation of subterranean cultural heritage*: 185–92. Leiden: CRC Press. https://doi.org/10.1201/b17570-23

Ontañón, R., V. Bayarri, E. Castillo, R. Montes, J.M. Morlote, E. Muñoz & E. Palacio. 2019. New discoveries of Pre-Magdalenian cave art in the central area of the Cantabrian region (Spain). *Journal of Archaeological Science: Reports* 28. Special Issue. https://doi.org/10.1016/j.jasrep.2019.102020

Ripoll, E. 1956. Nota acerca de algunas nuevas figuras rupestres de las cuevas de El Castillo y La Pasiega (Puente Viesgo, Santander), in Consejo Superior de Investigaciones Científicas (ed.) *IV Congreso Internacional de Ciencias Prehistóricas y Protohistóricas (Madrid, 1954)*: 301–10. Zaragoza: Secretaria General de los Congresos Arqueológicos Nacionales.

Rivero, O., J. Bécares & E. Álvarez-Férnandez. 2021. Arte paleolítico en Salamanca. Nuevos hallazgos en el yacimiento de El Paraje de La Salud. *Trabajos de Prehistoria* 78: 153–63. https://doi.org/10.3989/tp.2021.12270

Ruiz, J.F., *et al.* 2016. *4D—arte rupestre* (CEPAR Monografías 3). Murcia: Centro de Estudios de Prehistoria y Arte Rupestre.

Sakamoto, T., P. Pettitt & R. Ontañon-peredo. 2020. Upper Paleolithic installation art: topography, distortion, animation and participation in the production and experience of Cantabrian cave art. *Cambridge Archaeological Journal* 30: 665–8.

Saura Ramos, P., M. Muzquiz Pérez-Seoane, F. Bernaldo De Quirós, J.A. Lasheras Corruchaga & A. Beltrán. 1998. *Altamira*. Barcelona: Lunwerg.

Sauvet, G. & G. Tosello. 1998. Le mythe paléolithique de la caverne [The Palaeolithic cave myth], in F. Sacco & G. Sauvet (ed.) *Le propre de l'homme: psychanalyse et préhistoire* [*Uniquely human: psychoanalysis and prehistory*]: 55–90. Lausanne: Delachaux et Niestlé.

Slimak, L., J. Fietzke, G. Jean-Michel & R. Ontañon. 2018. Comment on 'U-Th dating of carbonate crusts reveals Neandertal origin of

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https://doi.org/10.15184/aqy.2023.122 Published online by Cambridge University Press

Iberian cave art'. *Science* 361(6408): eaau1371. https://doi.org/10.1126/science.aau1371

VILLAVERDE, V. 2021. Scenes in the Paleolithic and Levantine art of Eastern Spain, in I. Davidson & A. Nowell (ed.) *Making scenes: global perspectives on scenes in rock art*: 223–39. New York: Berghan Books. https://doi.org/10.2307/j.ctv2tsxj5z.20

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