



Paleolithic cave art at Simanya Gran (Northeast of Spain): New graphic and symbolic expressions in novel territories

Míriam Salas-Altès^{a,b,*}, Marcos García-Díez^c, Josep Maria Vergès^{a,b}, Artur Cebrià^d,
María Soto^{e,f}, Juan Ignacio Morales^{a,b}

^a Universitat Rovira i Virgili, Departament d'Història i Història de l'Art, Tarragona, Spain

^b Institut Català de Paleoeologia Humana i Evolució Social (IPHES-CERCA), Tarragona, Spain

^c Department of Prehistory, Ancient History and Archaeology, Complutense University of Madrid (UCM), Madrid, Spain, Research Group of Prehistoric Archaeology (GLAP, UCM 970949), Spain

^d SERP, Departament d'Història i Arqueologia, Secció de Prehistoria, Universitat de Barcelona, Barcelona, Spain

^e Madrid Institute for Advanced Study, MIAS, Madrid, Spain

^f Departamento de Prehistoria y Arqueología, Facultad de Filosofía y Letras, Universidad Autónoma de Madrid, Madrid, Spain

ARTICLE INFO

Keywords:

Rock art
Magdalenian
Iberian Peninsula
Social networks
Graphic territory

ABSTRACT

Recent years have witnessed significant advancement in the understanding of prehistoric behavior, leading to the discovery of new assemblages that challenge established knowledge within the discipline. This study presents a newly discovered Paleolithic art site in the northeast region of the Iberian Peninsula, specifically within the Simanya Gran cave complex. Excavations conducted since 2019 have revealed Neanderthal human remains and a complex litho-stratigraphic sequence dating back to the Middle Paleolithic, indicating human occupation spanning multiple periods. The documented graphic device (engravings and painting) exhibits thematic and formal characteristics comparable to Paleolithic art found in Spain and France. Through stylistic and contextual analysis, the paper proposes a tentative chronology for the graphic evidence, situating it within the mid-late Magdalenian period. Furthermore, the study explores the concept of graphic territories, suggesting that the distribution of similar graphic motifs across distant regions reflects intense socio-cultural interactions among prehistoric human groups. The significance of this discovery extends beyond its immediate geographic location, contributing to a broader understanding of Paleolithic art in the Mediterranean region and highlighting the importance of continued research in this field.

1. Introduction

In recent years, our understanding of prehistoric graphic and symbolic expressions has undergone new discoveries, reshaping or refining the foundations of knowledge accumulated over the past 125 years within the discipline. Beyond instrumental applications facilitating advancement in documentation, chronology, execution processes, uses, contexts, etc. (Barcia-García et al., 2023; Gheco et al., 2017; Hoffmann et al., 2017; Monna et al., 2022; Nelson et al., 2017; Ochoa and García-Díez, 2018; Tascon et al., 2016), the prospecting and search for new assemblages, mainly linked to the formalisation of researchers and the awareness of archaeological and speleological groups outside the

“traditional territories”, are associated with the delineation of new geographies for prehistoric art in general, and particularly for Paleolithic-aged art manifestations.

Paleolithic assemblages are recognized in “atypical” European contexts (Bahn et al., 2003; Clottes et al., 2010; di Maida et al., 2018; Ruiz-Redondo et al., 2018, 2019, 2020; Sigari et al., 2018, 2022), as well as in Asia (Aubert et al., 2014, 2018, 2019), Oceania (David et al., 2013) and Africa (Henshilwood et al., 2009; Huyge et al., 2007; Texier et al., 2013), some of them even dated to very early dates approaching the earliest presence of Anatomically Modern Humans in Europe. Focusing on the Iberian Peninsula as the geographic study case, it is now possible to certify the rupture of the traditional geographic distribution of

* Corresponding autor at: Institut Català de Paleoeologia Humana i Evolució Social (IPHES-CERCA), Zona Educacional 4, Campus Sescelades URV (Edifici W3), 43007 Tarragona, Spain.

E-mail addresses: msalas@iphes.cat (M. Salas-Altès), marcos.garcia.diez@ucm.es (M. García-Díez), jmverges@iphes.cat (J. Maria Vergès), marial.soto@uam.es (M. Soto), jmorales@iphes.cat (J. Ignacio Morales).

<https://doi.org/10.1016/j.jasrep.2024.104626>

Received 8 March 2024; Received in revised form 25 May 2024; Accepted 31 May 2024

Available online 17 June 2024

2352-409X/© 2024 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

Paleolithic art, considering that: i) the southern region of the peninsula (Collado Giraldo et al., 2019; Fernández-Sánchez et al., 2021; Medina-Alcaide et al., 2020; Ruiz Trujillo et al., 2015) and the Atlantic area (Baptista, 2001b, 2001a; Clottes, 1995; García-Diez et al., 2021b; Moreno and Álvarez, 2011; Teixeira and Sanches, 2017) present numerous and diverse graphic assemblages; ii) in the inland regions of the peninsula (Garate Maidagan et al., 2016; Reis and Vázquez Marcos, 2019) the addition of new locations is progressive, despite the absence of a homogeneous distribution across the territory; iii) in the northern region of the peninsula, (Garate Maidagan, 2018; García-Diez et al., 2021b) the extremes of dispersion are shifting both eastward and westward; iv) and in the Mediterranean region (Medina-Alcaide et al., 2023), despite a limited number of assemblages being documented, the current

dispersion covers the extremes of this area. This implies that the Iberian Peninsula is becoming an increasingly stable territory in terms of the dispersion of Paleolithic art manifestations.

The aim of this study is to present a new assemblage of prehistoric art, chrono-culturally attributable to the Paleolithic, located in the northeast region of the Iberian Peninsula. We present the documented graphic device and discuss its chronology and graphic position, as well as the significance of this new discovery for understanding the socio-cultural geographies of Paleolithic populations.

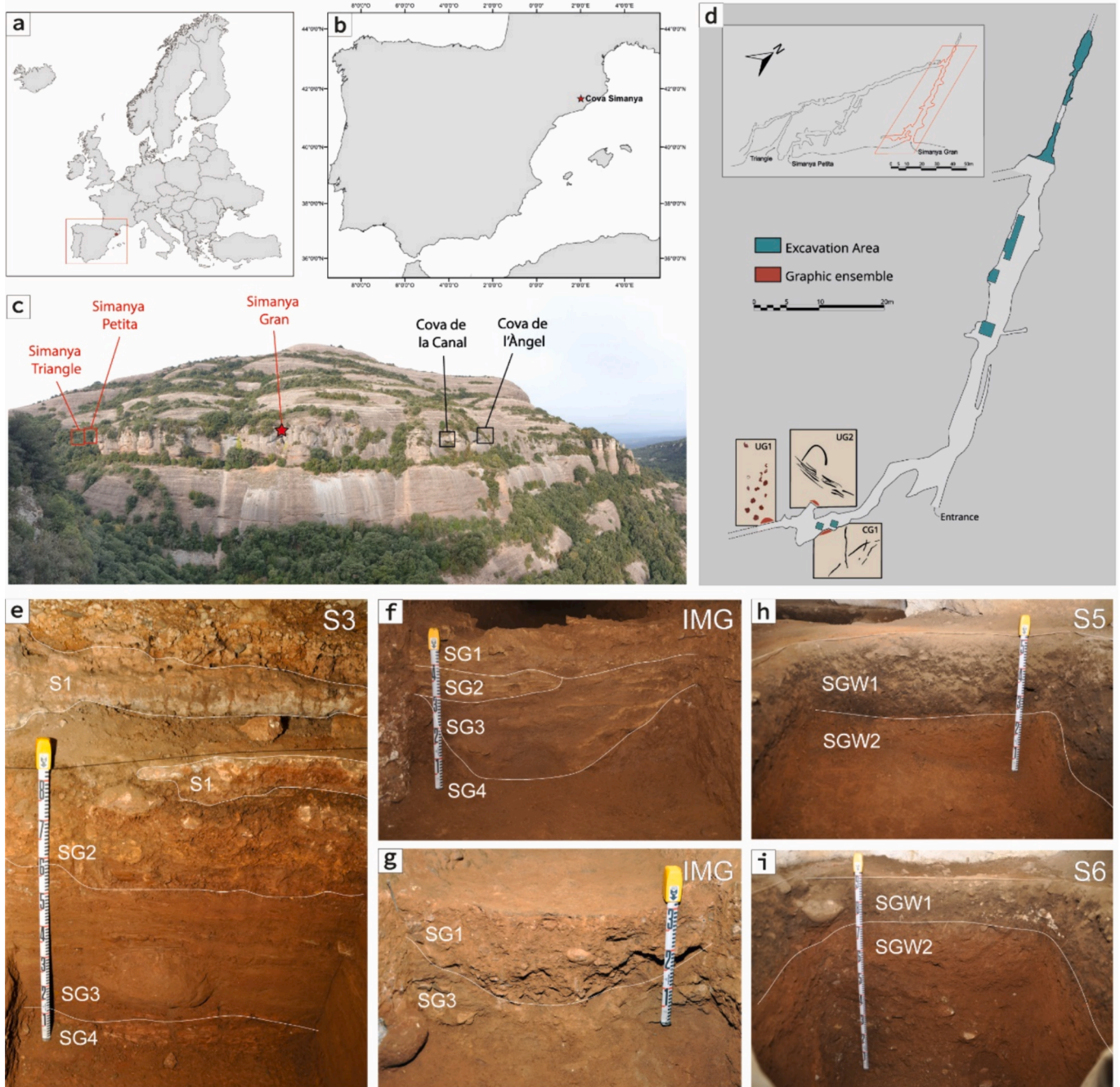


Fig. 1. (a-b) Location of Simanya Gran in Europe and Iberian Peninsula; (c) Panoramic view of the Montcau caves. The galleries known to belong to the Cova Simanya system are highlighted in red (Photo: E. Moreno); (d) Topographic map of Simanya Gran; Stratigraphic sections from the Main Gallery (e to g) and from the Western Gallery (h-i) sequence.

2. The Simanya complex and Simanya Gran: location, the cave and human occupations

The Simanya Complex (UTM ETRS89 417517–4614066, 885 m above sea level) is located in the Paleogene conglomerate formations of the Northeastern Iberian Peninsula, within the Sant Llorenç del Munt i l'Obac Natural Park (Barcelona) (Fig. 1). It comprises a set of cavities that are either part of a single karst system or share similar speleogenesis dynamics. This complex includes caves such as Cova del Triangle, Simanya Petita, Simanya Gran, Cova de la Canal, and Cova de l'Àngel (Morales et al., 2022).

Simanya Gran is the largest cave of the Simanya Complex, encompassing over 300 m of interconnected galleries including the western gallery, the main gallery, the so-called Pas de l'Oca Gallery, and the inner part of the main gallery. These galleries also connect Simanya Gran with Simanya Petita and Cova del Triangle.

Excavation tasks have been conducted in different sectors of the complex since 2019. Fieldworks in Simanya Gran began in 2020 following the discovery of Neanderthal human remains belonging to at least three individuals during the analysis of materials from unregulated excavations from the 1970's (Morales et al., 2023). Different test-pits have been performed along the cave, including the western gallery, the main gallery, and the inner part of the main gallery. The primary objectives of these excavations were to confirm the presence of Pleistocene record, identify the original context of the Neanderthal remains, and explore the potential use of the cave at different periods during the Paleolithic.

The excavations have confirmed the presence of both Holocene and Pleistocene archaeological records. Initial results suggest that the cave may have been a significant Middle Paleolithic site. However, due to a complex taphonomic history, much of this potential record has been lost, with only punctual remnants preserved of what once existed.

The litho-stratigraphic sequence of the main gallery reveals a primary Pleistocene sequence topped by a thin Holocene layer (5–30 cm thick) extending up to 53 m from the entrance. Beyond this, the Pleistocene units are uncapped, with four main litho-stratigraphic units identified (Unit SG4 to Unit SG1, from bottom to top).

Three archaeological layers within this sequence have been documented. Layer P1 from the Holocene phase contains artifacts ranging from the Late Neolithic to Late Antiquity, with funerary evidence dating back to the 5th century CE. The Pleistocene layer O300-PO400 (Unit SG1) features a paleontological scenario dominated by *Ursus cf. arctos* and *Capra pyrenaica*, and evidence of occasional Middle Paleolithic occupations, including a small lithic assemblage with Mousterian characteristics and faunal remains showing anthropogenic marks. A third upper Neanderthal molar was also found in this layer. The chronology available so far places the Mousterian occupations beyond 50 ka BP (Morales et al., 2023). Layer P300, has yielded a faunal assemblage of

Capra pyrenaica and isolated remains of *Cervus elaphus*, with no evidence of human activity up to date (Table 1).

Adding to the previously outlined litho-stratigraphic sequence, two test-pits have been excavated in the western gallery, though their stratigraphic correlation with the main gallery remains uncertain. In these test-pits, two distinct levels were identified: level SGW1, which appears to be equivalent to level P1 from the main gallery, and level SGW2. The latter, consisting of silts and reddish sands, yielded a single flint flake, presumably pre-Holocene, suggesting some level of Paleolithic activity in this gallery.

3. The graphic assemblage

3.1. Discovery and methodology

On 20th September 2020, during a visit to the site while the excavation campaign was taking place, one of the authors (JMV) observed engravings and traces of pigment on the walls of the west gallery that appeared to be prehistoric. As a result, during the archeological campaign of 2022, two of us, JMV and MSA, carried out a systematic visual survey of the walls and ceilings of the cave on 20th and 21th October in order to document new prehistoric graphic evidence, yielding positive results.

Subsequently, the documentation followed the field and laboratory protocols established by Servei d'Arqueologia i Paleontologia del Departament de Cultura de la Generalitat de Catalunya (2022), utilizing a photographic equipment consisting of a Nikon D750 reflex camera and two lenses of 40 mm and VR 28–300 mm.

3.2. Description

The identified evidence is located in the west gallery (Figs. 1 and 2), which has a length of 26.30 m and maximum dimensions of 7.39 m in height by 3.25 m in width. Except for the end section, where there are no graphic elements, the space is wide and easily passable. To access the gallery, it is necessary to walk through part of the vestibule, and at 7 m from the entrance, head towards the first passage on the west wall. Currently, this space is filled by numerous modern graffiti, created during times when the cave has been open to the public, as well as numerous bat scratches, especially at the end of the passage.

The survey has identified the following graphic evidence:

- Graphical unit 1 (UG1, Fig. 3). It is associated with a speleogenetic formation of coralloid type. The reading is limited due to the calcite growth processes that occurred after its execution, which may imply that our understanding of its formal recognition is partial. It is positioned 74 cm from the current floor of the cavity. The surface is convex, smooth and arranged vertically. It is formed by 14 associated

Table 1

Available ^{14}C dates from Simanya Gran. Calibrated in OxCal v4.4 (Bronk Ramsey, 2009) with IntCal 20.

Sample ID	Unit	Sector	Material	Species	AMS Code	^{14}C Age	1 s Error	Cal BP Age (68,3%)	Cal BP Age (95.4 %)	Reference
SG21.06.39	O300-PO400	301-70	Bone	Caprini	MAMS 56486	38,009	410	42440–42110	42620–41930	Morales et al., 2023
SG21.11.53	O300-PO400	301-72	Charcoal	<i>Pinus sylvestris</i> type	MAMS 56487	>49000	–	–	–	Morales et al., 2023
SG21.03.05	O300-PO400	301-86	Charcoal	<i>Pinus sylvestris</i> type	MAMS 56488	>49000	–	–	–	Morales et al., 2023
SG20.03.30	P1	299-48	Tooth	<i>Homo sapiens</i>	Beta-574953	1640	30	1548–1418	1588–1412	This study
SG20.08.40	SGW1	288-5	Tooth	<i>Homo sapiens</i>	Beta-574954	1630	30	1541–1418	1568–1409	This study
SG20.07.26	P1-F1	301-40	Charcoal	<i>Arbutus unedo</i>	CIRAM-9308	3427	31	3815–3592	3823–3574	This study
SG20.07.10	P1-F2	301-40	Charcoal	<i>Quercus ilex/coccifera</i>	CIRAM-9309	3315	31	3564–3486	3626–3455	This study



Fig. 2. Location of the graphic evidences UG1 and UG2 at west gallery from Simanya Gran and the spatial relationship between them.

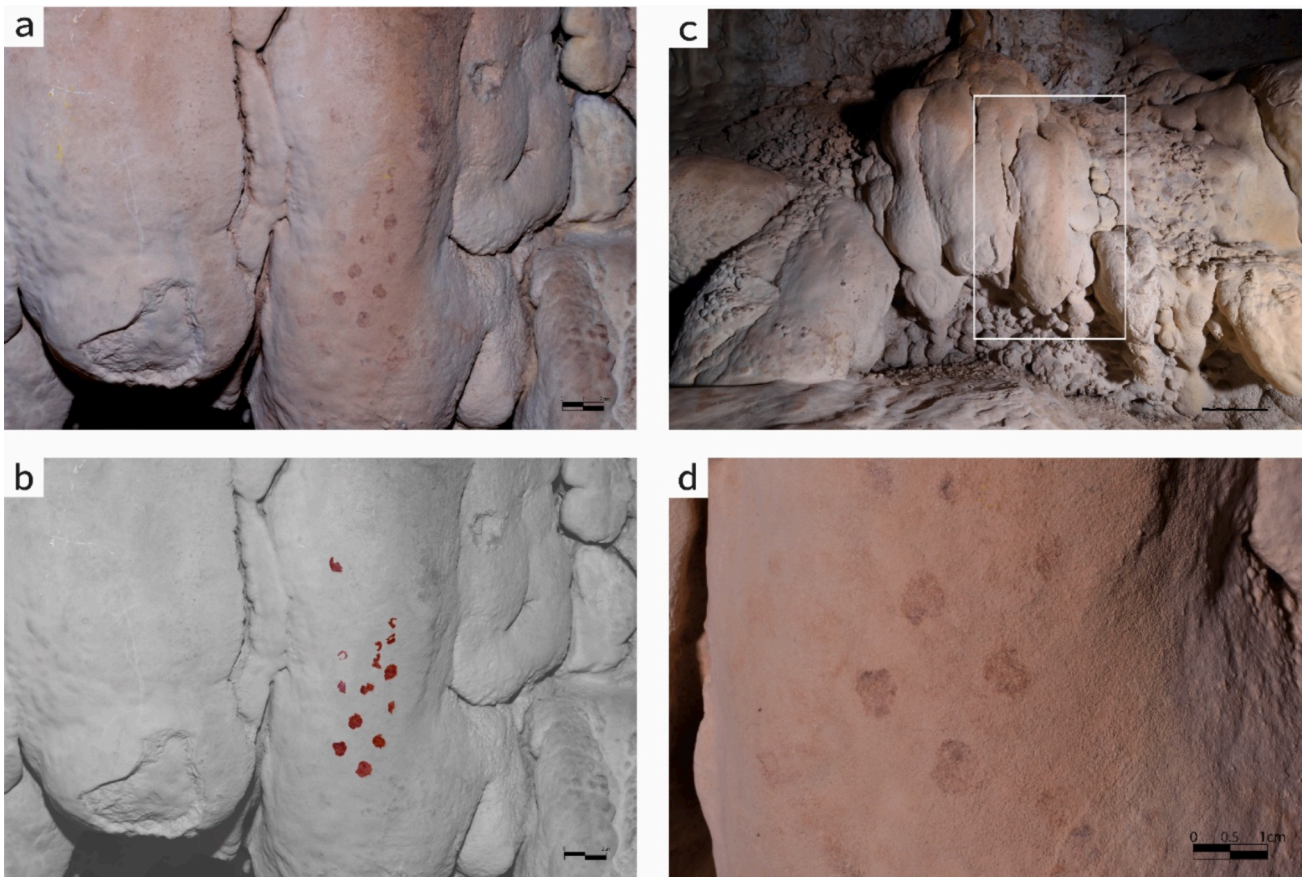


Fig. 3. Photograph and tracing of UG1 from Simanya Gran.

points with a morphology tending to be circular or semi-circular and a diameter between 0.3 and 0.7 cm. Four of these points have a lack of pigment in their interior, making only their perimeter visible. The majority of the dots (11) are arranged in two discontinuous lines forming two slightly oblique parallel series; the remaining three appear to be aligned vertically in a discontinuous manner. The execution technique is red paint, and, despite its poor state of preservation, the application medium is most likely digital. Considering the morphology of the support and its context, the unit was deliberately implanted in the central part of the formation, which is delimited by cracks and a change of surface. Its distribution corresponds to a maximum area of 9.1 cm in height and 2.7 cm in width.

- Graphical unit 2 (UG2, Fig. 4). It is located on the wall, 1.3 m from the current floor and 7.8 m in a straight line and to the right of UG1. Its reading is limited due to calcite growth processes that cover it. The surface is flat, smooth and arranged vertically. It is a complex representation that combines parallel and oblique lines with a semicircle physically linked to the lines in the upper left-medial part. According to typological classifications, it would fall into the clavi-form category. It measures a maximum of 5.2 cm in height and 7.1 cm in width. The execution technique is simple engraving, with a groove of variable width between 0.6 and 2 mm, and U-shaped morphology.
- Graphic ensemble 1 (CG1, Fig. 5). It is located on the wall, 2.6 m from the current floor and 2.2 m in a straight line and to the right of UG1 (on the opposite wall). The support is flat, irregular and arranged vertically. It consists of a small group of straight, curvilinear, and sinuous lines, some of them intersecting angularly. It measures a maximum of 17.8 cm in height and 23.6 cm in width. The execution technique is simple engraving, with a groove of variable width between 2.4 and 4.2 mm, and U-shaped morphology.

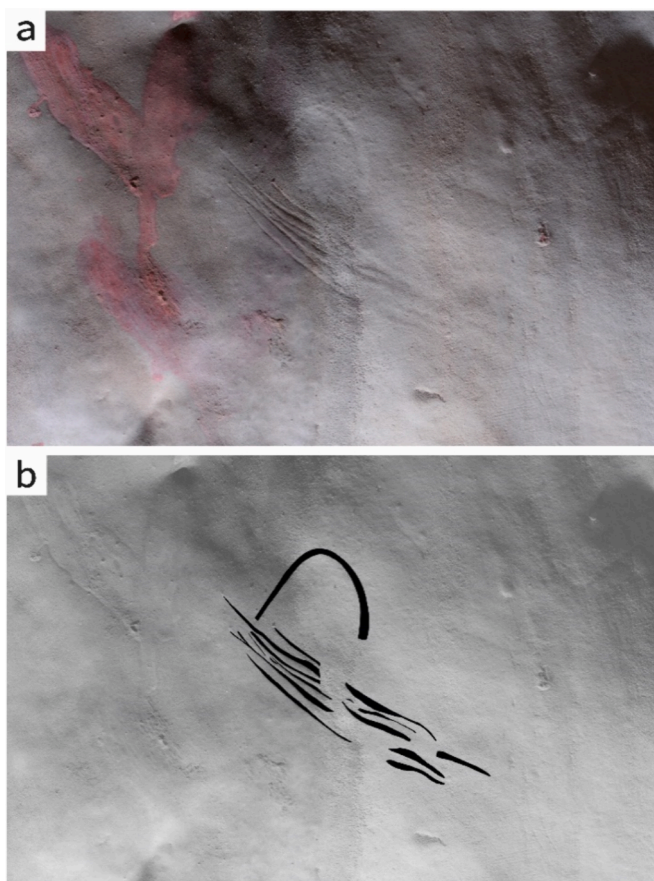


Fig. 4. Photograph and tracing of UG2 from Simanya Gran.

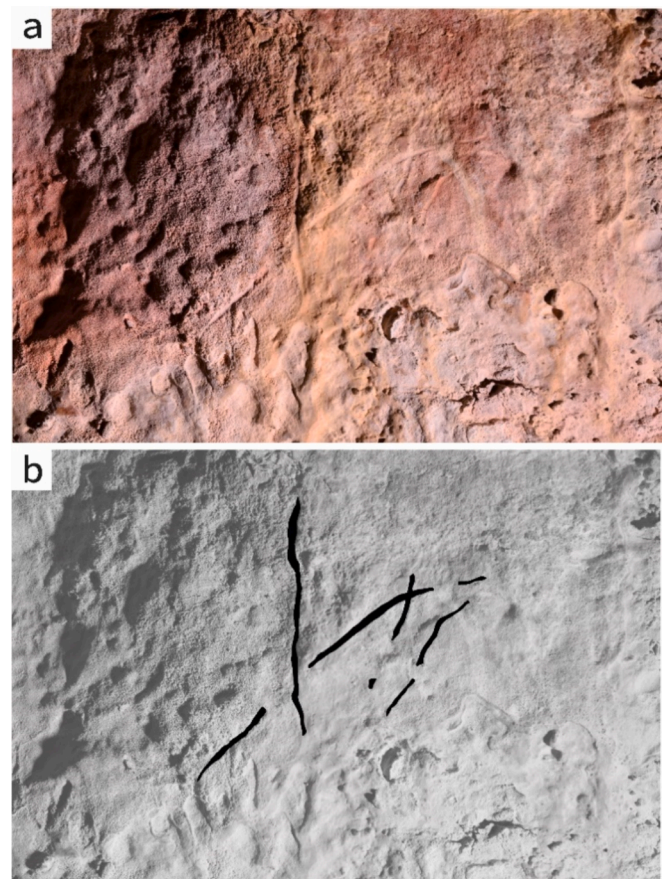


Fig. 5. Photograph and tracing of CG1 from Simanya Gran.

4. Discussion

4.1. Chronology

There is no numerical data to formalize a proposal about when the graphic evidence was executed. Furthermore, the cave has been occupied by humans since at least the Middle Palaeolithic and up to recent times, which theoretically opens up the possibility of considering a diversity of transits up to the present day, and consequently of potential chronologies. Additionally, the relative value of calcite growths is not applicable in this case, as certain 'modern' graffiti have been documented partially covered by this type of deposit. Therefore, the chronological discussion of UG1 and UG2 must be based on thematic comparisons with all the precision and certainty that entails; the limited formal definition of GC1 does not allow for comparisons.

4.1.1. About UG1

UG1 is classified within representations of dots (it should be noted that we dissociate the concept of dots from that of disks or "large" points, considering that the latter must exceed 5 cm in diameter), in this case organized in series.

The presence of dots in Paleolithic chronologies is documented in numerous archeological sites from the Iberian Peninsula (Ontañón et al., 2018) and their compositional variability is high, ranging from isolated dots to series whose diversity is related to the number of punctuations and their internal distribution/relationship. The search for comparisons for UG1 is focused on multiple and parallel alignments of points. This specific composition is documented in the interior of cavities distributed throughout the Iberian Peninsula, such as Los Marranos, Porquerizo, Chuffín, Calero II, Cudón, Cullalvera, La Garma, Cueva Auria, Peña de Candamo, Alto de Peñajorao, Fuente del Trucho, Nerja, Cueva del Moro,

Maltravieso and, among others, Cueva Hermosa (Ochoa and García-Díez, 2018; Robert, 2009). They are also documented in sites in the French Pyrenees, such as Niaux, Marsoulas, Trois Frères, Bedeilhac, Font de Gaume, Pech Merle, Fieux, Cougnac, Travers de Janoye, Combe Nègre, Merveilles and, among others, Moulin de Laguenay (Feruglio et al., 2007; Mélard et al., 2010; Petrognani and Robert, 2009; Robert, 2007, 2012).

The chronology attributed to these Paleolithic sites is diverse and not usually based on chronometric methodologies, thus their assignment is confined to a broad period, encompassing virtually all phases of the Upper Palaeolithic, from the Aurignacian to the Magdalenian. Assignments are typically determined, for apparently synchronous assemblages, based on the stylistic analysis of the zoomorphic figures with which they are associated, and for sites where different phases are identified on the basis of superimposition or spatial proximity with other motifs susceptible to dating, at least stylistically (Fernández-Sánchez et al., 2021; García-Alonso et al., 2022; García-Díez and Ochoa, 2017). Chronometrically, there are dates for similar figures to UG1 in Peña de Candamo, although the validity of the data has been under discussion (Corchón et al., 2014, 2015), and in Fuente del Trucho, it has been determined to be prior to 31,170 years ago (Hoffmann et al., 2017).

However, it must be recognised that seeking comparisons exclusively in Paleolithic sites conditions, *a priori*, the chronological evaluation. For this reason, it is necessary to evaluate the immediate surroundings, where morphologies of dots attributable to Levantine and Schematic graphic traditions are recognized. For example, in illuminated areas of shelters such as, among others, Cova dels Segarulls (Olèrdola, Catalonia), with diverse groupings of points of variable dimensions and highly irregular morphologies associated with anthropomorphs identified as archers; Abric de Can Castellví (Olèrdola, Catalonia), with a small grouping of punctuations associated with simplified zoomorphic figures; Abric de la Mariana (Sales de Llierca, Catalonia), with groupings of dots (one of them associated with a geometric motif) of variable dimensions and irregular morphologies (Viñas and Rubio, 2023); Abric de la Vall d'Inglà (Bellver de la Cerdanya, Catalonia), contains five punctuations, and Balma dels Punts (L'Albi, Cataluña), with zoomorphs and a large composition of small dots arranged in parallel lines that are over one m in length and 20 cm in height. (Alonso et al., 20043; Viñas, 2006). Historiography disassociates these sites, whose dots do not determine a composition similar to UG1, from Paleolithic phases, as it seems logical *a priori* in those ensembles with associated figurative motifs. Instead, they are attributed to prehistoric chronologies of Levantine and Schematic graphic tradition, or even later ones, as in Cova dels Segarulls, due to the presence of roman and medieval occupations in the surrounding area, as well as burials from recent prehistoric times (VVAA, 1990, 1994).

Based on the established comparisons, we consider that there are more connections between UG1 from Simanya Gran and Paleolithic sites than post-Paleolithic ones. These links are concretized by establishing comparisons: i) specific thematic comparisons, in terms of subject matter (common to both Paleolithic and post-Paleolithic traditions) and, particularly, in compositional or internal organization of the dots (linked only to the Paleolithic tradition); and ii) in terms of internal topographical location, as dark environments are only documented in the Paleolithic tradition. This would imply that the UG1 from Simanya Gran is more likely to belong to the Paleolithic art corpus than to post-Paleolithic traditions.

4.1.2. About UG2

Thematic connections in UG2 should be established considering its typology. According to Leroi-Gourhan's (1965) proposal, it would fit into the E typology of reduced claviform, and according to Casado (1977) it would fall into the B.II.1 form of claviform stem sign. We consider the formal affinity of UG2 with these categories is remarkable, both for the definition of a baseline (in our case executed by several lines, reminiscent of a flat area achieved through painting) and for the rounded tendency protuberance associated with the "base". This

morphology is documented in sites from the Cantabrian and French areas (Fuentes et al., 2019). In some of these sites, including Niaux and Cullalvera, similar forms to both UG2 and UG1 have been documented.

Traditionally they are attributed (González Sainz et al., 1997; Intxaube et al., 2019; Petrognani and Robert, 2009), based on style and specific theme, to a timeframe that is difficult to specify but, can be referred to a period comprised between 14/14,500 and 12,000 BP.

No similar forms to UG2 have been documented in post-Paleolithic assemblages. Therefore, based on the presented discussion, the most plausible hypothesis is to consider that UG2 was executed during the Paleolithic period.

4.2. Graphic territories

In recent decades, several authors have implemented the idea of Palaeolithic art as an indicator of social dynamics (Barandiarán, 1988; Bourdier et al., 2017; Conkey, 1987; Fritz et al., 2007; Fuentes et al., 2019; García Díez and Eguizabal, 2003; García-Díez, 1999; García-Díez et al., 2008, 2015; García-Díez et al., 2021a; Moure Romanillo, 1994; Naudinot et al., 2017; Rivero, 2015; Sauvet et al., 2008; Sieveking, 2003). The study of graphic convergences and divergences in the artistic evidence can be used to understand the culture, mobility and interaction systems of human groups. The concept of graphic territory should be understood from a wide perspective (García-Díez, 1999, 2002) and has traditionally been discussed and analyzed through anthropological and ethnographic studies (Fitzhugh et al., 2011; Gamble, 1982; Gravel-Miguel, 2016; Grove, 2009; Whallon, 2006; Wiessner, 1982; Wobst, 1976). Within the difficulty of defining a graphic territory, it must be understood as a part of the symbolic territory and, at the same time, of the social territory encompassing economic and other subsistence aspects of the groups.

Therefore, graphic territory should be taken as the representation of convergences in form, techniques and/or style in the graphic language and expression of Paleolithic groups. In the case of the study of social graphic territories, we need an assessment, not only of the chronology and the distribution of the iconographic representations, but also and most important, of the choice and value of the variables used. These elements determine the definition of a graphic territory.

The Simanya Gran cave is used to analyze the territorial and social value of Paleolithic graphics. The unique thematic and formal features of UG2 allow us to trace this specific formal element (claviform) in other Paleolithic art ensembles. The concept of claviform encompasses a wide variety of forms, but in our case study, the classic or conventional claviform morphotype is considered (González Sainz and González Morales, 1986), it is typically characterized by a straight line, arranged either horizontally or vertically, with a protuberance typically tending to be semicircular and positioned centrally or offset from the line. The metric formats are usually small or medium-sized.

The study of this topic is a common theme in literature (Bégouën et al., 2009; Fuentes et al., 2019; García-Díez, 2002; González Sainz, 2020; González Sainz et al., 1997; Vialou, 1986). Similar forms have been documented in El Pindal, La Cullalvera, Armintxe, Mas d'Azil, Bédeilhac, Fontanet, Niaux, Le Portel, Trois Frères, Tuc d'Audoubert, Sainte-Eulalie y Lascaux, and even, with less formal certainty but still relatable, could be recognized in Villars and Le Gabillou (Fig. 6).

The location of this morphotype in Simanya Gran, south of the Pyrenees, does not significantly deviate from the traditionally considered distribution, as it is located less than 200 km from the cave of Niaux, a significantly shorter distance compared to the maximum distances determined by the caves so far known: between El Pindal and Niaux (around 600 km), between El Pindal and Lascaux (around 600 km), and between Niaux and Lascaux (around 300 km). The discovery of Simanya Gran expands the distribution towards the eastern Iberian Peninsula and the southern Pyrenees.

The significance of the geographical distribution of this specific morphotype highlights the existence of graphic-symbolic links during

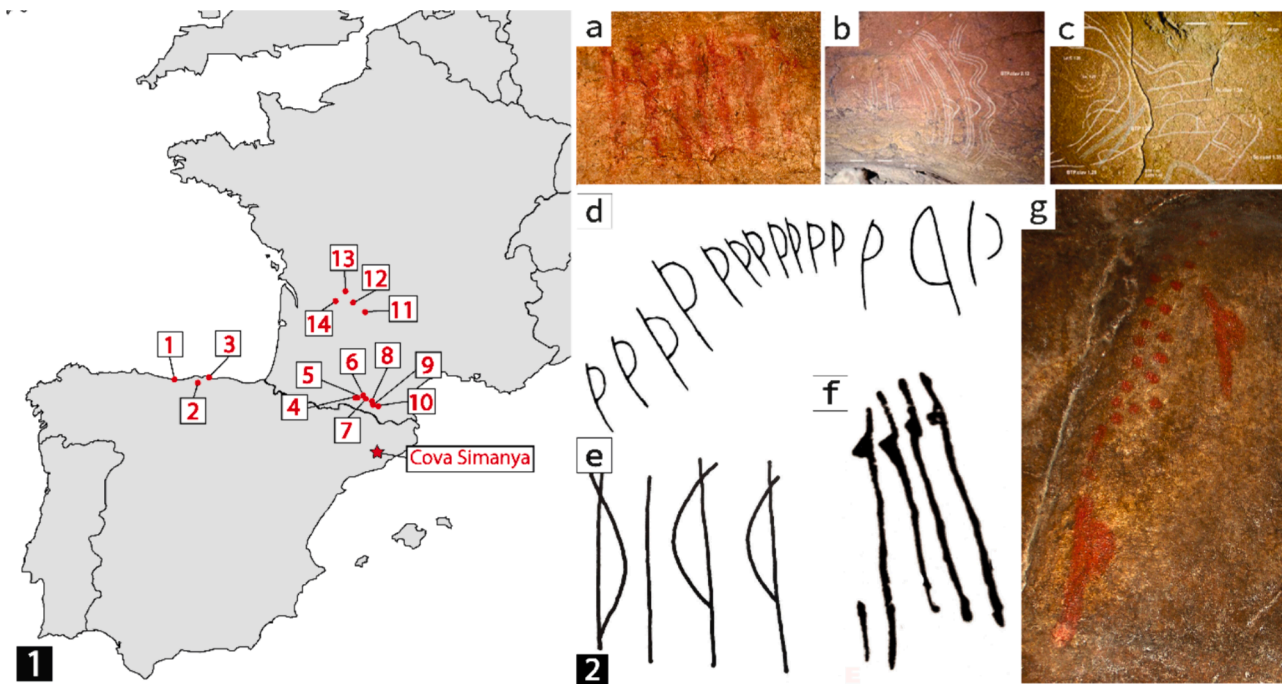


Fig. 6. (1) Geographical distribution of conventional claviform morphotypes in Paleolithic rock art mentioned in the text: 1. El Pindal; 2. La Cullalvera; 3. Armintxe; 4. Tuc d'Audoubert; 5. Trois-Frères; 6. Mas d'Azil; 7. Fontanet; 8. Bédouilh; 9. Niaux; 10. Le Portel; 11. Sainte-Eulalie; 12. Lascaux; 13. Villars; and 14. Le Gabillou. (2) Claviform formal types used for comparison for the UG2 of Simanya: A. Cullalvera; B and C. Armintxe; D. Trois-Frères; E. Lascaux; F. Fontanet; and G. Niaux. (González Sainz, 2020; Leroi-Gourhan and Allain, 1979; Vialou, 1986).

the middle-late Magdalenian periods. These links should reflect the intense socio-cultural and thought affinities, as well as the mobility of human groups across a wide territory.

5. Conclusions

The Simanya Gran cave contains a small corpus of rock art consisting mainly of a set of internally organized dots and a claviform shape located within the same interior space of the cave.

The location of the figures in an interior and unlit cave environment, as well as the established thematic comparisons, allow us to support that their execution corresponds to a Paleolithic period. Based on the established links, and considering the absence of numerical dating, it is viable to contextualize, on the basis of UG2 and the coexistence of forms similar to UG1 and UG2 within the same cavity, the graphic ensemble to a period between 14/14,500 and 12,000 BP, a mid-late phase of the Magdalenian.

The study of this subject enables a deeper understanding of graphic territories during the late Upper Paleolithic. It exemplifies and extends a model of distribution of graphic affinities over long distances that could correspond to intense and close social links. This could be representative of identity-based socio-cultural affinities.

Thus, the Simanya Gran rock art contributes to expanding the corpus of Paleolithic rock art sites in the Mediterranean region (including Cova del Tendo, Cova de la Font Major, possibly Cova de la Taverna, Cova de les Dones, Les Meravelles, Cova del Comte, and Abric d'En Melià, among others) (Casabó et al., 2017; Fullola and Viñas, 1985; Guillem Calatayud et al., 2001; Morales et al., 2022; Ripoll-Perelló, 1965; Ruiz-Redondo et al., 2023; Villaverde et al., 2009).

This discovery underscores the role that research on Paleolithic art will play in this sector in the coming years, addressing the current void more due to factors related to the research itself than to archaeological reality, as demonstrated by the discovery of the Paleolithic rock art site in Cova de la Font Major.

CRediT authorship contribution statement

Míriam Salas-Altès: Writing – original draft, Investigation, Formal analysis. **Marcos García-Diez:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Josep Maria Vergès:** Writing – review & editing, Resources, Methodology, Investigation. **Artur Cebrià:** Writing – review & editing, Project administration. **María Soto:** Writing – review & editing, Project administration. **Juan Ignacio Morales:** Writing – review & editing, Writing – original draft, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Acknowledgements

Research at Cova Simanya is funded by the Departament de Cultura de la Generalitat de Catalunya through the project CLT ARQ001SOL-172-2022, by the AGAUR Consolidated Research Groups 2021 SGR 01237 & SGR 01239, by the Spanish Ministry of Science and Innovation through the “María de Maeztu” excellence accreditation (CEX2019-000945-M), and by the Diputació de Barcelona through the Parc Natural de Sant Llorenç del Munt i l'Obac. MSA is funded by a FPU contract from the Spanish Ministry of Universities [FPU21/02177] and the work of MGD was supported by the Ministry of Science and Research of the Government of Spain [PID2020-115347GBI00].

References

- Aubert, M., Brumm, A., Ramli, M., Sutikna, T., Saptomo, E.W., Hakim, B., Morwood, M. J., van den Bergh, G.D., Kinsley, L., Dosseto, A., 2014. Pleistocene cave art from Sulawesi, Indonesia. *Nature* 514 (7521), 223–227. <https://doi.org/10.1038/nature13422>.
- Aubert, M., Setiawan, P., Oktaviana, A.A., Brumm, A., Sulistyarto, P.H., Saptomo, E.W., Istiawan, B., Ma'rifat TA, T.A., Wahyuono, V.N., Atmoko, F.T., Zhao, J.X., 2018. Palaeolithic cave art in Borneo. *Nature* 564 (7735), 254–257. <https://doi.org/10.1038/s41586-018-0679-9>.
- Aubert, M., Lebe, R., Oktaviana, A.A., Tang, M., Burhan, B., Hamrullah, Jusdi A., Abdullah, Hakim B., Zhao, J.X., Geria, I.M., 2019. Earliest hunting scene in prehistoric art. *Nature* 576, 442–445. <https://doi.org/10.1038/s41586-019-1806-y>.
- Bahn, P., Pettitt, P., Ripoll, S., 2003. Discovery of palaeolithic cave art in Britain. *Antiquity* 77 (296), 227–231. <https://doi.org/10.1017/S0003598X0009222X>.
- Baptista, A.M., 2001a. *Ocrez (Envendos, Mação, Portugal central): um novo sítio com arte paleolítica de ar livre*. *Arkeos: Perspectivas Em Diálogo* 11, 163–192.
- Baptista, A.M., 2001b. *Trabalhos do Centro Nacional de Arte Rupestre*. Al-Madan, II^a série(10), 201–203.
- Barandiarán, I., 1988. Constantes y variabilidad del arte portátil magdaleniense en la vertiente cantábrica. *Veleia* 5, 45–60.
- Barcia-García, C., Mas-Cornellà, M., Maximiano Castillejo, A. M., Jordá Pardo, J. F., 2023. Dots, circles and horses: New rock art evidence through image-based digital methods in Moro Cave (Tarifa, Spain). *Journal of Archaeological Science: Reports* 47 (December 2022). [10.1016/j.jasrep.2023.103826](https://doi.org/10.1016/j.jasrep.2023.103826).
- Bégouën, R., Fritz, C., Tosello, G., Clottes, J., Pastoors, A., Faist, F., 2009. Le sanctuaire secret des Bisons. II y a 14 000 ans, dans la caverne du Tuc d'Audoubert. *Somogy éditons d'Art and Association Louis Bégouën*.
- Bourdier, C., Chehmana, L., Malgarini, R., 2017. Introduction, in: *L'essor Du Magdalénien. Aspects Culturels, Symboliques et Techniques Des Faciès à Navettes et à Lussac-Angles, Actes de La Séance de La Société Préhistorique Française de Besançon, 17-19 Octobre 2013*. Bourdier, C., Chehmana, L. Malgarini, R. Poltowicz-Bobak, M., Paris, pp. 9–17.
- Bronk Ramsey, C., 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51 (1), 337–360. <https://doi.org/10.1017/S0033822200033865>.
- Casabó, J., de Dios, Boronat J., Marco, Y.C., Esquembre, M.A., Guillem, P.M., Martínez-Valle, R., Soler, B., Costa, P., Bolufer, J., 2017. New evidence of Palaeolithic rock art at the Cova del Comte (Pedreguer, Spain): Results of the first surveys. *Quaternary Int.* 432, 25–40. <https://doi.org/10.1016/j.quaint.2015.12.061>.
- Clottes, J., 1995. *Les Gravures Paléolithiques de Foz Côa (Portugal)*. *Int. Newsletter Rock Art* 10, 2–3.
- Clottes, J., Besesek, M., Gély, B., Ghemis, C., Kenez, M., Lascu, V.T., Meyssonier, M., Philippe, M., Plichon, V., Prud'homme, F., 2010. Découverte d'une nouvelle grotte ornée paléolithique en Roumanie, dans le département du Bihor. *L'art Pléistocène Dans Le Monde. Actes Du Congrès IFRAO, Tarascon-Sur-Ariège*, pp. 513–528.
- Collado Giraldo, H., Bea, M., Ramos-Muñoz, J., Cantalejo, P., Domínguez-Bella, S., Bello, J. R., Angás, J., Miranda, J., Gracia Prieto, F. J., Fernández-Sánchez, D., Aranda, A., Luque, A., García Arranz, J. J., Aguilar, J. C., 2019. Un nuevo grupo de manos paleolíticas pintadas en el sur de la Península Ibérica. La cueva de Las Estrellas (Castellar de la Frontera, Cádiz). *Zephyrus* 83(0 SE-Artículos), 15–38. [10.14201/zephyrus2019831538](https://doi.org/10.14201/zephyrus2019831538).
- Conkey, M., 1987. *L'art mobilier et l'établissement de géographies sociales*. *Colloque International D'art Mobilier Paléolithique* 293–295.
- Corchón, M.S., Garate, D., Valladas, H., Rivero, O., Pons-Branchu, E., Ortega, P., Hernandez, C., 2014. Back to the point: New datings for La Peña de Candamo Cave Art (Asturias). *Zephyrus* 73, 67–81. <https://doi.org/10.14201/zephyrus2014736781>.
- Corchón, M.S., Garate, D., Rivero, O., Valladas, H., Pons-Branchu, E., Murelaga, X., Ortega, P., Vicente, F.J., 2015. U-series and 14C datings for a newly discovered decorated area in the Palaeolithic cave of La Peña de Candamo (Asturias, Northern Spain). *J. Archaeol. Sci.: Rep.* 3, 371–380. <https://doi.org/10.1016/j.jasrep.2015.06.011>.
- Servei d'Arqueologia i Paleontologia del Departament de Cultura de la Generalitat de Catalunya, 2022. *Protocol II. Documentació dels Conjunts Rupestres de Catalunya*.
- David, B., Geneste, J.M., Petchey, F., Delannoy, J.J., Barker, B., Eccleston, M., 2013. How old are Australia's pictographs? a review of rock art dating. *J. Archaeol. Sci.* 40 (1), 3–10. <https://doi.org/10.1016/j.jas.2012.08.019>.
- di Maida, G., García-Díez, M., Pastoors, A., Terberger, T., 2018. Palaeolithic art at Grotta di Cala dei Genovesi, Sicily: a new chronology for mobiliary and parietal depictions. *Antiquity* 92(361), 38–55. [10.15184/ayq.2017.209](https://doi.org/10.15184/ayq.2017.209).
- Fernández-Sánchez, D., Collado Giraldo, H., Vijande Vila, E., Domínguez-Bella, S., Luque Rojas, A., Cantillo Duarte, J. J., Mira, H. A., Escalona, S., Ramos-Muñoz, J., 2021. A contribution to the debate about prehistoric rock art in southern Europe: New Palaeolithic motifs in Cueva de las Palomas IV, Facinas (Tarifa, Cádiz, Spain). *J. Archaeol. Sci.: Rep.* 38(May). [10.1016/j.jasrep.2021.103806](https://doi.org/10.1016/j.jasrep.2021.103806).
- Feruglio, V., Jaubert, J., Lorblanchet, M., 2007. Deux sanctuaires ornés en Quercy: le réseau de Combe Nègre à Frayssinet-le-Gélat (Lot). *Arts Et Cultures De La Préhistoire* 71–82.
- Fitzhugh, B., Phillips, S. C., Gjesfeld, E., 2011. Modeling hunter-gatherer information networks: an archaeological case study from the Kuril Islands in Information and its role in hunter-gatherer band adaptations, pp. 85–115. *Cotsen Institute of Archaeology Press Los Angeles, CA*.
- Fritz, C., Tosello, G., Sauvet, G., 2007. Groupes ethniques, territoires, échanges: la «notion de frontière» dans l'art magdalénien. In: *Cazals, N., González Urquijo, J.E., Terradas, T. (Eds.), Frontières Naturelles Et Frontières Culturelles Dans Les Pyrénées Préhistoriques*. Universidad de Cantabria, pp. 165–181.
- Fuentes, O., Lucas, C., Robert, E., 2019. An approach to Palaeolithic networks: The question of symbolic territories and their interpretation through Magdalenian art. *Quat. Int.* 503, 233–247. <https://doi.org/10.1016/j.quaint.2017.12.017>.
- Fullola, J.M., Viñas, R., 1985. El primer grabado parietal naturalista en Cueva de Cataluña: la Cova de la Taverna (Margalef de Montsant, Priorat, Tarragona). *Caesaraugusta* 61–62, 67–78. <https://ifc.dpz.es/recursos/publicaciones/10/40/04fullolavinas.pdf>.
- Gamble, C., 1982. *Interaction and alliance in Palaeolithic society*. *Man* 17, 92–107.
- Garate Maidagan, D., 2018. New insights into the study of Palaeolithic rock art: dismantling the "Basque Country Void". *J. Anthropol. Res.* 74 (2), 168–200. <https://doi.org/10.1086/695721>.
- Garate Maidagan, D., Rios Garaizar, J., Pérez Martín, R., Rojas Mendoza, R., Santonja Gómez, M., 2016. Arte Rupestre Paleolítico Al Aire Libre En El Paraje De La Salud (Valle Del Tormes, Salamanca). *Zephyrus* 77, 15–29. [10.14201/zephyrus2016771529](https://doi.org/10.14201/zephyrus2016771529).
- García Díez, M., Eguizabal, J., 2003. La cueva de Covalanas. El grafismo rupestre y la definición de territorios gráficos en el Paleolítico cantábrico in *Monografías Arqueológicas de Cantabria*. Gobierno de Cantabria.
- García-Alonso, B., Menéndez Fernández, M., Pérez-Díez, S., Maguregui, M., 2022. A study of the artistic corpus of red cave paintings in El Buxu cave (Cangas de Onís, Asturias, Spain). *J. Archaeol. Sci.: Rep.* 45, 103636. <https://doi.org/10.1016/j.jasrep.2022.103636>.
- García-Díez, M., 1999. Reflexiones en torno a la diversidad gráfica paleolítica. *Krei* 4, 29–47.
- García-Díez, M., 2002. Comportamiento gráfico durante el Paleolítico superior en el Alto Asón: análisis de los dispositivos iconográficos rupestres. *University of the Basque Country/UPV-EHU*.
- García-Díez, M., Ochoa, B., 2017. Arte rupestre en la cueva de Praileaitz I (Deba, Gipuzkoa). *Munibe Monographs. Anthropology and Archaeology Series* 1, 505–513. [10.2161630/mmaas.2017.1.20](https://doi.org/10.2161630/mmaas.2017.1.20).
- García-Díez, M., Eguizabal, J., Arrizabalaga, A., 2008. La Cueva de Venta Laperra. El grafismo parietal paleolítico y la definición de territorios gráficos en la región cantábrica. *Ayuntamiento De Carraza*.
- García-Díez, M., Ochoa, B., Rodríguez-Asensio, J.A., 2015. Arte rupestre paleolítico en la cueva de La Covaciella. Principado de Asturias.
- García-Díez, M., Ochoa, B., Vigiola-Toña, I., Garrido, D., Rodríguez-Asensio, A., 2021a. Reconstructing social networks through Palaeolithic art: graphic interactions in the Later Magdalenian. *Takurruna* 11, 367–386. <https://iers.squarespace.com/revista-takurruna>.
- García-Díez, M., Viñas, R., de Lombera-Hermida, A., Rubio, A., Rodríguez-Álvarez, X.P., Ochoa, B., Fábregas-Valcarce, R., 2021b. Cova Eirós (Galicia, Spain): The 'Finisterre' of Paleolithic cave art. *J. Archaeol. Sci. Rep.* 35. <https://doi.org/10.1016/j.jasrep.2020.102756>.
- Gheco, L., Gastaldi, M., Marte, F., Quesada, M., Tascon, M., Mastrangelo, N., 2017. About fires and paintings: Three stratigraphic insights on the history of a cave with prehispanic rock art. *J. Archaeol. Sci. Rep.* 15, 48–58. <https://doi.org/10.1016/j.jasrep.2017.07.009>.
- González Sainz, C., 2020. El conjunto rupestre de la cueva de Armitxe (Lekeitio, Bizkaia). Un centro ceremonial Magdaleniense con figuras raspadas. *Kobie, Serie Bizkaiko Arkeologi Indusketak*, pp. 5–128.
- González Sainz, C., González Morales, M.R., 1986. *La Prehistoria in Historia General de Cantabria (Vol. 1)*. Tatín.
- González Sainz, C., Muñoz Fernández, E., Morlote Expósito, J.M., 1997. De nuevo en la Cullalvera (Ramales, Cantabria). Una revisión de su conjunto rupestre paleolítico. *VELEIA* 14, 73–100.
- Gravel-Miguel, C., 2016. Using Species Distribution Modeling to contextualize Lower Magdalenian social networks visible through portable art stylistic similarities in the Cantabrian region (Spain). *Quat. Int.* 412, 112–123. <https://doi.org/10.1016/j.quaint.2015.08.029>.
- Grove, M., 2009. Hunter-gatherer movement patterns: Causes and constraint. *J. Anthropol. Archaeol.* 28, 222–233.
- Guillem Calatayud, P.M., Martínez Valle, R., Meliá Martínez, F., 2001. Hallazgo de grabados rupestres de estilo paleolítico en el norte de la provincia de Castellón: el Abric d'en Melià (Serra d'en Galceran). *SAGVNTVM* 33, 133–140.
- Henshilwood, C.S., D'Errico, F., Watts, I., 2009. Engraved ochres from the Middle Stone Age levels at Blombos Cave, South Africa. *J. Hum. Evol.* 57 (1), 27–47. <https://doi.org/10.1016/j.jhevol.2009.01.005>.
- Hoffmann, D.L., Utrilla, P., Bea, M., Pike, A.W.G., García-Díez, M., Zilhão, J., Domingo, R., 2017. U-series dating of Palaeolithic rock art at Fuente del Trucho (Aragón, Spain). *Quat. Int.* 432, 50–58. <https://doi.org/10.1016/j.quaint.2015.11.111>.
- Huyge, D., Aubert, M., Barnard, H., Claes, W., Coleman Darnell, J., De Dapper, M., Figari, E., Ikram, S., Lebrun-Nélis, A., Therasse, I., 2007. "Lascaux along the Nile": Late Pleistocene rock art in Egypt. *Antiquity* 81 (313), 1–3.
- Intxaurbe, I., Rivero, O., Salazar, S., Garate, D., 2019. La Cueva de Baltzola (Dima, Bizkaia): un nuevo conjunto de arte parietal paleolítico en un yacimiento clásico. *Trab. Prehist.* 76 (2), 323–334. <https://doi.org/10.3989/tp.2019.12240>.
- Leroi-Gourhan, A., Allain, J., 1979. *Lascaux inconnu*. Gallia Préhistoire 12.
- Medina-Alcaide, M., Intxaurbe Alberdi, I., Salazar, S., Torres Riesgo, A., Garate, D., Rivero, O., Sanchidrián Torti, J., Cosano, S., Granados, A., Ruiz-Márquez, R., G.I.E. X., 2020. "Los Márquez" cave: an unknown rock art site in Andalusia. *INORA* 86, 14–17.
- Medina-Alcaide, M.A., Vandevelde, S., Quiles, A., Pons-Branchu, E., Intxaurbe, I., Sanchidrián, J.L., Valladas, H., Deldicque, D., Ferrer, C., Rodríguez, E., Garate, D., 2023. 35,000 years of recurrent visits inside Nerja cave (Andalusia, Spain) based on

- charcoals and soot micro-layers analyses. *Sci. Rep.* 13 (1), 5901. <https://doi.org/10.1038/s41598-023-32544-1>.
- Mélar, N., Pigeaud, R., Primault, J., Rodet, J., 2010. Gravettian painting and associated activity at le Moulin de Lagenay (Lissac-sur-Couze, Corrèze). *Antiquity* 84 (325), 666–680. <https://doi.org/10.1017/S0003598X00100158>.
- Monna, F., Rolland, T., Magail, J., Esin, Y., Bohard, B., Allard, A.C., Wilczek, J., Chateau-Smith, C., 2022. ERA: A new, fast, machine learning-based software to document rock paintings. *J. Cult. Herit.* 58, 91–101. <https://doi.org/10.1016/j.culher.2022.09.018>.
- Morales, J.I., Cebrià, A., Soto, M., Rodríguez-Hidalgo, A., Hernando, R., Moreno-Ribas, E., Lombao, D., Rabuñal, J.R., Martín-Perea, D.M., García-Taberner, A., Allué, E., García-Basanta, A., Lizano, E., Marquès-Bonet, T., Talamo, S., Tassoni, L., Lalueza-Fox, C., Fullola, J.M., Rosas, A., 2023. A new assemblage of late Neanderthal remains from Cova Simanya (NE Iberia). *Front. Earth Sci.* 11 <https://doi.org/10.3389/feart.2023.1230707>.
- Morales, J. I., Cebrià, A., Vergès, J. M., Bañuls-Cardona, S., Cervelló, J. M., Hernando, R., Lombao, D., Marín, J., Marsal, R., Oms, F. X., Rabuñal, J., Rodríguez-Hidalgo, A., Soto, M., Rosas, A., Fullola, J. M., 2022. Palaeolithic archaeology in the conglomerate caves of north-eastern Iberia. *Antiquity* 96(387), 1–9. 10.15184/ajq.2022.34.
- Moreno, J.J.F., Álvarez, M.B., 2011. *Siega Verde. Arte Paleolítico al Aire Libre*. Junta de Castilla y León, Consejería de Cultura y Turismo.
- Moure Romanillo, A., 1994. *Arte paleolítico y geografías sociales. Asentamiento, movilidad y agregación en el final del Paleolítico cantábrico*. Complutum 5, 313–330.
- Naudinot, N., Bourdier, C., Laforge, M., Paris, C., Bellot-Gurlet, L., Beyries, S., Thery-Parisot, I., Le Goffic, M., 2017. Divergence in the evolution of Paleolithic symbolic and technological systems: The shining bull and engraved tablets of Rocher de l'Impératrice. *PLoS One* 12, e0173037.
- Nelson, E., Hall, J., Randolph-Quinney, P., Sinclair, A., 2017. Beyond size: The potential of a geometric morphometric analysis of shape and form for the assessment of sex in hand stencils in rock art. *J. Archaeol. Sci.* 78, 202–213. <https://doi.org/10.1016/j.jas.2016.11.001>.
- Ochoa, B., García-Díez, M., 2018. The use of cave art through graphic space, visibility and cave transit: A new methodology. *J. Anthropol. Archaeol.* 49, 129–145. <https://doi.org/10.1016/j.jaa.2017.12.008>.
- Ontañón, R., Montes, R., Morlote, J.M., Muñoz, E., 2018. Cueva Auria (Peñarrubia, Cantabria, Spain): a new cave with Palaeolithic rock art in Northern Spain. *INORA* 80, 11–18.
- Petrognani, S., Robert, E., 2009. À propos de la chronologie des signes paléolithiques. Constance et émergence des symboles. *Anthropologie – Int. J. Human Diversity Evolut.* 47 (1–2), 169–180. <https://shs.hal.science/halshs-01706629>.
- Reis, M., Vázquez Marcos, C., 2019. Arroyo de las Almas (La Fregeneda, Salamanca): un nuevo sitio con arte paleolítico al aire libre. *Trab. Prehist.* 76 (1), 138–146. <https://doi.org/10.5209/cmpl.66333>.
- Ripoll-Perelló, E., 1965. Una pintura de tipo paleolítico en la Sierra del Montsià (Tarragona) y su posible relación con los orígenes del arte levantino in *Miscelánea en Homenaje al Abate Henri Breuil*, pp. 97–305.
- Rivero, O., 2015. *Art mobilier des chasseurs magdaléniens de la façade atlantique (146th ed.)*. ERAUL, Études et recherches archéologiques de l'Université de Liège.
- Robert, E., 2007. L'utilisation des reliefs pariétaux dans la réalisation des signes au Paléolithique supérieur. *Anthropologie* 111 (4), 467–500. <https://doi.org/10.1016/j.anthro.2007.07.004>.
- Robert, E., 2009. The exploitation of the natural architecture of caves in the Upper Palaeolithic: the example of signs. *Bulletin De La Société Préhistorique Ariège-Pyrénées* 64, 39–50.
- Robert, E., 2012. Signes, parois, espaces. Modalités d'expression dans le Paléolithique supérieur ouest-européen in J. Clottes (Ed.), *L'art pléistocène dans le monde*, pp. 1941–1958. 10.4000/palethnologie.5582.
- Ruiz Trujillo, A.R., Barea, A.M.G., González, M.L., 2015. Síntesis de las manifestaciones gráficas paleolíticas en cavidades poco profundas del Campo de Gibraltar (Cádiz). *Las Sociedades Prehistóricas y Sus Manifestaciones Plásticas, Sobre Rocas y Huesos*, pp. 152–169.
- Ruiz-Redondo, A., Komšo, D., Maidagan, D. G., Moro-Abadía, O., González-Morales, M. R., Jaubert, J., Karavanić, I., 2019. Expanding the horizons of Palaeolithic rock art: the site of Romualdova Pečina. *Antiquity* 93(368), 297–312. 10.15184/ajq.2019.36.
- Ruiz-Redondo, A., Barciela, V., Martorell, X., 2023. Cova Dones: a major Palaeolithic cave art site in eastern Iberia. *Antiquity* 97(396):e32, 1–5. 10.15184/ajq.2023.133.
- Ruiz-Redondo, A., Mihailovic, D., Kuhn, S.L., Floss, H., Pastoors, A., 2018. First results of rock art survey in Central Balkans: Analysis of the graphic remains of Selacka 3 (Serbia). *Palaeolithic Rock Cave Art Central Europe* 109–117.
- Ruiz-Redondo, A., Yanovskaya, K., Zhitenev, V.S., 2020. The Easternmost European Palaeolithic Artists: Iconography and Graphic Features at Kapova Cave (Southern Urals, Russia). *J. Paleolithic Archaeol.* 3 (4), 967–988. <https://doi.org/10.1007/s41982-020-00065-2>.
- Sauvet, G., Fortea, J., Fritz, C., Tosello, G., 2008. Echanges culturels entre groupes humains paléolithiques entre 20.000 et 12.000 BP. *Préhistoire, Art Et Sociétés LXIII*, 73–92. <https://www.researchgate.net/publication/276936993>.
- Sieveling, A., 2003. *Groupes locaux et contacts à grand distance dans l'art paléolithique*. *Préhistoire, Arts et Sociétés, LVIII*, pp. 5–97.
- Sigari, D., 2022. *Palaeolithic rock art of the Italian peninsula. Edizioni del Centro, Capo di Ponte*.
- Sigari, D., Shirinli, S., Abdullayev, R., 2018. Gobustan Rock Art Cultural Landscape (Azerbaijan). *Encyclopedia Global Archaeol.* 1–8 https://doi.org/10.1007/978-3-319-51726-1_2827-1.
- Tascon, M., Mastrangelo, N., Gheco, L., Gastaldi, M., Quesada, M., Marte, F., 2016. Micro-spectroscopic analysis of pigments and carbonization layers on prehispanic rock art at the Oyola's caves, Argentina, using a stratigraphic approach. *Microchem. J.* 129, 297–304. <https://doi.org/10.1016/j.microc.2016.07.003>.
- Teixeira, J.C., Sanches, M. de J., 2017. O abrigo rupestre da foz do rio Tua no contexto da arte paleolítica e pós-paleolítica do Noroeste da Península Ibérica. *Portugalia* 38, 8–48. <https://doi.org/10.21747/09714290/port/ISSN>.
- Texier, P.J., Porraz, G., Parkington, J., Rigaud, J.P., Poggenpoel, C., Tribolo, C., 2013. The context, form and significance of the MSA engraved ostrich eggshell collection from Diepkloof Rock Shelter, Western Cape, South Africa. *J. Archaeol. Sci.* 40 (9), 3412–3431. <https://doi.org/10.1016/j.jas.2013.02.021>.
- Vialou, D., 1986. *L'art des grottes en Ariège magdalénienne. Supplement Gallia Préhistoire* 22 (1).
- Villaverde, V., Cardona, J., Martínez-Valle, R., 2009. L'art pariétal de la grotte Les Meravelles. Vers une caractérisation de l'art paléolithique pré-magdalénien du versant méditerranéen de la Péninsule Ibérique. *L'anthropologie* 113 (5), 762–793. <https://doi.org/10.1016/j.anthro.2009.09.017>.
- Viñas, R., Rubio, A., 2023. Primeres descobertes d'art rupestre esquemàtic a les comarques gironines: la Mariana i Bellavista. *Tribuna d'Arqueologia* 2023. https://www.youtube.com/watch?v=KA2NB7rDJk&list=PLo5dotam3UniCMHK_HaScmrpQtP-1TWk&t=1744s.
- VVAA, 1990. *Inventari del Patrimoni Arqueològic de Catalunya. Corpus de Pintures Rupestres: La Conca del Segre*, first ed. Departament de Cultura, Generalitat de Catalunya.
- VVAA, 1994. *Inventari del Patrimoni Arqueològic de Catalunya. Corpus de Pintures Rupestres: Àrea Central i Meridional*, second ed. Departament de Cultura, Generalitat de Catalunya.
- Whallon, R., 2006. Social networks and information: Non-“utilitarian” mobility among hunter-gatherers. *J. Anthropol. Archaeol.* 25 (2), 259–270. <https://doi.org/10.1016/j.jaa.2005.11.004>.
- Wiessner, P., 1982. Risk, reciprocity and social influences on !Kung San economics in E. Leacock and R. Lee (Eds.), *Politics and history in band societies*, pp. 61–84. Cambridge University Press.
- Wobst, H.M., 1976. Locational relationships in Paleolithic society. *J. Hum. Evol.* 5 (1), 49–58.