

The chronology of hand stencils in European Palaeolithic rock art: implications of new U-series results from El Castillo Cave (Cantabria, Spain)

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Summary - *The hand stencils of European Paleolithic art tend to be considered of pre-Magdalenian age and scholars have generally assigned them to the Gravettian period. At El Castillo Cave, application of U-series dating to calcite accretions has established a minimum age of 37,290 years for underlying red hand stencils, implying execution in the earlier part of the Aurignacian if not beforehand. Together with the series of red disks, one of which has a minimum age of 40,800 years, these motifs lie at the base of the El Castillo parietal stratigraphy. The similarity in technique and colour support the notion that both kinds of artistic manifestations are synchronic and define an initial, non-figurative phase of European cave art. However, available data indicate that hand stencils continued to be painted subsequently. Currently, the youngest, reliably dated examples fall in the Late Gravettian, approximately 27,000 years ago.*

Keywords - *Hand stencils, Origin of graphic behavior, Uranium series, Palaeolithic rock art, Chronology, Europe, Upper Palaeolithic.*

Introduction

In recent years, direct radiometric dating of most Palaeolithic parietal art has been based on the AMS radiocarbon method (Valladas *et al.*, 2001, 2013), the application of which is limited to figures drawn with charcoal. With regard to

hand stencils, therefore, this method has been used exclusively to date black examples, yet the greater majority of these are red and were made with a pigment based on iron minerals (Pettit & Pike, 2007). Developments in the application of the geo-chronological method of Uranium-series dating, however, now make it possible to

measure the age of very small samples of calcite stratigraphically associated with rock art (Pike *et al.*, 2005, 2012; García-Diez *et al.*, 2013a). Maximum and minimum dates for the creation of Palaeolithic engravings, paintings, drawings or even sculptures can thus be established when suitable calcite deposits exist.

The first published synthesis of Palaeolithic rock art (Alcalde del Río *et al.*, 1911) suggested that hand stencils were relatively old, placing them in the Aurignacian-Perigordian (approximately from 40,000 to 22,000 BP). This opinion was subsequently maintained by H. Breuil (1952). Later, A. Leroi-Gourhan (1965) proposed that these motifs were mostly of pre-Magdalenian age but that some could belong in his *style IV ancien* (Early Magdalenian). Later schemes have added nuances or simply accepted Breuil and Leroi-Gourhan's hypotheses. A. R. Verbrugge (1969) claimed that they were produced over a long period (from the Early or Middle Gravettian to the Late Magdalenian). R. Balbín & A. Moure (1981), and F. Jordá & J. L. Sanchidrián (1992) posited the existence of Magdalenian hand motifs, and Ripoll *et al.* (1999, pp. 113–114) suggested that some of these motifs were produced in the Late Magdalenian. C. González Sainz (1999) reasserted a pre-Magdalenian (essentially Gravettian) chronology, while others (Snow, 2006) assumed a generic pre-Solutrean chronology. Lorblanchet (2010) claimed they are all Gravettian, reflecting the present-day consensus—largely a by-product of the application of AMS radiocarbon dating to parietal art—that this kind of motif was produced mainly (if not exclusively) in the Gravettian.

Here, we discuss data provided by the recent U-series dating of calcite overgrowths associated with red hand stencils in El Castillo Cave (Cantabria, Spain), and assess it in the context of the cave's parietal art. We then consider the El Castillo pattern in the context of the direct and indirect chronological information available for the hand stencils of European cave art as a whole: namely AMS radiocarbon and U-series determinations, superimposition of figures, inclusion in or covering by sedimentary deposits, immediate archaeological context, and evidence from *art mobilier*.

The El Castillo hand stencils

El Castillo Cave is located in Monte Castillo (Puente Viesgo, Cantabria, Spain) (Fig. 1), a conical hill that stands out in the landscape and would have been a landmark for prehistoric populations. The hill overlooks the valley of the River Pas, and can be reached quickly from the valley bottom. Set in an area of high biotope diversity, rich in natural resources, the place would have been of great strategic and economic importance, as indeed implied by its outstanding archaeological record. Featuring rich evidence of human occupation since at least 150,000 BP, the hill's material culture and parietal art have played a key role in the reconstruction of the society and lifeways of European Palaeolithic hunter-gatherers. In addition, five of its caves—El Castillo (Alcalde del Río *et al.*, 1911), Las Monedas (Ripoll, 1972), Las Chimeneas (González Echegaray, 1974), La Pasiega (Breuil *et al.*, 1913; González Sainz & Balbín, 2010) and La Cantera (García-Diez, 2010a)—contain Palaeolithic art, forming a site complex with unique conditions for the understanding of the symbolic behaviour of Palaeolithic societies.

El Castillo Cave was discovered in 1903 and inscribed as a UNESCO World Heritage site in 2008. It is the most important of the Monte Castillo caves. From top to bottom, the archaeological sequence (Cabrera, 1984; Cabrera *et al.*, 2006) begins with Medieval and Chalcolithic deposits, which overlie an Azilian layer. Flowstone separates these levels from the Late Magdalenian ones, which yielded a large bone tool assemblage (uniserial and biserial harpoons, *sagaies* with circular cross-sections, and a perforated *bâton* with an engraved figure of a stag). An Early Magdalenian level follows, which documents intense human occupation, with numerous portable art objects including scapulae engraved mostly with figures of red deer hinds (Almagro, 1976). Below this level there is evidence of Solutrean, Gravettian and Aurignacian activity. The Mousterian sequence is long and comprises several levels, over the course of which one can observe the technical and cultural variability displayed by regional Neanderthal populations. The basal levels contain Acheulian lithics.

El Castillo Cave contains one of the most significant Palaeolithic art ensembles of Western Europe (Alcalde del Río *et al.*, 1911; González García, 2001; Groenen *et al.*, 2012). The interior of the cave, with numerous engravings, drawings and paintings —some of which enhance the natural shapes of wall and stalagmites to produce a volumetric, sculpture-like effect— is an “encyclopaedia of Palaeolithic cave art” as it covers almost the full range of the period’s themes, techniques and styles (García-Díez & Gutiérrez, 2010b).

The ensemble includes some 60 hand stencils, located mostly in the initial and middle parts of the cave (Fig. 2), between the Panel of the Polychromes and the Panel of the Hands (including an adjacent side passage). There are a few examples deeper in the cave, the innermost one being found in the Gallery of the Disks. All these stencils were made in red using the technique of spraying the pigment over the hand by blowing it from the mouth, directly or by means of a hollowed instrument.

Pike *et al.* (2012) obtained five dates for calcite samples covering two hand stencils in the Panel of the Hands (Tab. 1). For a detailed description of the analytical method, sampling procedure and quality control, see Pike *et al.* (2012)-supplementary materials, and García-Díez *et al.* (2013a). These results provide a *terminus ante quem* for the production of the paintings.

For one of these hands (Fig. 3A), located in the main part of the panel (Frieze F: in Alcalde del Río *et al.*, 1911, plate LXV, top LXVI: Fig. 105), two *ante quem* dates (2σ errors) were obtained from two different calcite overgrowths: $37,630 \pm 340$ years (sample CAST-6; O-82), and $25,020 \pm 290$ years (sample CAST-5; O-90). Since both dates are minimum ages, we can conclude that this hand stencil was painted at least 37,290 years ago with a 95.4% probability, and at least 37,130 years ago with a 99.7% probability.

The other stencil (Fig. 3B) is located in the side passage to the left of the Panel of the Hands (Frieze G, in Alcalde del Río *et al.* 1911, Fig. 105). The calcite film that covers it was sampled in two different points. Sample CAST-8 (O-58) gave a result of $24,340 \pm 120$ years. The upper part



Fig. 1 - Location of El Castillo cave.

of sample CAST-9 (subsample CAST-9A) gave a result of $20,810 \pm 120$ years (O-64) while its lower part (subsample CAST-9B) gave a stratigraphically consistent result of $22,260 \pm 110$ years (O-65). Consequently, this hand stencil was painted at least 24,220 years ago with a 95.4% probability, and at least 24,160 years ago with a 99.7% probability.

The earliest of these *termini* falls at the boundary between the Aurignacian I and the Aurignacian II in Europe (Banks *et al.*, 2013a,b), while the later falls at the boundary between the Terminal Gravettian and the Proto-Solutrean of Iberia and south-western France (Zilhão *et al.*, 1999; Renard, 2011). Is it possible that these hand stencils were painted at two different times? One must remember that these are minimum ages only —not absolute ages— and all of them are at least 24,000 years old yet *could* all be at least 37,000 years old. Their similar appearance (they are both complete, with palm, fingers and thumb, wrist, and part of the forearm), size, and technique (spray painting), as well as their spatial proximity (in two sectors of the same Panel of the Hands), suggest that they were produced within a relatively short time span. In addition, the two stencils are in all these respects very similar to the other motifs of the same kind found in the panel. Therefore, it seems

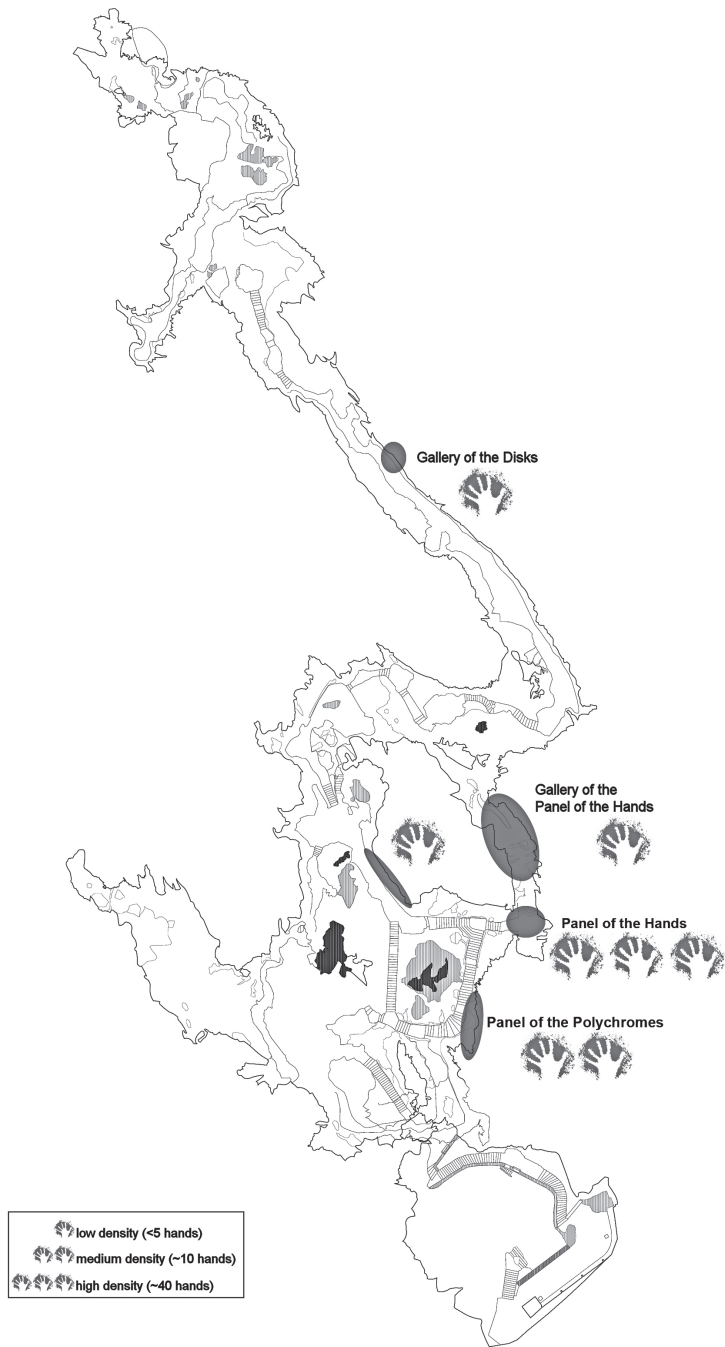


Fig. 2 - El Castillo cave: topographic plan and distribution of hand stencils.

Tab. 1 - Results of U-series disequilibrium dating for El Castillo samples. All isotopic ratios are activity ratios; errors are at 2σ . Ages are corrected for detritus by using an assumed $^{232}\text{Th}/^{238}\text{U}$ activity of 1.250 ± 0.625 and $^{230}\text{Th}/^{238}\text{U}$ and $^{234}\text{U}/^{238}\text{U}$ at equilibrium.

SAMPLE BIG-UTH	$^{230}\text{Th}/^{238}\text{U}$	$^{234}\text{U}/^{238}\text{U}$	$^{230}\text{Th}/^{232}\text{Th}$	UNCORRECTED AGE (KA)	CORRECTED AGE (KA)	YOUNGER AGE LIMIT (KA) (MINIMUM AGE)
O-82 (CAST-6)	0.5112 \pm 0.0029	1.6970 \pm 0.0035	48.81 \pm 0.49	38.15 \pm 0.27	37.63 \pm 0.34	37.29
O-90 (CAST-5)	0.38160 \pm 0.0028	1.8031 \pm 0.0034	36.81 \pm 0.34	25.51 \pm 0.21	25.02 \pm 0.29	24.73
O-58 (CAST-8)	0.5272 \pm 0.0020	2.5774 \pm 0.0049	222.70 \pm 0.49	24.42 \pm 0.11	24.34 \pm 0.12	24.22
O-64 (CAST-9A)	0.4244 \pm 0.0016	2.3851 \pm 0.0041	79.67 \pm 0.16	21.00 \pm 0.095	20.81 \pm 0.12	20.69
O-65 (CAST-9B)	0.4510 \pm 0.0017	2.3913 \pm 0.0046	145.57 \pm 0.28	22.37 \pm 0.10	22.26 \pm 0.11	22.15

reasonable to attribute the *ensemble* of hand stencils in the Panel of the Hands to a time around or prior to 37,000 years ago.

From an archaeological point of view, this attribution is contradicted neither by the parietal stratigraphy of the El Castillo art in general nor by that of the Panel of the Hands in particular. Since the time of the first study (Alcalde del Río *et al.*, 1911), the Panel of the Hands has been used in chronological models of Palaeolithic art based on the superimposition of figures, the comparison with *art mobilier*, and on notions of stylistic change through time. Both early (e.g., Breuil) and later (e.g., Leroi-Gourhan) scholars have observed that the hand stencils and disks from El Castillo form the base of the panel's artistic sequence (Breuil, 1952; Leroi-Gourhan, 1965). Above them were painted the first figurative representations in yellowish and orange hues (mainly bison), followed by signs (in yellow and red, of medium and large size), animals (mostly hinds) with multiple-line outlines and sometimes with striated interior shading, and, finally, red dots, black bison and engravings with single-line outlines.

This graphic stratigraphy, which in all likelihood covers a long period of time, demonstrates that hand stencils were among the first examples of parietal art to be produced at El Castillo. The

hypothesis that *all* of the hand stencils of the Panel of the Hands are more than 37,000 years old is also consistent with the fact that, on the basis of comparisons with well dated examples of *art mobilier*, an age of 29,000–27,000 cal BP has been proposed for the superimposed yellowish/orange bison (García-Díez *et al.*, 2008; García-Díez & Ochoa, 2012). Elsewhere in the cave, the Panel of the Hands' graphic stratigraphy is replicated in the Panel of the Polychromes, where hand stencils are located under a black bison dated to the Magdalenian by radiocarbon (Valladas *et al.*, 2001) and under red animal figures for which a pre-Magdalenian chronology is widely accepted.

Chronological information of European hand stencils

Chronological information is available for a total of 33 different instances of hand stencils of the European Palaeolithic. This information is summarized in appendix, and discussed below at greater length.

U-series determinations taken from calcite samples

The only U-series determinations of calcite directly covering hand motifs are those from El Castillo Cave described above.

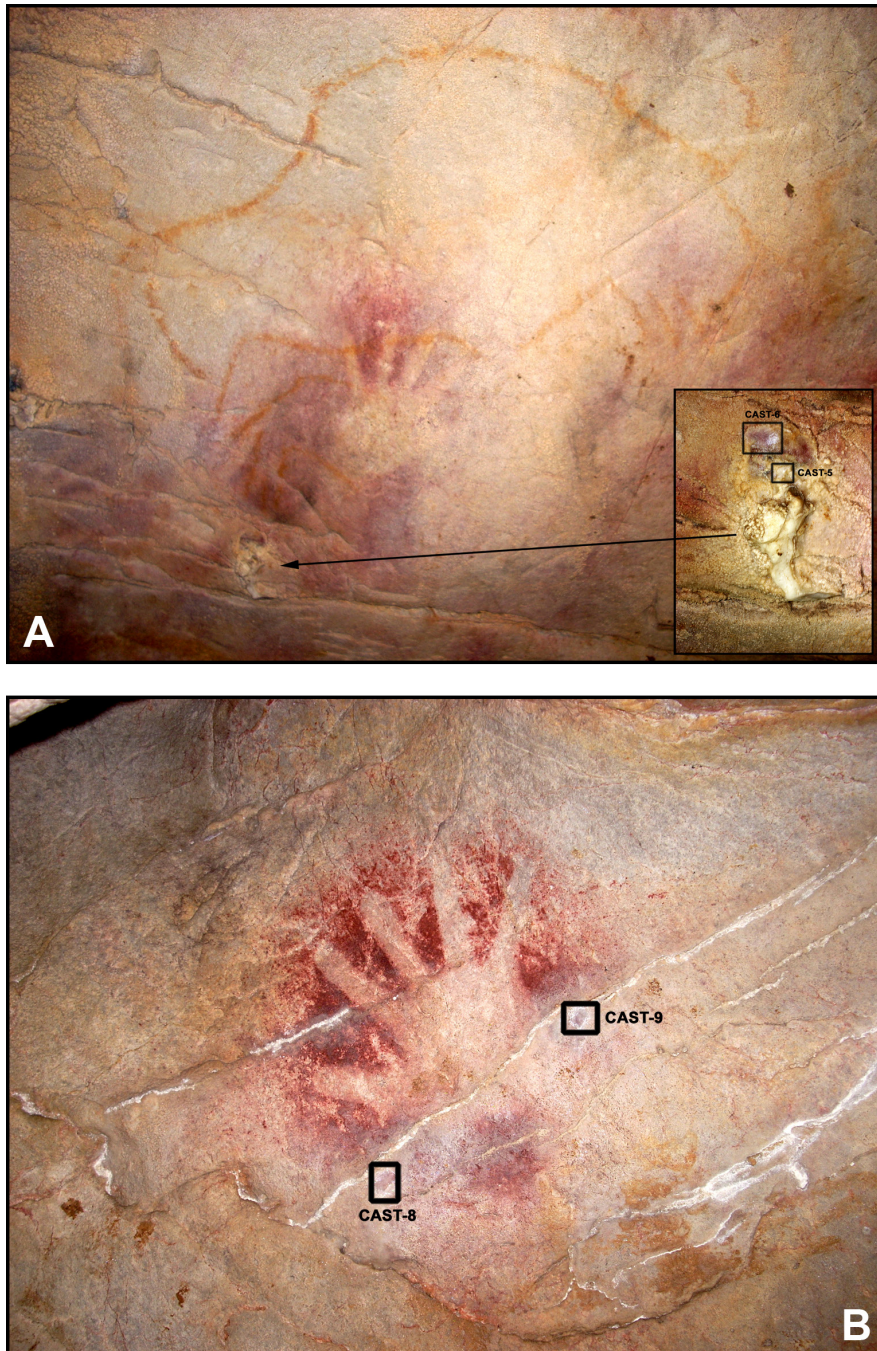


Fig. 3 - U-series dates stratigraphically associated with hand stencils from El Castillo Cave: (A) hand in Frieze F; (B) hand in and Frieze G.

A calcite sample taken a few centimetres away from a hand motif (Fig. VI/29) in the Galeria Inferior of La Garma Cave has been U-series-dated to $33,000 \pm 2,000$ BP (Arias & Ontañón, 2008); however, no direct stratigraphic relation exists between the painting and the calcite, and this determination cannot therefore be used to constrain the age of the stencil. The same applies to another red hand from La Garma (Arias & Ontañón, 2008, Fig. IX/17), for which the lack of direct stratigraphic relationship invalidates age claims based on the TL dating of adjacent stalagmitic material.

AMS radiocarbon determinations

Most radiocarbon determinations concerning hand stencils were obtained from three such black motifs in Cosquer Cave (Valladas *et al.*, 2001; Clottes *et al.*, 1997, 2005).

- M7. Right hand with folded or “mutilated” fingers: $27,110 \pm 430$ years BP (purified charcoal fraction; analysed carbon: 0.86 mg), $27,110 \pm 400$ years BP (purified charcoal fraction) and $26,180 \pm 370$ years BP (humic fraction; analysed carbon: 0.44 mg).
- M12. Left hand with intact and outstretched fingers: $24,840 \pm 340$ years BP (purified charcoal fraction) and $23,150 \pm 620$ years BP (humic fraction).
- M19. Left hand with folded small, ring and fore-fingers: $27,740 \pm 410$ years BP (purified charcoal fraction).

A further date is available for a stencilled black hand in La Fuente del Salín (González Morales & Moure, 2008): $18,200 \pm 70$ years BP (purified charcoal fraction; $\delta^{13}\text{C}$ of -24.5‰).

Stratigraphic relationship with a sedimentary deposit

Excavations in Abri Labattut documented two Gravettian levels and a Solutrean level, separated by sterile deposits. The Gravettian levels (with Noailles burins, La Gravette points and micro-gravettes) contained limestone blocks collapsed from the walls and roof as a result of natural processes. These blocks displayed remains of black and red paint, as well as pecked and engraved

lines (Breuil & Obermaier, 1935, pp. 151, 154). One of these limestone blocks bears a black hand stencil (Delluc & Delluc, 1982-1983), which must, therefore, be of at least Gravettian age. This age assignment is consistent with the general similarity of the Labattut art with that found in similarly fallen blocks recovered in Aurignacian deposits from nearby rock shelters (cf. Delluc & Delluc, 1991).

Stratigraphic relationship with directly dated motifs

Two AMS radiocarbon dates (purified charcoal fraction) exist for two figures in Magdalenian style of El Castillo’s Panel of the Polychromes (Moure & González Sainz, 2000).

- Bison 18a (superimposed on two red hinds and two red hand stencils): $13,520 \pm 130$ years BP, $13,060 \pm 200$ years BP, and $12,620 \pm 110$ years BP.
- Bison 18b (superimposed on three, perhaps four red hand stencils): $12,910 \pm 180$ years BP.

The Panel of the Dotted Horses of Pech Merle Cave was produced in the course of five phases (Lorblanchet, 2010). One of the horses is found under a black hand stencil; a sample from this horse was dated to $24,640 \pm 390$ years BP (Lorblanchet *et al.*, 1995).

In the Gallery of the Red Panels of Chauvet Cave, the black outline of a possible mammoth found under a red hand stencil has been dated to $26,340 \pm 330$ years BP (humic acid fraction; Feruglio *et al.*, 2011).

Immediate archaeological context

In Gargas Cave, a bone fragment placed in a natural crack next to Hand 4 in Panel 4 of the Entrance Chamber was dated to $26,860 \pm 460$ years BP (Clottes *et al.*, 1992) though again there is no demonstrable relationship between the bone fragment and art.

In Pech Merle, a piece of charcoal collected from the floor opposite the Panel of the Dotted Horses was dated to $11,380 \pm 390$ years BP (Lorblanchet, 1981), while a reindeer metacarpal with cut marks was dated to $18,400 \pm 350$ years BP (Valladas *et al.*, 1990). The “*rares, infimes et*

dispersées" pieces of charcoal, bone (broken splinters, mainly of reindeer and horse) and lithic artefacts have been related to a "few" prehistoric visits to the cave.

In the Grande Grotte d'Arcy, a bone found at the foot of a panel with partially represented hands was dated to $26,700 \pm 410$ years BP (Baffier & Girard, 1995).

Several pieces of charcoal on the floor of the Gallery of the Red Dots Panel in Grotte Chauvet have been dated. Two results were obtained for a piece collected at the foot of the panel with hand motifs: $26,360 \pm 290$ BP and $26,250 \pm 280$ years BP (Valladas *et al.*, 2001). The two results are similar and overlap at two sigma between 31,247 and 30,499 years calBP. A hard-to-interpret, anthropic pile of calcite fragments was documented opposite this panel (Geneste, 2005, p. 136).

A series of red dots, a black stencilled hand, and a red hand-print have been documented in the final part of Le Moulin de Laguenay Cave (Pigeaud & Primault, 2007). An archaeological excavation at the foot of the panel revealed two hearths, three lithic artefacts, fragments of stalactites (possibly used for the manufacture of pendants), and numerous fragments of the wall bearing red and black pigment that may be associated with the parietal paintings. One of the two hearths was dated to $26,770 \pm 380$ years BP.

A chamber in Les Garennes Cave displays a black hand stencil associated with red dots, black lines and remains of non-figurative red paintings (Airvaux *et al.*, 2006). The remains of a 10 to 20 year old human (vertebrae, sacrum, ribs, coccyx, femur and tibia) were found on the floor. The skeleton, attributed to *Homo sapiens*, was not complete and the skull was located in a nearby narrow passage. Two of the ribs were dated, to $27,110 \pm 210$ years BP and $26,790 \pm 190$ years BP (Henry-Gambier *et al.*, 2007). Their pooled mean radiocarbon age of $26,934 \pm 141$ years BP corresponds to the 95.4% probability interval of 31,089–31,471 years calBP.

In La Fuente del Salín (González Morales & Moure, 2008), a hearth was documented in Level 2, at the foot of an ensemble of red hand stencils. Dated to $22,340 \pm 510$ –480 years BP

and $22,580 \pm 100$ years BP ($\delta^{13}\text{C}$ of -26.6‰), this hearth was associated with fragments of red pigment, of a similar hue to the hand motifs. One bone fragment recovered on the floor elsewhere in the same chamber was dated to $23,190 \pm 900$ years BP ($\delta^{13}\text{C}$ of -21.5‰).

Art mobilier

Hand motifs are usually thought to be found exclusively in rock or parietal art. However, in Level B II of the Abri Morin (Deffarge *et al.*, 1975), in association with Late Magdalenian material, there was a horn fragment engraved with the palms of two hands and showing the fingers and nails.

Discussion

Chronology: quality, limitations and synthesis

The chronological information available for hand motifs in European Palaeolithic art is thus varied in source as much as in significance. In a few cases we have radiometric dates obtained directly on pigment itself (i.e. AMS radiocarbon dates for black hands); mostly, however, chronological information is indirect, deriving from stratigraphically related radiometric dates (U-series ages for over- or underlying calcite, AMS radiocarbon dates for superimposed or superposed black figures), the age of covering deposits, or the age of the immediate archaeological context. There is a single *art mobilier* example concerning a related theme.

Currently, the dating of calcite associated with rock art provides secure minimum ages only at El Castillo. One of the hand stencils in the Panel of the Hands is more than 37,290 years old and there is good reason to extrapolate this age to all the other hands in the same panel.

AMS radiocarbon determinations provide an age for the death of the wood that formed the charcoal. Assuming a short period between the time of death of the organism whence the charcoal derives and the time of painting, that age, if accurate, is also that of the paintings' production. Assessment of the determinations

for the hand motifs in Grotte Cosquer suggests, however, that not all are equally reliable because of problems with contamination revealed by the differences in apparent ages of the humic and humin fractions (Valladas *et al.*, 2003). For instance, in the case of Hand M12, the humic acid fraction result ($23,150 \pm 620$ years BP) is statistically younger than that of the purified charcoal fraction ($24,840 \pm 340$ years BP). There remains therefore the possibility that unremoved contaminants were present in the purified fraction and, therefore, that the corresponding result may also be too young.

The youngest result for sample M7 ($26,180 \pm 330$ years BP) is for its humic acid fraction; the purified charcoal fraction was dated to $27,110 \pm 390$ years BP. Both are statistically identical, and the latter result is virtually identical to the date of $27,110 \pm 350$ years BP obtained for the purified fraction of another sample taken on the same motif, strengthening the case for the M7 hand to have been accurately dated by these results. This date also agrees with the purified charcoal fraction of the Hand M19, so it is likely that the execution of both hands took place around 32 ka calBP.

Comparison of the three hands dated at Cosquer shows the following similarities and differences: a) M12 and M19 are associated spatially as they are both located in Group III of the same panel (Clottes & Courtin 1994, pp. 72-73), while M7 is located in Group VI of a different panel; b) all three hands were painted with black charcoal using the spraying technique; c) phalanges are missing from some of the fingers in both the M19 and M7 hands, while M12 is a complete hand; and, d) M12 is associated with “*profondes stries apparemment incisées avec un outil de silex surchargent cette main à la base des doigts*” (Clottes & Courtin, 1994, p. 72), while M19 and M7 display neither striations nor engravings.

The differences in anatomical rendering and in the presence of overlying striations and engravings may be regarded as supporting the contemporaneity of M19 and M7, on one hand, and a different age for M12, on the other; however, the radiocarbon data are insufficient to support such

a case. Therefore, the contemporaneity of these three hands cannot be eliminated, and perhaps should not, considering the spatial proximity of M12 and M19.

Regarding the direct radiocarbon date obtained on the Fuente del Salín hand, it has been stated that “it is not impossible that this sample could have been rejuvenated by organic contamination, in an environment with free air circulation and presence of numerous insects on the cave walls, owing to proximity to the surface” (In the original Spanish: “*no es imposible que esta muestra se haya rejuvenecido por contaminación orgánica, en un ámbito con amplia circulación de aire y presencia de abundantes insectos en las paredes por proximidad al exterior*”; González Morales & Moure, 2008, p. 81). One can also add that the sample was taken in a sector with thick calcite overgrowths, indicating the percolation of water potentially rich in organic acids. Therefore, this result should be considered as a minimum age only.

In sum, considering only the reliable results, available direct radiocarbon dates for the colouring matter used in hand motifs indicates the 30-33 ka calBP time span for their execution. There are no dates for the Gravettian occupation levels of Abri Labattut, but from the chronology of the technocomplex in France we can nonetheless assign a minimum age between 25,000 and 35,000 years calBP to the hand found on the fallen block recovered in those levels; this minimum age is consistent with the chronology indicated by the direct dates obtained elsewhere.

In combination with the ages obtained for associated motifs that have been directly dated, the position of hands in parietal stratigraphies can also yield indirect chronological information, namely at El Castillo, where, however, the relevant radiocarbon measurements present certain problems. Two of the three dates for Bison 18a are statistically the same and place its execution in the 15-17 ka calBP interval, but the third is significantly younger and falls in the same time range (14.2-15.4 ka calBP) as the single result for Bison 18b. This discrepancy may indicate that all are affected by residual contamination but, even as minimum

ages only, these results still provide a *terminus ante quem* of 14,000 years calBP ago for the production of the underlying motifs that is consistent with the direct dating evidence. The black line (a possible simplification of a mammoth) in Grotte Chauvet could in turn provide a *terminus post quem* of 30,423 years calBP for the overlying hand but the result obtained for this line was measured on the humic acid fraction and its accuracy must therefore be treated as an open issue. In fact, this sample is probably just a particular example of the issues of accuracy and association affecting the dating of Chauvet, as discussed by a number of authors (e.g., Pettit *et al.*, 2009).

Concerning the information provided by the immediate archaeological context, the Fuente del Salín hearth and bone dates are consistent, and indicate use of the cave during the 28th millennium calBP. Their functional relationship with the paintings, although strengthened by the similarity in composition between the pigment on the walls and the pigment remains on the floor, must be treated, however, as a working hypothesis, not a certainty. In Gargas Cave, the dates obtained for samples from the excavation performed in the *Chamber of the Hands* and for a bone fragment inserted in the walls of the GES Sector attest a series of occupations in the range of 30–35 ka calBP (Foucher *et al.*, 2011). Intense human activity took place in the decorated area from where the bone-on-the-wall comes, and is possibly dated by this sample to between 32 and 30.5 ka calBP.

At Pech Merle, one of the two “context” dates ($11,380 \pm 390$ years BP) is in fact a minimum age only, as noted by the dating laboratory: “*Il n’a pu être procédé à l’enlèvement des parties humiques, c’est pourquoi peut-être, l’âge est manifestement trop jeune: en fait devant des quantités aussi faibles de matière, la moindre pollution peut avoir de grandes conséquences. Le résultat est donc à considérer comme un âge minima.*” (Évin in Lorblanchet, 2010, p. 19). The other result indicates human visits around 22,000 years BP that do not necessarily relate to the art in the Panel of the Dotted Horses, where the graphic stratigraphy indicates that we are dealing with a single

composition and, hence, an age of around 30 ka calBP for the hand stencils therein (accepting the validity of the results for the dotted horses, produced a long time ago and by current standards best considered as potentially inaccurate). At the sites of Arcy, Chauvet, Le Moulin de Laguenay and Les Garennes no chronology is available for the art itself. The archaeological context is dated by five results placing human visits to these five caves in the 31.8–30.5 ka calBP range, the same as at Gargas.

Taken in isolation, the available contextual information indicates human visits to caves with hand stencils during the Early Gravettian (seven out of the ten radiocarbon determinations), the Middle-Late Gravettian (two determinations), and the Solutrean. Only at Fuente del Salín, however, is there some evidence to link the dated archaeological remains to the art on the walls. As cautioned by Clottes (1993), the human activities implicated in such visits could correspond to numerous situations not necessarily related with the parietal art either in time or in purpose.

No formal or stylistic comparisons can be made for the hand stencils produced with the spraying technique, as the outline depends on the anatomy of each hand (García-Díez & Garrido, 2013b). In contrast, stylistic variations can be appreciated in *art mobilier* because the production is associated with an artistic decision, as illustrated by the characterisation of the finger nails in the hands engraved on the Abri Morin horn core. The lack of intrinsic stylistic information thus prevents the use of comparisons with *art mobilier* as a means to assess the age of the parietal hands, while the fact that the Abri Morin object remains an isolated instance means that the thematic coincidence is in all likelihood devoid of chronological implications.

In conclusion, the information available is scant. The U-series dating of calcite shows that the production of hand stencils began in Aurignacian I times or earlier. The radiocarbon determinations define a period centred on the first half of the Gravettian. The combined radiometric information is consistent with that provided by the single instance of direct stratigraphic relationship

with an archaeological deposit, which indicates a minimum age in the Gravettian. A possible execution in the Solutrean and Magdalenian is unsupported by this evidence, and the couple of instances where an archaeological context of such age exists in caves with stencilled hands are insufficient to contradict the pattern arising out of the instances of direct relationship between motifs and chronological proxies.

Parietal hand stencils and the first expressions of non-figurative Palaeolithic art

As noted above, Palaeolithic hand stencils constitute a theme conditioned in their form by the specific anatomy of the hand that the artists used as a stencil to paint around. Therefore, they are not susceptible to displaying variations in their form that respond to an artistic decision, ones that could be used to determine styles. In this respect, from the thematic point of view, the hand motifs are natural figures (i.e. they refer to a real object in nature, like the animal figures), but from the graphic or artistic viewpoint they are non-figurative representations.

The information currently available, or at least the *terminus ante quem* dates derived from calcite overgrowths, places the origin of hand stencilling in a time range no later than the Early Aurignacian. At El Castillo, disks (or large dots) were spray-painted in a reddish-violet colour in a similar way to the hand stencils. In addition, both themes occupy a similar position in the graphic stratigraphy of the cave, as they are always at the bottom of all instances of superimposition. Therefore, the two themes seem to be associated, even though most hand stencils are in the Panel of Hands, in the initial part of the cave, and most disks are in the Gallery of the Disks, in its central part. Unless future chemical analysis of the colouring matter produces evidence suggesting otherwise, the parsimonious reading of this evidence is that the two themes are broadly synchronic. Given the date of $41,400 \pm 570$ years (Pike et al., 2012) for calcite covering one of the disks in the Panel of the Hands, the hand stencils are probably as old. It may therefore be proposed that, in Cantabrian Spain, Palaeolithic art

began with a non-figurative phase, as figurative representations are not documented until about 32,000 years ago (García-Díez & Ochoa, 2012).

Given that 41,800 years is but a minimum age for the earliest art, we cannot rule out the possibility that its beginnings in fact predate the Aurignacian, and that the earliest art was made by Neanderthals. The origin of non-figurative traditions in other contexts may be traced back to earlier times (García-Díez et al., 2013a). A reappraisal of decorated *art mobilier* and decorated bone tools older than the Aurignacian (d'Errico et al., 2003; Zilhão, 2007, 2011; García-Díez et al., 2013c) demonstrates that linear motifs (mainly simple lines or series of lines, more exceptionally geometric shapes) become relatively more common from about 60-50 ka years onwards. The potential for this early non-figurative tradition to include painting disks and hand stencils in caves is a relatively straightforward hypothesis to test, and would be confirmed by calcite ages predating the arrival of modern humans into Northern Spain at around 42-43 ka.

Conclusion

Hand motifs are non-figurative representations, as their form is generated by the spraying of pigment over a natural stencil. For this reason, they cannot be subjected to formal and stylistic analysis, as the anatomy conditions the form.

Based on the available information, these motifs were produced over a long period of time, beginning at least in the early Aurignacian (>37,000 years ago) and lasting until the Middle Gravettian (approximately 27,000 years calBP), as indicated both by direct AMS radiocarbon dating and by stratigraphic relationship with U-series-dated calcite overgrowths or with covering archaeological deposits. No directly relevant data support at present a later chronology for the hand stencils of European Palaeolithic parietal art.

Under an assumption of contemporaneity with the red disks from El Castillo Cave, the production of hand motifs goes back to >40,800 years; both themes would therefore represent the origin of

graphic expression in northern Spain. The fact that instances of non-figurative themes are known in earlier, Middle Paleolithic and Transitional archaeological contexts suggests that a similar chronology is conceivable for at least some of the hands stencilled on the walls of El Castillo Cave. The implication is that at least some of them those hands well be of Neanderthals, a hypothesis whose testing is the object of ongoing research on the chronology, mineralogy and biogeochemistry of the motifs and of the pigments used to paint them.

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The chronology of hand stencils in European Palaeolithic rock art

Appendix - Summary of the chronological information available for European Palaeolithic hand motifs.

ARCHAEOLOGICAL SITE	CONTEXT OF AGE MEASUREMENT	MOTIF	YEARS BP	YEARS CALBP (2 SIGMA)	YEARS AGO
Cosquer	Radiocarbon pigment date (AMS)	Black hand (MR7)	27110±430	32563-30933	
Cosquer	Radiocarbon pigment date (AMS)	Black hand (MR7)	27110±400	32439-30956	
Cosquer	Radiocarbon pigment date (AMS)	Black hand (MR7)	26180±370	31284-30310	
Cosquer	Radiocarbon pigment date (AMS)	Black hand (M12)	24840±340	30441-28861	
Cosquer	Radiocarbon pigment date (AMS)	Black hand (M12)	23150±620	29365-26529 (93.2%) 26516-26304 (2.2%)	
Cosquer	Radiocarbon pigment date (AMS)	Black hand (M19)	27740±410	33051-31273	
Fuente del Salín	Radiocarbon pigment date (AMS)	Black hand	18200±70	22097-21435	
El Castillo	Age of overlying calcite (U-series)	Red hand (frieze F)			37630±340
El Castillo	Age of overlying calcite (U-series)	Red hand (frieze F)			25024±290
El Castillo	Age of overlying calcite (U-series)	Red hand (friezeG)			24340±120
El Castillo	Age of overlying calcite (U-series)	Red hand (frieze G)			22260±110
El Castillo	Age of overlying calcite (U-series)	Red hand (frieze G)			20810±120
Labattut	Age of deposit containing fallen block with the motif	Black hand	~26500/~23500	~29500/~25500	
El Castillo	Date for overlying motif (AMS)	Black bison (18a)	12620±110	15425-15384 (0.7%) 15247-14174 (94.7%)	

Appendix - Summary of the chronological information available for European Palaeolithic hand motifs (continued).

ARCHAEOLOGICAL SITE	CONTEXT OF AGE MEASUREMENT	MOTIF	YEARS BP	YEARS CALBP (2 SIGMA)	YEARS AGO
El Castillo	Date for overlying motif (AMS)	Black bison(18a)	13060±200	16659-15.077	
El Castillo	Date for overlying motif (AMS)	Black bison(18a)	13520±130	16967-16024 (94.7%) 16016-15975 (0.7%)	
El Castillo	Date for overlying motif (AMS)	Black bison(18b)	12910±180	16543-14842 (95%) 14837-14801 (0.4%)	
Chauvet	Date for underlying motif (AMS)	Black mamut	26340±330	31330-30435	
Pech-Merle	Date for underlying motif (AMS)	Black horse	24640±390	30310-28560	
Gargas	Spatially associated archaeology	Bone in natural crack	26860±460	32265-30539	
Pech-Merle	Spatially associated archaeology	Charcoal from floor	11380±390	14229-12518 (95%) 12488-12425 (0.4%)	
Pech-Merle	Spatially associated archaeology	Bone from floor	18400±350	23210-23146 (0.6%) 22974-21170 (94,8%)	
Arcy	Spatially associated archaeology	Bone from floor	26700±410	31755-30495	
Chauvet	Spatially associated archaeology	Bone from floor	26360±290	31314-30499	
Chauvet	Spatially associated archaeology	Bone from floor	26250±280	31247-30447	
Moulin de Laguenay	Spatially associated archaeology	Charcoal from hearth	26770±380	31765-30611	

The chronology of hand stencils in European Palaeolithic rock art

Appendix - Summary of the chronological information available for European Palaeolithic hand motifs (continued).

ARCHAEOLOGICAL SITE	CONTEXT OF AGE MEASUREMENT	MOTIF	YEARS BP	YEARS CALBP (2 SIGMA)	YEARS AGO
Les Garennes	Spatially associated archaeology	Human bone	27110±210	31643-31109	
Les Garennes	Spatially associated archaeology	Human bone	26790±190	31439-31008	
Fuente del Salín	Spatially associated archaeology	Charcoal from hearth	22580±100	27815-26792	
Fuente del Salín	Spatially associated archaeology	Charcoal from hearth	22340+510-480	28209-25600	
Fuente del Salín	Spatially associated archaeology	Bone from floor	23190+900	30195-25910	
Morin	Mobiliary art parallel		~13000/~12000	~15000/~13500	