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News and Views

# Still no archaeological evidence that Neanderthals created Iberian cave art

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## 1. Introduction

Based on uranium-thorium (U-Th) dating of calcite deposits overlying paintings in three Spanish caves, Hoffmann et al. (2018a) have proposed that a rectangular sign at La Pasiega (Cantabria), hand stencils at Maltravieso (Cáceres) and red traces on stalagmites at Ardales (Málaga) are at least 65,000 years old. Consequently, the authors claim Neanderthal authorship of the first parietal art in Europe. This proposition is alarming to many archaeologists (Aubert et al., 2018a; Pearce and Bonneau, 2018; Slimak et al., 2018; but see Hoffmann et al., 2018b, c), due to the multiple sources of error inherent in this dating method, notably the leaching of uranium resulting in an overestimation of sample ages (Borsato et al., 2003; Plagnes et al., 2003; Ortega et al., 2005; Scholz and Hoffmann, 2008; Pigeaud et al., 2010; Bajo et al., 2016; Valladas et al., 2017a). The possible overestimation of the U/Th dates is not discussed in Hoffmann et al. (2018a). Instead they considered that a correct stratigraphy is enough to prove a closed system because "it is highly unlikely that leaching of U or incorporation of Th would simultaneously affect all of its layers" (Hoffmann et al., 2016b:110).

The results presented by Hoffmann et al. (2018a) are especially troubling since they contradict more than one hundred years of research observations on the Neanderthal and modern human archaeological record. The authors seem to abandon that whole body of archaeological knowledge and reasoning, instead placing all their trust in physicochemical measurements. This approach is puzzling given that certain of the coauthors have previously railed against "the interpretative abuses derived from the uncritical application of 'hard science' analytical methods to the study of the Palaeolithic rock art phenomenon" (Alcolea-González and González-Sainz, 2015:1). While absolute dating methods have certainly modified some of our ideas about the chronology of rock art in Europe, the application of these methods (including U-Th dating) is not without problems.

The reasoning underlying this newly published research mirrors that of Pike et al. (2012), which provoked many doubts (Clottes, 2012; Bednarik, 2012; Pons-Branchu et al., 2014; Sauvet et al., 2017a; but see Pike et al., 2017). Of the 54 samples dated by Pike et al. (2012) fully two-thirds fall in the Holocene, not surprising given that calcite is deposited in humid periods, often long after the act of painting. Only one-third of the samples yield Upper Paleolithic dates, and only one (minimum age 40.8 ka for a red disk at Castillo) might possibly correspond to the late Mousterian, leading the authors to state that "it cannot be ruled out that the earliest paintings were symbolic expressions of the Neanderthals" (Pike et al., 2012:1412). From a large number of widely dispersed dates, only the oldest is selected to justify the claim for a pre-Upper Paleolithic origin for cave painting.

Hoffmann et al. (2018a) retained only the date of 64.86 ka for La Pasiega, chosen from among 20 much more recent dates (Table 1; Fig. 1). No consideration is given to the possibility that this outlier date could be due to uranium leaching resulting from local hydrological conditions.

Hoffmann's et al. (2018a) have very little discussion of the archaeological data that contradict their results. This led us to undertake a review of the totality of available data, focusing in particular on rectangular signs and hand stencils. To avoid distraction, we leave aside the question of Neanderthal symbolic and cognitive capacities in favor of a close examination of archaeological and geophysical facts and observations. It goes without saying that if the ca. 65 ka date is spurious, the claim for Neanderthal authorship dissolves, exclusive of whether Neanderthals were capable or not of such behavior.

## 2. Discussion

### 2.1. Cases of open system

Thin layers of calcite in wet environments can behave as an open system, either continuously or periodically, implying a loss of uranium and an overestimation of the calculated ages. An example was provided by Scholz and Hoffmann (2008) in the study of a flowstone in an Austrian cave (see Supplementary Online Material [SOM] S1 and Fig. S1) and a similar case was found for a fractured stalagmite in Maltravieso (MAL 24, Hoffmann et al., 2018a; see SOM S1 and Fig. S2). The uptake of detritic thorium or the transformation of aragonite in calcite (Lachniet et al., 2012; Bajo et al., 2016) may also be the reason for an overestimation effect (SOM S2).

In most cases, it is difficult to assert whether opening of the system occurred or not. Even the observation of a strict stratigraphic order of the ages of various subsamples does not prove that the ages are right. Indeed, if uranium loss occurs regularly with time, the outer layers have less time to lose uranium. They are less

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**Table 1**
Calcite crusts dated by U/Th in La Pasiega Cave after Pike et al. (2012) and Hoffmann et al. (2016a, b, 2018a). Most of the dates are Holocene, a few are Upper Paleolithic and only one corresponds to the Middle Paleolithic (Neanderthal).

| Sample | Gallery | Age (ka) | Underlying motif |
|---|---|---|---|
| O-101 | C | 0.73 ± 0.14 | red bovid |
| PAS-35 | C | 1.12 ± 0.04 | red acephalous deer (78 left) |
| O-103 | B | 1.706 ± 0.023 | red megaloceros |
| PAS-38 | C | 2.16 ± 0.09 | lines of points (superior 78) |
| O-109 | B | 2.258 ± 0.013 | undetermined figure |
| O-106 | B | 2.523 ± 0.017 | undetermined figure |
| PAS-33 | C | 3.07 ± 0.05 | right side of rectangle (78) |
| O-107 | B | 3.307 ± 0.055 | red bison |
| O-108 | B | 3.342 ± 0.029 | red bison |
| O-105 | B | 3.967 ± 0.027 | red horses |
| PAS-29 | C | 4.10 ± 0.06 | yellow zoomorph (above PAS-31) |
| O-110 | B | 4.34 ± 0.044 | red horse |
| PAS-07 (O-73) | C | 4.585 ± 0.022 | red triangle (idem PAS31) |
| O-102 | C | 5.323 ± 0.078 | black ibex |
| PAS-37 | C | 5.39 ± 0.06 | rectangle (76) |
| O-76 | B | 5.615 ± 0.116 | red claviform |
| PAS-02 (O-98) | C | 7.107 ± 0.044 | red dot (idem PAS 32) |
| PAS-39 | C | 7.54 ± 0.05 | rectangle (72) |
| O-74 | C | 8.732 ± 0.085 | yellow double arch |
| O-100 | C | 8.924 ± 0.063 | red deer |
| PAS-30 | C | 11.70 ± 0.1 | red horse (75) |
| PAS-31 | C | 11.80 ± 0.2 | red triangle (75 right) |
| O-97 | C | 11.89 ± 0.45 | red deer |
| PAS-03 (O-99) | C | 12.58 ± 0.14 | line of points (lower 78) |
| PAS-32 | C | 13.2 ± 0.1 | lines of points (75 left) |
| PAS-36 | C | 17.70 ± 0.34 | red acephalous hind (82) |
| O-72 | C | 18.47 ± 0.1 | red triangle (idem PAS-28) |
| PAS-28 | C | 22.90 ± 0.2 | red triangle (75) |
| PAS-34 | C | 79.66 ± 14.9 (mini 64.8) | left side of rectangle (78) |

affected by the aging and appear younger than the inner layers, which preserve the stratigraphy.

Another difficulty is the sampling procedure to be used. Aubert et al. (2014) in Indonesia cut a section through the calcite up to the bedrock and then dated in the laboratory very thin layers (<500 μm) successively excavated in the core sample. This is the best way to be sure to date the carbonate layer just overlying the paint. The technique used in La Pasiega cave (Hoffmann et al., 2018a), consisting of digging subsamples, without controlling for orientation and geometry, gives only mean values and does not prove that paint was present below the concretion. Importantly, Aubert et al. (2018a: Fig. 1D) reported cases in which calcite was already present when an artist painted over and weathering has since removed the paint. In this case, the age of the calcite might indeed be much older than the painting.

### 2.2. Current archaeological knowledge

We know from archaeostratigraphy and the many dates obtained by various techniques ($^{14}$C, thermoluminescence [TL], optically stimulated luminescence) that the 'transition' from Neanderthals to modern humans took place over a few millennia. In Western Europe, the latest Mousterian dates fall between 41 and 39 ka cal BP (Higham et al., 2014) and the oldest dates for the Aurignacian are between 43 and 41 ka cal BP at Geissenklösterle in the Swabian Jura (Higham et al., 2012). In the Southern Iberian Peninsula, the 'transition' is probably prior to 42 ka cal BP (Wood et al., 2010).

This chronological scheme, based on the most recent dating by $^{14}$C, may well be refined and modified as radiocarbon techniques progress. Nonetheless, in the current state of knowledge, U-Th dates obtained in such fashion are far too sensitive to causes of error to cast doubt on the archaeological knowledge based on hundreds of stratified sites and absolute dates obtained over decades of research (Petrognani, 2013). Today, there exist more than 130 direct $^{14}$C dates for paintings in decorated caves and shelters. None of them are older than 38 ka, even though $^{14}$C dating is now able to reach back to 50 ka BP (Cottereau et al., 2007). Clearly, if such pre-40 ka BP radiocarbon ages were published, they would have to be taken as suggestive of Neanderthal authorship.

The symbolic practices of Neanderthals are exceedingly rare and often ambiguous. One may cite incised lines on bone (Lorblanchet, 1999; for a synthesis for Eastern Europe see Majkić, 2017), the engraving on limestone, possibly dating to the Mousterian, at Gorham's Cave (Rodríguez-Vidal et al., 2017), and digital flutings at La Roche-Cotard Cave (Marquet et al., 2014). Neanderthals occupied Bruniquel Cave (Tarn-et-Garonne, France) building complex structures of stalagmites, but leaving no trace of graphic activity (Jaubert et al., 2016).

No Mousterian site has revealed anything comparable to the figurative art that develops around 40 ka in the Swabian Jura (Floss, 2017), around 36 ka at Chauvet Cave (Quiles et al., 2016), and around 38 ka in the Vézère Valley of SW France (White et al., 2012, 2018; Bourrillon et al., 2018). There is broad consensus that "figurative art starts at the time that modern humans people the planet" (Lorblanchet, 1999:265). An 'artistic explosion' took place in Europe near 40 ka (White, 2000). Any remaining doubt concerns a very short period from roughly 42–40 ka, when the last Mousterians (Neanderthals) seem to have coexisted with the first Aurignacians, though there is no known interstratification (Bar-Yosef and Bordes, 2010).

### 2.3. The red-stained stalagmitic draperies of Ardales

In Ardales Cave (Málaga, Spain), red marks in the folds of a stalagmitic column were dated to between 65 and 40 ka by U-Th (Hoffmann et al., 2018a). According to the authors, these correspond to an initial prefigurative phase in prehistoric cave art such as they had already proposed for Castillo Cave (Pike et al., 2012). This would assume a limited symbolic capacity for Neanderthals.

At Ardales, the wide range of dates found by U-Th on the same stalagmitic column is seen by the authors as evidence of "distinct episodes over a period of more than 25 ka […] with a long tradition" (Hoffmann et al., 2018a:915). The hypothesis of erroneous dates seems to us far more likely.

In addition, it is not sure that these red stains are really paintings since they could be natural (Aubert et al., 2018b) or result from involuntary gestures (Medina-Alcaide et al., 2017). The case is different in Nerja (Málaga, Spain) where red-stained stalagmitic draperies are clearly associated with animals, such as a red deer doe and an ibex in the recess called Los Órganos. The floor of this narrow space is dated by $^{14}$C to 24,140 ± 140 (28,182 ± 181 cal BP; Beta-277744; Sanchidrián Torti et al., 2013).

### 2.4. The place of La Pasiega in the archaeology of rectangular signs

More than 20 U-Th dates were obtained for La Pasiega. Most are Holocene, some corresponding to the Upper Paleolithic, only one is older (Table 1; Fig. 1). A minimum age of 65 ka was obtained for the left side of a large rectangular sign on panel 78 in La Pasiega C (PAS 34c), while the right side of the same rectangle yielded a date of less than 3.1 ka (Fig. 2). Moreover, the age of the outermost layer of sample PAS 34a is 50.5 ka, little different from that of the deepest layer (64.8 ka). Why would growth stop at 50 ka when most of the nearby concretions in the same panel started their growth after 12 ka? We know that "speleothem growth can be affected by several highly localized factors" (Aubert at al., 2018a:215), but this argument cannot be put forward in place of a geomorphological and hydrological study that could explain how a concretion that has

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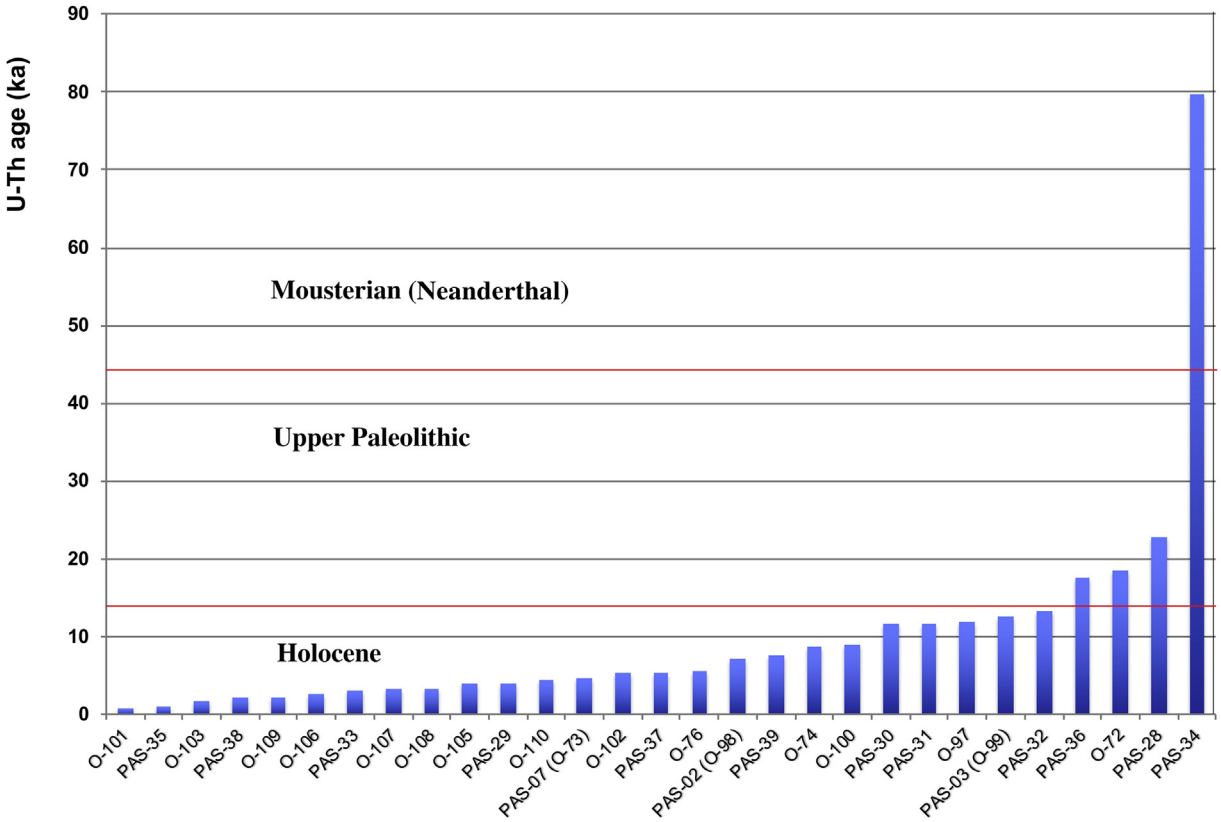


**Figure 1.** U-Th dates from La Pasiega Cave in chronological order. The graph shows the exceptional character of the date of 79.66 ± 14.9 ka (minimum age 64.8 ka) among other dates from the Holocene or Upper Paleolithic. The hypothesis of an open system is the most probable explanation.

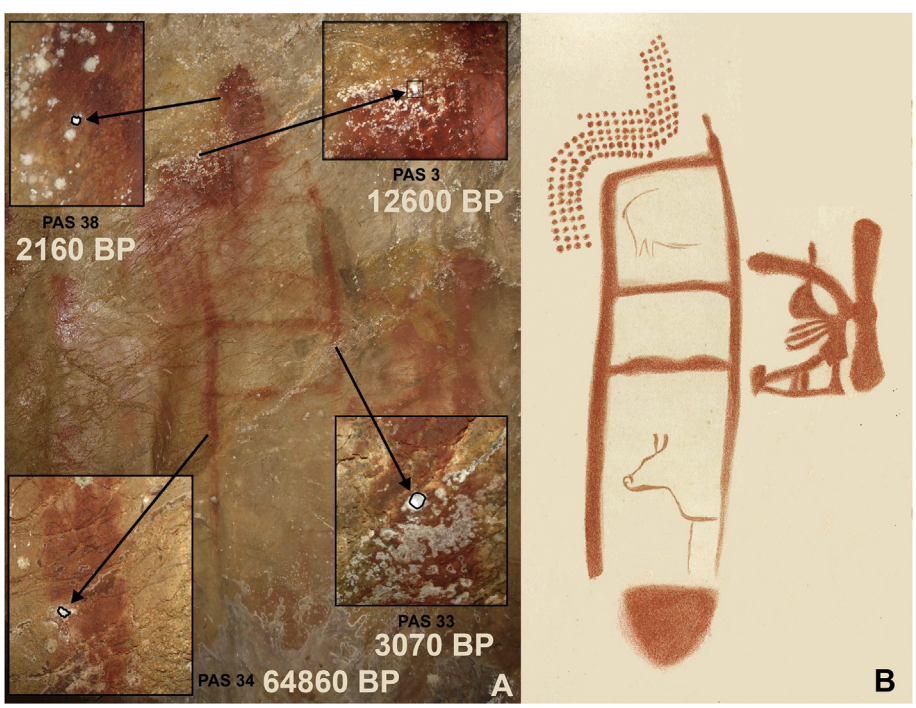


**Figure 2.** A) Panel 78 at La Pasiega C with four U-Th dates reported by Hoffmann et al. (2018a). Note the discrepancy between the left side and the right side of the same rectangle. B) Tracing by Breuil et al. (1913).

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exactly the same aspect as those surrounding it, could be so much older than the others.

Is the date of 65 ka reliable in the light of current archaeological knowledge? Rectangular signs constitute a highly diverse family of forms present in all of Franco-Iberia. Statistical analysis allowed Sauvet et al. (2017b) to distinguish a group characterized by a tripartite division of the sign. Available dates situate most of these tripartite signs in the Magdalenian. Those from Altamira have been directly dated by $^{14}$C to 15,440 ± 200 (18,699 ± 219 cal BP; GifA-91185), and those from Las Chimeneas Cave in the same hillside as La Pasiega, to 13,940 ± 140 (16,899 ± 231 cal BP; GifA-95230) by dating of a line in the panel of quadrilaterals. Clearly, sign 78 from La Pasiega C belongs to this category of signs.

A complete study of this panel (Fig. 2) is required before accepting that it was made by Neanderthals. A study of all the anthropogenic marks should be undertaken according to the current methods of rock art study (Fritz and Tosello, 2007) in order to determine the techniques and the sequence of lines. Such work must be accompanied by a hydrological and geomorphological study to reconstruct the whole history of the wall before and after the paintings. Accordingly, we could know whether the incomplete zoomorphs inside the quadrilateral were made prior to the frame around them as suggested by the first investigators (Breuil et al., 1913). Such knowledge is essential to testing the hypothesis of a Neanderthal work. Indeed, if Breuil et al. (1913) were right and if the Hoffmann et al. (2018a,b,c) date is accepted, Neanderthals would be the authors of the first figurative art, contrary to the claim that their art was "a restricted and nonfigurative set of subjects" (Hoffmann et al., 2018a:914). We emphasize, however, that Upper Paleolithic rectangular signs are frequently associated with animals (Fig. 3). In this same gallery of La Pasiega C, Magdalenian works are found: a bison and an ibex, both black, were dated respectively to 12,460 ± 160 (14,626 ± 308 cal BP; GifA-98165) and 13,730 ± 130 (16600 ± 211 cal BP; GifA-98166). If one supposes that the incomplete animals were drawn by *Homo sapiens* long after the rectangle, we would have to accept a time lag of 45–50 kyr between the tripartite quadrangular sign made by Neanderthals and the addition of the small animals by modern people. In sum, a single isolated date, detached from its archaeological context, leads to the most unlikely of interpretations.

### 2.5. Negative handprints in the archaeology of Franco-Iberian caves

The chronology of known negative handprints has been well established (Jaubert, 2008; Feruglio et al., 2011; Floss and Ostheider, 2013). Most of them can be assigned to the Gravettian period between 25 and 31.5 ka (SOM S3; SOM Table S1). Some of them have been directly dated by $^{14}$C (Cosquer Cave, France) or by the dating of associated artifacts (Gargas Cave, Pech-Merle Cave). At La Fuente del Trucho (Spain), the calcite overlying negative handprints has been dated by U-Th and gave minimum ages ranging between 25.11 and 27.37 ka, compatible with the Gravettian (Hoffmann et al., 2016a:53). In this case, the results completely match the archaeological evidence, reinforcing their credibility.

A dozen hand stencils have also been found, from Northern France (the Grande Grotte d'Arcy) to Southern Spain (Ardales), within an archeological context that confirms a Gravettian origin for most of them (22.34–30.16 ka BP, i.e. 26.665 to 34.29 ka cal BP; SOM Table S2). This large and coherent sample of temporal data for negative handprints shows a relatively well defined chronological range.

At Maltravieso Cave, the U-Th dating of five samples of calcite obtained within a perimeter of 5 cm around a negative hand gave very dispersed minimum ages ranging from 14.7 to 55.2 ka and 66.7 ka for two of them (Hoffmann et al., 2018a). These dates are argued by these authors to support the attribution of the hand stencil to Neanderthals. It is noteworthy that some handprints in Maltravieso present foreshortened fingers, a particularity that is only known from the Gravettian caves of Gargas and Tibiran on the French side of the Pyrenees, and from La Fuente del Trucho and Cudón on the Spanish side.

It is noteworthy that hand stencils have also been found on Sulawesi Island and Borneo (Indonesia) and dated by U-Th to ca. 40 ka (Aubert et al., 2014, 2018b). The microstratigraphy of layers less than 500 μm thick in good stratigraphic order allows us to be confident that the calcite behaves as a closed system in this case. The Indonesian hand stencils are attributed to early *H. sapiens* (Curnoe et al., 2016).

### 2.6. The need to confirm U-Th dates by other methods

In order to control for postdepositional alteration of calcite veils, it is essential to apply independent dating methods to the same

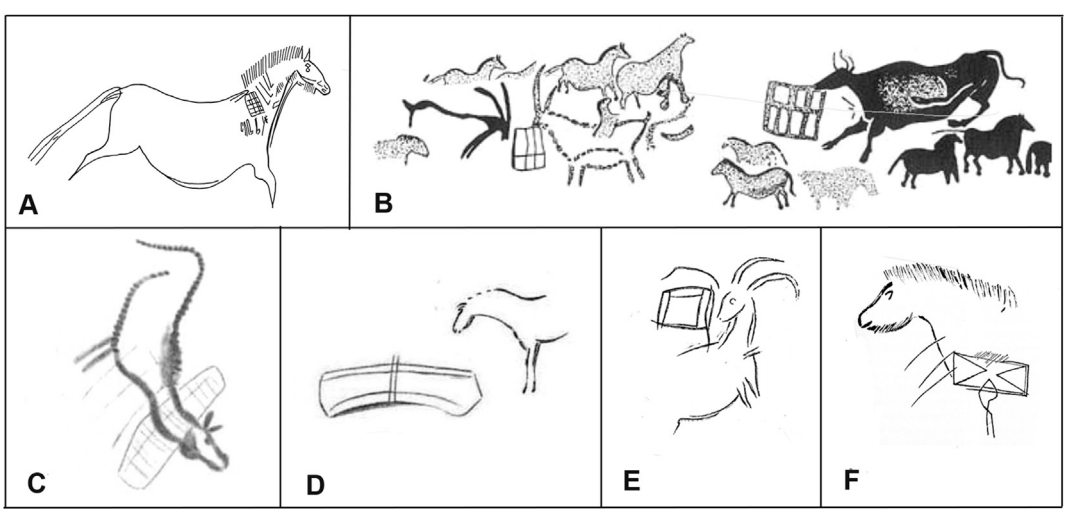


**Figure 3.** Examples of animals associated with rectangular signs. A) Lascaux (after A. Glory in Leroi-Gourhan and Allain, 1979); B) Lascaux (after Ruspoli, 1987); C–D) La Pasiega A (after Breuil et al., 1913); E) Gabillou (after Gaussen, 1964); F) Cosquer (after Clottes et al., 2005).

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samples (Pons-Branchu et al., 2014; Sauvet et al., 2017a). Experiments consisting in combining U-Th dating with $^{14}C$ dating of the same carbonate have recently been carried out by the Laboratory of Climatic and Environmental Sciences at Gif-sur-Yvette (France) in Nerja cave (Spain; Quiles et al., 2014; Sanchidrián et al., 2017; Valladas et al., 2017a). There, in the case of a thin layer of calcite overlying a red dot, the authors found a U-Th age between 60 and 56 ka (depending on the initial $^{230}Th/^{232}Th$ detrital value used) whereas the $^{14}C$ age varied from 33,769 to 27,491 cal BP, depending on the level of dead carbon used in the calculation (see SOM S4). Thus, the difference between the two methods is at least 22 kyr, which implies an important loss of uranium. Moreover, the U-Th date falls outside the Upper Paleolithic. If the authors had only used U-Th dating, they might have concluded that Neanderthals created the first drawings in Nerja.

The reliability of the method is shown by a second experiment carried out in the same cave of Nerja. In this case, the two methods are in good agreement, showing that no uranium loss occurred. Indeed, $^{14}C$ cannot be used alone to determine a minimum age for the underlying painting because of the uncertainty on the dead carbon fraction, but it is a good way to detect open systems. In our opinion, U-Th results can be useful as long as they are validated by an independent method. In the absence of such confirmation, results remain unconvincing.

The use of a third element, protactinium (Pa), has been suggested to test whether the system had been partially open. More complicated to apply in the current state of the technique, the U-Th-Pa system could nonetheless offer, in the future, an effective means of evaluating uranium loss or gain over the history of the material being dated (Cheng et al., 1998; Dickin, 2018).

An additional possibility is to couple U-Th and TL dating. At La Garma (Cantabria, Spain) a strand of calcite overlying a red ibex was dated by these two methods (González Sainz, 2003). Three U-Th dates range between 26 and 28 ka, while TL gives an age of $34.2 \pm 3.85$ ka. As in the case of $^{14}C$, the precision of TL is mediocre due to the difficult estimation of annual dose rates, so that the method cannot be used alone, but it could help to detect cases of open system.

## 3. Conclusions

Five conclusions can be drawn.

(a) As many studies have shown, U-Th results are sensitive to lixiviation of part of the uranium, leading to an overestimation of age. This possibility should be evaluated by all available means (hydrogeology, mineralogy) prior to sampling.
(b) Awareness of this important source of error imposes a protocol by which the U-Th values obtained, in order to be credible, must be cross-checked with other independent methods, and whenever possible with the results obtained on the same sample by other laboratories. In addition, to be sure that no uranium loss occurred, the stratigraphic order of the subsamples should be established by a sufficiently refined procedure (i.e., microstratigraphy of layers <500 μm).
(c) Under no circumstances should minimum ages as old as 65–70 ka be accepted for works of parietal art on the sole basis of U-Th dates on overlying calcite. Such dates are in contradiction with abundant archaeological data, now rigorously dated by $^{14}C$.
(d) Archaeological context and reasoning need to be part of the process. A close reading of archaeological panels being dated should give pause to claims, such as that for La Pasiega, where two opposing sides of the same geometric form are accepted as giving minimum ages 60,000 years apart, in the absence of a geological explanation for this anomaly.
(e) In each case, geomorphological and paleoclimatic studies must accompany such U-Th based claims of great antiquity in order to account for the possible hiatus of calcite growth and the apparent discrepancy in the ages of closely located concretions.

Given the causes of error now demonstrated by numerous studies, and awaiting new results obtained by other methods, the claimed dates in the vicinity of 65 ka for prehistoric paintings in the Iberian caves, and consequently their attribution to Neanderthals, should be treated with extreme caution. Known sources of error can and often do result in dramatic overestimation of U-Th ages, making it both premature and scientifically unjustifiable to undertake a profound revision of the history of humanity and the evolution of symbolic graphic expressions based solely on such dates.

The paleoanthropological stakes are high. Art is intimately dependent on the sociocultural context in which it is produced. So far, we have no proof that Neanderthal society needed a long-lasting means of communication to consolidate its values and beliefs. A high degree of chronological certainty is required if that view is to be falsified. In short, there is still no convincing archaeological evidence that Neanderthals created Iberian cave art.

## Supplementary Online Material

Supplementary online material to this article can be found online at https://doi.org/10.1016/j.jhevol.2019.102640.

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