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DATING FRENCH AND SPANISH PREHISTORIC DECORATED CAVES IN THEIR ARCHAEOLOGICAL CONTEXTS

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ABSTRACT. The Laboratoire des Sciences du Climat et de l'Environnement (LSCE) research program on prehistoric art conducts chronological studies of parietal representations with their associated archaeological context. This multidisciplinary approach provides chronological arguments about the creation period of parietal representations. This article presents chrono-logical investigations carried out in several decorated caves in France (La Grande Grotte, Labastide, Lascaux, La Tête-du-Lion, Villars) and Spain (La Garma, Nerja, La Pileta, Urdiales). Several types of organic materials, collected from different areas of the caves close to the walls and in connection with parietal art, were dated to determine the periods of human presence in the cave, a presence that may have been related to artistic activities. These new radiocarbon results range from 33,000– 29,000 (La Grande Grotte) to 16,000–14,000 cal BP (Urdiales).

INTRODUCTION

Developing a chronological framework for Paleolithic parietal art (paintings and drawings) remains a difficult and controversial issue. Indeed, direct radiocarbon dating on paintings is exceptional, primarily because of preservation concerns and also due to the scarcity of organic pigments. Therefore, the results are not numerous and are often challenged. Reservations bear upon the taphonomic evolution of cave walls and especially upon the possible presence of extraneous organic materials, which can contaminate the parietal representations and thus distort the dating results. This problem is particularly important in the case of frequently visited caves. The temporal connection between the dated samples and the creation period of paintings or drawings is another difficulty. How can we be certain that the death of the tree whose charcoal was used by prehistoric people is contemporaneous with the creation of the parietal representations themselves?

That is why ¹⁴C dating has also been carried out from organic remains recovered from the archaeological sediments in decorated caves, but connections between these ¹⁴C results and the parietal representations are often problematic. Indeed, caves may have been occupied without painting events, and painting events can occur without any other evidence of occupation. Moreover, archaeological investigations reveal that human occupations of caves were relatively frequent during the Pleis-tocene and that archaeological remains underwent complex depositional patterns with erosion and

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deposition periods that disturbed the integrity of the stratigraphic sequences. However, for certain caves whose geological context is well studied, a multidisciplinary approach provides arguments to propose chronological connections between their archaeological deposits and parietal representations. Such connections will not date the paintings and drawings themselves, but they appear to provide the most parsimonious interpretation, and therefore, they give valuable and precious information to place the representations within a chronological framework.

In this article, we will first present ^{14}C results obtained from organic remains sampled on the wall (torch wipes and dots) or in the archaeological sediments of French decorated caves (La Grande Grotte, Labastide, Lascaux, Villars, Table 1) and then we will discuss direct ^{14}C dating for drawings from 3 Spanish caves (La Garma, Urdiales, and La Pileta; see Table 2).

THE DECORATED DATED CAVES

With the exception of La Pileta (Andalusia), belonging to private owners, the decorated caves (Tables 1 and 2) presented in this article have been the subject of multidisciplinary research for several years. Our program included fieldwork to refine the stratigraphic sequence and the site formation processes. This provided information on human presence locations in the cave as well as on the occupation periods thanks to previous ^{14}C dating (in italics in Tables 1 and 2). Also, when lithic remains were available, they were analyzed and the parietal representations were thoroughly described. We will first briefly describe these decorated caves and their archaeological context, then emphasize the connection between their contextual remains and parietal representations.

La Grande Grotte (Arcy-sur-Cure, Yonne; Baffier and Girard 1998, 2013) has been intensively studied by the D Baffier and M Girard's team for about 20 yr, since the discovery of red and black parietal representations. More than 200 representations (engravings, paintings, and drawings) have been found and studied so far. Calcitic deposits have covered the charcoal drawings, so direct ^{14}C dating has not been possible so far. However, the choice of species (mammoth, lion, rhinoceros, etc.) for the animal depictions at La Grande Grotte d'Arcy and their similarity to some ancient parietal art, such as that of Chauvet-Pont d'Arc Cave (Clottes 1996, 2001; Baffier and Girard 1998, 2012; Valldas et al. 2001a) suggests that the Arcy decoration could be attributed to the Aurignacian-Gravettian period (Figure 1; Girard et al. 1996; Baffier and Girard 1998). Test excavations in different sectors of the cave revealed the existence of a thin archaeological layer encompassed in sterile sediment layers bracketed by 2 stalagmitic deposits. They have been dated by the uranium series method to $53,410 \pm 160$ yr BP for the deepest and $13,730 \pm 90$ yr BP for the youngest, which corresponds to the current ground surface (L. Ayliffe, personal communication, 2000). In particular, 2 excavations located near the decorated wall yielded anthropic remains in connection with wall decorations, which are particularly interesting from a chronological point of view. Near La Corniche au Bison (P68–69), the archaeological layer contained the remains of a small hearth on top of which an ochred stalagmitic fragment and a partly burned cave bear metatarsal bone with an ochred epiphysis had been deposited. Near that structure, 2 drops of red paint were found: their chemical composition is similar to that of the red paintings located on the panel above. Test excavation J81–82 along the La Salle des Noyaux de Cerises wall yielded remains (yellow ochre, red powder, grinding stone) from the preparation of color in the archaeological layer in contact with the upper stalagmitic layer. The new ^{14}C -dated samples (charcoal and burnt bones) were collected in these interesting structures.

The first investigations in **La Tête-du-Lion** Cave (Comber 1984; Monney et al. 2013) go back to the 1970s. Red drawings were discovered then. They represent a bovid, 2 ibex heads, a stag, and at least 2 groups of red dots located in a concave part of the wall called the Apse (L'Abside). Excavations carried out at 1.20 m from the painted wall revealed a single archaeological layer without any

lithic industry but containing remains of a fire with several *Pinus sylvestris* charcoal fragments and at least 4 ochred drops 2–3 cm in diameter, which were interpreted as being pigment remains. These drops made of hematite had the same composition as the pigment used for the bovid image but a different one from those used for the stag and dots. The first ^{14}C dating of the charcoal fragments gave a Solutrean age in agreement with stylistic expectations (Leroi-Gourhan's Style III) but with a rather large margin of error, $21,650 \pm 800$ BP (Evin et al. 1975). In the course of recent excavations by Monney et al. (2013) in the vicinity of the Apse, the archaeological layer yielded new charcoal fragments whose dating will be presented hereafter.

The **Lascaux** (Montignac; Aujoulat 2004) and **Villars** caves (Villars; Delluc and Delluc 1974) in the Dordogne, discovered respectively in 1940 and 1953, have been extensively studied and are well known. The representations in each cave show a great unity as well as stylistic and thematic affinities between them (i.e. Leroi-Gourhan's Style III). In both caves, for instance, there are representations of a man facing a bison, a rather rare scene. This similarity raises the question of the possible contemporaneity of their decorations (Delluc and Delluc 1984; Baffier 1988) and emphasizes the necessity to get some accelerator mass spectrometry (AMS) dates for these caves. It is not possible to directly date the Lascaux and Villars paintings because physical-chemical analyses revealed that their black color was obtained from manganese dioxide and therefore did not contain any organic residue (Beck et al., these proceedings). Contrary to Villars, where scarce anthropic remains are scattered on the ground, the Lascaux archaeological layer provided a wealth of lithic and bone work, stone lamps, animal bones, and charcoal fragments. In the 1960s, ^{14}C dates (in italics in Tables 1 and 2) were obtained for the Lascaux cave by US (Libby, Chicago) and European laboratories (Groningen and Saclay). Three of them were in the 17,000–15,000 ^{14}C yr BP time range and the 8 others during the Holocene, from 7000 to 5000 ^{14}C BP (Delibrias et al. 1964; Leroi-Gourhan and Evin 1979; Aujoulat et al. 1998; Glory 2008). Because of the scarcity and the dispersion of these first ^{14}C dates, it was important to refine the Lascaux occupation period by dating other organic samples by AMS in close association with cultural activities. The Lascaux selected samples were fragments from a spear and from a reindeer antler, while the only available samples for Villars were parietal torch wipes and burnt (or unburnt) bones.

Discovered in 1932, the decorated cave of **Labastide** (Labastide, Hautes Pyrénées), as well as other Pyrenean caves such as Niaux, Bédeillac, Enlène, and Le Portel, is attributed to the Middle Magdalenian period (Simonnet et al. 1984; Simonnet 1993). Magdalenian occupations have left remains of well-preserved hearths, lithic artifacts, animal bones, and many engraved stone plaquettes and carved bones on or near the soil surface all along the cave. Like the lithic tools and mobile art objects, the parietal paintings and engravings are also typical of the Middle Magdalenian (Leroi-Gourhan's Style IV). Four conventional ^{14}C dates were obtained in the 1980s on burnt bones by the Gif-sur-Yvette and Lyon laboratories from samples including several pieces of bones, some of which could have been contaminated. A few years later, we decided to carry out some new dates on single pieces of burnt and unburnt bones.

Finally, in the case of **La Garma**, the associated samples (bone specimens and artifacts) were AMS dated by the Oxford Laboratory, while a charcoal splinter taken from a vertical bison drawing was measured at Gif-sur-Yvette. These decorated caves are located in Spain (Table 2): **La Garma** and **Urdiales** (Cantabria; González Sainz 2007; Univ. of Cantabria 1999), **Nerja** and **La Pileta** (Andalusia; Sanchidrián Torti 1994).

Table 1 Data and ¹⁴C results for the French caves. Parietal samples (drawings and torch rubbings) are given in bold and previously obtained ¹⁴C results in italics.

Cave	Sector	Sample	Lab code	mg C	¹⁴ C age BP (1) 2	Calibrated age
Labastide	Gisement1 (100 m)	Bone	GifA 99423	0.7	13,870 ± 130	16,705–17,402
		Bloc B5	Bone	GifA 99104	1.2	14,150 ± 130
	Bloc B5	Parietal mark (LBT5, P20)	GifA 98181	0.82	480 ± 50	334–634
	Diverticule	Burnt bone	<i>GIF 6367</i>		<i>12,700 ± 110</i>	<i>14,240–15,608</i>
	Diverticule	Burnt bone	<i>GIF 6612</i>		<i>13,500 ± 120</i>	<i>15,975–16,938</i>
	Diverticule	Burnt bone	<i>GIF 6611</i>		<i>13,700 ± 120</i>	<i>16,527–17,101</i>
	Diverticule	Burnt bone	GifA 102394	0.94	13,610 ± 120	16,374–17,029
	Diverticule	Stuck bone (LB OF8)	GifA 99105	2.35	14,010 ± 140	16,800–17,506
	Diverticule	Parietal mark (LBT29)	GifA 98182	0.76	1240 ± 60	1010–1290
	Diverticule	Parietal mark (LBT22)	GifA 98183	0.31	–170 ± 60	
	Gisement Casteret 2 (400 m)	Bone	<i>LY405</i>		<i>14,250 ± 440</i>	<i>16,427–18,563</i>
	Gisement Casteret 2 (400 m)	Bone	GifA 99424	0.74	14,360 ± 120	17,077–17,875
	Gisement Casteret 2 (400 m)	Parietal mark (23TC)	GifA 100391	1.66	1110 ± 70	912–1238
Lascaux	Puits	Charcoal	<i>C 406</i>		<i>15,516 ± 900</i>	<i>16,747–20,949</i>
	Passage	Charcoal	<i>GrN 1632</i>		<i>17,190 ± 140</i>	<i>20,046–21,122</i>
	Puits	Charcoal	<i>Sa 102</i>		<i>16,000 ± 500</i>	<i>18,060–20,276</i>
	Puits	Spear bone	GifA 101110	1.64	18,930 ± 230	22,088–23,359
	Puits	Reindeer antler (III-48)	GifA 95582	1.62	18,600 ± 190	21,507–22,584
Villars	Entrance (LB784)	Charcoal	GifA 90216/SacA 14201	0.48	985 ± 30	796–959
	Soil surface	Burnt bone	GifA 09508/SacA 18206	0.27	16,730 ± 80	19,565–20,193
	Soil surface	Burnt bone	GifA 11013/SacA 23428	1.11	16,100 ± 80	18,933–19,435
	Hearth	Burnt bone			16,480 ± 210	18,987–20,235
	Soil surface	Reindeer bone	GifA 10177/SacA 19773	1.37	18,420 ± 130	21,530–22,334
	Soil surface	Reindeer bone	GifA 10118/SacA 19774	1.36	18,470 ± 130	21,551–22,370
	Soil surface	Reindeer bone	GifA 10053/SacA 19021	1.16	18,790 ± 140	22,065–23,233
	Chapelle du balcon	Charcoal parietal mark	GifA 09393/SacA 15482	0.5	17,460 ± 90	20,397–21,247
	Chapelle du balcon	Charcoal parietal mark	GifA 10313/SacA 23086	0.53	18,150 ± 110	21,356–22,114
	Chatière	Charcoal parietal mark	GifA 10316/SacA 23089	0.41	17,680 ± 100	20,544–21,434
	Carrefour, below black triangle	Charcoal parietal mark	GifA 10314/SacA 23087	0.17	14,350 ± 90	17,104–17,842
Carrefour, in front of black triangle	Charcoal parietal mark	GifA 10315/SacA 23088	0.36	14,610 ± 90	17,265–18,054	
Tete-du-lion	Alcôve de la vache	Charcoal	GifA 10296/SacA 23069	1.18	22,120 ± 150	26,018–27,502
	Alcôve de la vache	Charcoal	<i>Ly 847</i>		<i>21,650 ± 800</i>	<i>24,005–27,988</i>
Grande Grotte Arcy-sur-Cure	Salle des Noyaux de Cerises	Burnt bone	GifA 102383	0.59	24,470 ± 240	28,497–29,848
	Corniche au Bison	Burnt bone	GifA 95620	0.93	27,950 ± 440	31,340–33,255

Table 1 Data and ^{14}C results for the French caves. Parietal samples (drawings and torch rubbings) are given in bold and previously obtained ^{14}C results in italics.

Cave	Sector	Sample	Lab code	mg C	Calibrated age	
					^{14}C age BP (1)	2
	Corniche au Bison	Burnt bone	GifA 93008	2.08	24,700 ± 360	28,629–30,302
	Corniche au Bison	Burnt bone	GifA 94589	2.19	26,700 ± 410	30,485–31,657
	Corniche au Bison	Torch rubbing	GifA 98184	0.48	26,470 ± 390	30,410–31,445
	Corniche au Bison	Torch rubbing	GifA 98185	0.47	27,080 ± 400	30,878–32,290
	Corniche au Bison	Burnt bone	OxA 5003		26,250 ± 500	29,795–31,491
	Salle des Vagues	Fresh bone	GifA 93012	0.45	29,640 ± 590	32,613–35,276
	Salle des Vagues	Horse tooth	GifA 93013	0.68	30,160 ± 640	33,315–36,294
	Salle des Vagues	Burnt bone	GifA 95619/CP	0.43	25,930 ± 360	29,800–31,213
	Salle des Vagues	Burnt bone	GifA 96680	2.06	27,280 ± 330	31,070–32,287
	Salle des Vagues	Burnt bone	GifA 97339	1.8	28,010 ± 350	31,451–33,136
	Salle des Vagues	Charcoal	GifA 102382	0.89	26,750 ± 260	30,907–31,504
	Salle des Vagues	Charcoal	GifA 91370		28,250 ± 430	31,418–33,854
	Salle des Vagues	Burnt bone	GifA 92330		27,630 ± 400	31,216–32,878
	Salle des Vagues	Fresh bone	GifA 97146	0.91	41,200 ± 2300	41,689–49,318
	Salle des Vagues	“Black pollution”	GifA 98178	0.63	1480 ± 60	1295–1455

Table 2 Data and ^{14}C results for the Spanish caves. The parietal samples (drawings and torch rubbings) are given in bold and the previously obtained ^{14}C results in italics.

Cave	Sample	Lab code	mg C	^{14}C age	
				(BP) (1)	Calibrated age BP (2)
Urdiales	Bison representation 2	GifA 11454/SacA 26196	0.12	12,750 ± 110	14,545–15,901
La Garma	Fresh bone, 34	<i>OxA 8721</i>		<i>14,050 ± 110</i>	16,837–17,491
	Fresh bone, 36	<i>OxA 8722</i>		<i>13,610 ± 100</i>	16,447–16,991
	Fresh bone	<i>OxA 7203</i>		<i>12,070 ± 100</i>	13,703–14,185
	Harpoon (<i>Cervus elaphus</i> antler), 26	<i>OxA 8720</i>		<i>11,470 ± 150</i>	13,080–13,715
	Vertical bison representation (IX, 1)	GifA 102581		13,780 ± 150	16,512–17,238
Nerja	Charcoal (GN6)	GifA 98191	1.26	19,900 ± 210	23,261–24,381
La Pileta	Aurochs representation	GifA 98162	0.39	20,310 ± 350	23,391–25,065
	Charcoal (LP4)	GifA 98158	0.52	3760 ± 60	3928–4400
	Paleosol (LP2)	GifA 98176	2.31	3880 ± 70	3464–3828

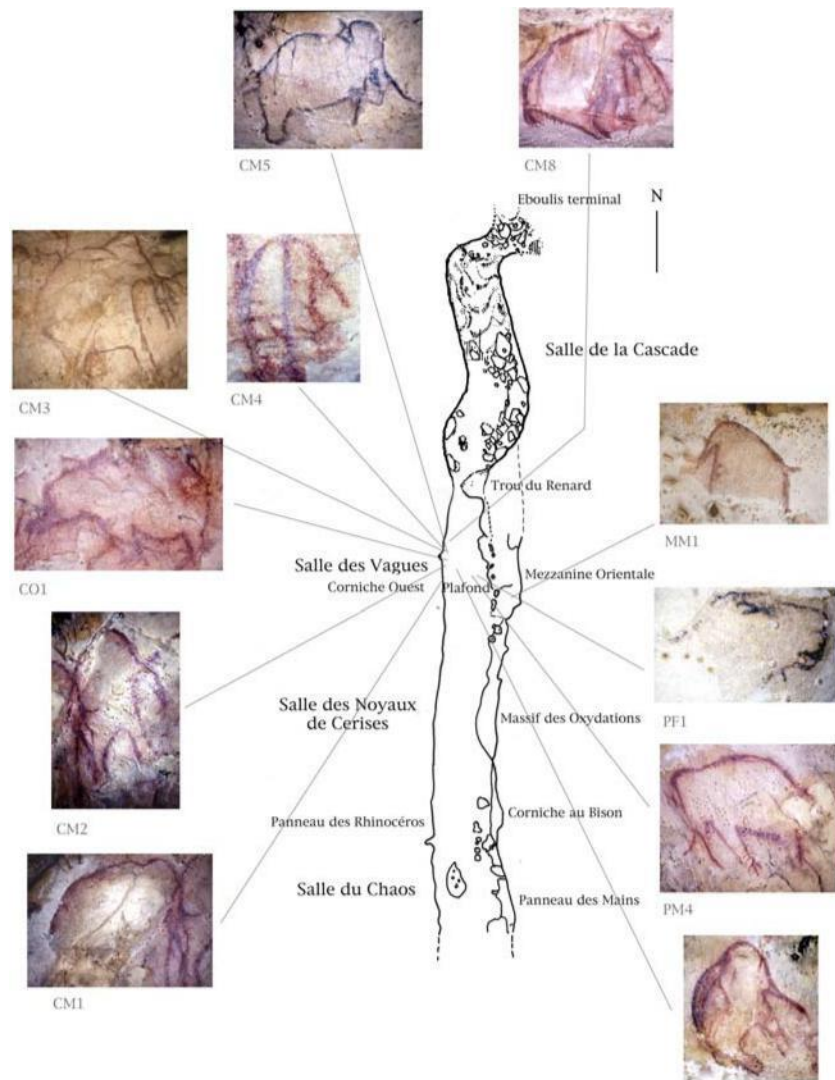


Figure 1 The main paintings in La Salle des Vagues at La Grande Grotte (Arcy-sur-Cure, Yonne; Baffier and Girard 1998).

MATERIALS AND METHODS

Whenever possible, we chose organic samples (Tables 1 and 2) associated with artistic activities, such as pigment remains (La Grande Grotte at Arcy and La Tête -du-Lion). We also selected material in close association with past human activities: parietal black marks and possible torch wipes at Labastide, Villars, and La Grande Grotte; a spearhead at Lascaux; a piece of bone purposely stuck into a crack of the wall at Labastide; and burnt bone fragments and pieces of charcoal originating from cave hearths at Villars, Labastide, and La Grande Grotte. Moreover, it was possible to directly date some animal representations such as the aurochs at La Pileta, the bison 2 at Urdiales, and the vertical bison at La Garma A (in bold in Tables 1 and 2). Finally, fresh bone specimens (3 reindeer fragments at Villars and 4 at La Grande Grotte) were also dated, even though these kinds of samples are less reliable, as they may have been brought into the caves by carnivores.

Due to a lack of samples, it was impossible to get more than 2 extra ^{14}C dates in the case of La Pileta and Lascaux and only 1 at La Garma, Nerja, and La Tête-du-Lion. On the other hand, we were able to get at least 10 dates at La Grande Grotte, Labastide, and Villars where available organic materials were more abundant.

The charred bone and charcoal specimens were pretreated by the acid-base- acid (ABA) method. Whatever remained was oxidized to carbon dioxide, then reduced to graphite and compressed into pellets, which were submitted to the Tandetron through 2004 and to the Artemis AMS facilities after 2005 (Arnold et al. 1989) . When available, the alkaline fractions resulting from the chemical pre-treatment were also dated (Batten et al. 1986). In the case of parietal samples (paintings and torch wipes), the pretreated charcoals collected on a precleaned quartz filter were heated in a stream of oxygen for about 1 hr between 280 and 320 °C to remove any additional organic contaminants.

Bone sample preparation is based on the specific reaction between the collagen amino acids and the ninhydrin reagent (Nelson 1991), which allowed us to extract the CO_2 from the carboxylic groups of amino acids (Tisnérat-Laborde et al. 2003). The extracted CO_2 was reduced to graphite (Arnold et al. 1989), which was then AMS dated.

RESULTS

The ^{14}C results and their calibrated ages obtained for each cave are given in Tables 1 (French caves) and 2 (Spanish caves). Figure 2 shows the calibrated ages deduced for the Spanish caves (using CALIB v 6; Stuiver et al. 2010). At Nerja, the 23,260–24,380 cal BP age for the charcoal sample found on a ledge a few cm below the stag representation falls into the Solutrean period, a result similar to the one obtained for the aurochs representation of La Pileta Sanctuary (23,390–25,065 cal BP), evidence of parietal art being made then in southern Spain. La Pileta was also visited during the Chalcolithic period as attested by the ages between 3900 and 3500 cal BP obtained from a comb-shaped drawing and a paleosol deposit.

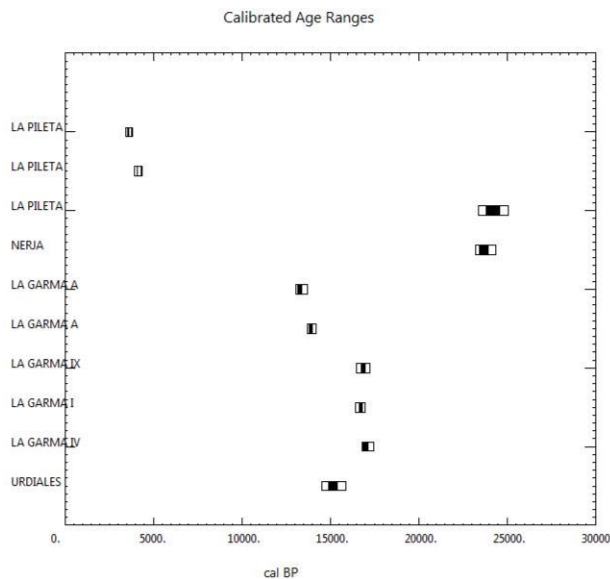


Figure 2 Calibrated ages (using OxCal v 6; Stuiver et al. 2010; IntCal09, Reimer et al. 2009) obtained for the Spanish caves.

Two successive occupation periods (17,500–16,500 and 14,200–13,000 cal BP) during the Magdalenian were revealed by the 4 bone specimens dated at La Garma. The vertical bison representation (area IX) (17,240–16,510 cal BP) falls within the first period of occupation. These results are quite similar to those previously obtained for the 3 Altamira and 2 Covaciella (Cantabria) bison representations, which range between 18,000 and 16,500 cal BP (Valladas et al. 2001b). The Urdi-ales bison 2 appears to be younger (15,900–14,500 cal BP) and falls into the same time interval as the Magdalenian El Castillo bison (16,800–14,000 cal BP; Valladas et al. 2001b). Dates obtained for the French caves range from ~33,000 to 16,000 cal BP (Table 1 and Figure 3).

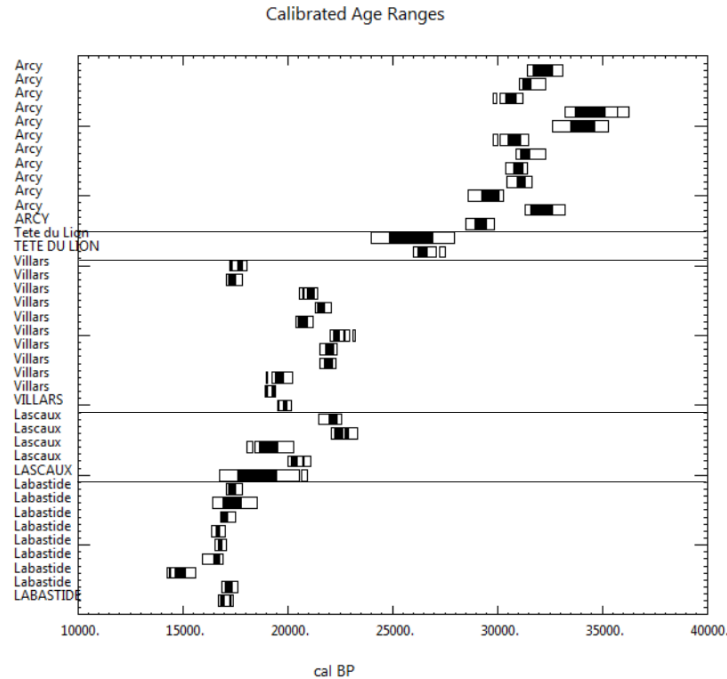


Figure 3 Calibrated ages (using OxCal v 6; Stuiver et al. 2010; IntCal09, Reimer et al. 2009) obtained for the French caves.

The new results for Labastide are in agreement with those obtained in the 1980s, and are included in the 17,500 and 16,000 cal BP time interval. They show that all the cave areas including those with parietal representations were intensively visited by Magdalenian people. Some parietal marks that had earlier been attributed to Paleolithic activities, however, now appear to date to the Holocene.

The new Lascaux results on a spearhead and reindeer antler fragments (23,000–22,000 cal BP) are somewhat older than those obtained in the 1960s on charcoal specimens (21,000–17,000 cal BP). They suggest that Lascaux may have been visited by prehistoric people earlier than suspected, but more dates on characteristic bone artifacts are still needed to support this hypothesis.

Until now, the prehistoric human occupations in Villars Cave were known from a single ^{14}C dating (20,500–19,000 cal BP) obtained about 15 yr ago from a burnt bone fragment (unpublished data). New results from parietal torch wipes and black spots provide more information about past human occupations. All these marks were first analyzed by a portable fluorescent X-ray apparatus that allows discarding of all black spots/lines/drawings that were made with manganese dioxide (Beck et

al., these proceedings). They display 2 distinct sets of dates a few thousand years apart: 3 black spots, among which one is situated near La Salle des Peintures, gave 22,000–20,500, while 2 others yielded 18,000–17,000 cal BP. The 3 ^{14}C ages (23,000–21,500 cal BP) on reindeer bone fragments are slightly older than the oldest parietal marks. These new results are in agreement with the parietal art stylistic investigations and suggest that the cave decoration was created during the ancient Magdalenian period.

Recent excavations by J Monney and more precise AMS ^{14}C dating (27,000–26,000 cal BP) at La Tête-du-Lion cave confirmed the presence of prehistoric people in the vicinity of the parietal aurochs drawing during the Solutrean period. As indicated by the archaeological association of ochre with the charcoal dated in the 1970s, this event is probably linked with the decoration of the Apse.

Sixteen dates have been made for La Grande Grotte (Arcy-sur-Cure) Upper Paleolithic occupations. The samples of anthropic origin (charred bone and charcoal fragments, parietal marks) were all collected in the vicinity of the decorated walls: below the red figurations painted on La Salle des Vagues ceiling; in an area containing a small hearth and 2 red paint drops (eastern wall, Corniche au Bison) and along a painted panel (western wall, Frise Rouge) of La Salle des Noyaux de Cerises. The samples from torch wipes were also collected in that chamber. Most of the ages are in agreement and fall into the 33,000–29,000 cal BP time period. Note that a fresh bone and a tooth collected in La Salle des Vagues gave ages slightly older (36,000–33,000 cal BP), which can testify to a more ancient occupation. All the results obtained for La Grande Grotte are coherent and correspond to the beginning of the Upper Paleolithic. Therefore, they support the archaeological interpretation that they are characteristic of the Aurignacian-Gravettian tradition (Baffier and Girard 1998).

CONCLUSION

Decorated caves (La Pileta, Nerja, La Garma, Urdiales, Labastide, Lascaux, Villars, La Tête-du-Lion at Bidon, and La Grande Grotte at Arcy-sur-Cure) yielded organic remains, which have been dated by the ^{14}C method. The results obtained on these associated samples gave very informative data that allow us to precisely know the occupation periods of those caves. They range from the beginning of the Upper Paleolithic with La Grande Grotte at Arcy-sur-Cure (33,000–29,000 cal BP) to the Magdalenian period with Villars (22,000–18,000 cal BP) and Labastide (18,000–16,500 cal BP). For most of those caves, direct dating of parietal representations was impossible because of the lack of organic pigment. Therefore, whenever feasible, it becomes essential to establish the chronology of human occupations in all decorated caves based on their archaeological context. At present, ^{14}C dating appears to be the most relevant method to achieve such an aim.

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