JOURNAL of ANTHROPOLOGICAL RESEARCH

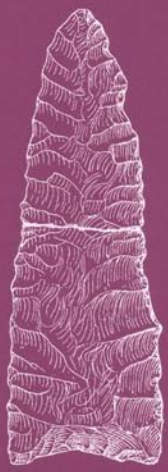
Published by the University of New Mexico in the interest of general anthropology since 1945.

VOLUME 71, NUMBER 4 WINTER 2015

Solutrean Studies: Human Adaptations to the Last Glacial Maximum in SW Europe

Edited by Lawrence G. Straus

Papers from a Commission VIII Symposium at the XVII UISPP Congress, Burgos, Spain, 2014



THE SOLUTREAN SITE OF AMBROSIO CAVE (ALMERÍA, SPAIN)
New Perspectives from Andalucia

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KEY WORDS: Solutrean, Ambrosio Cave, Radiocarbon dates, Iberian Peninsula, Bow and arrow; Subsistence diversity, Last Glacial Maximum

Recent research in Ambrosio Cave, in the southeastern corner of the Iberian Peninsula, has permitted us to establish more precisely the chronostratigraphic position of major Solutrean occupations within the late Upper Pleistocene. The calibration of a new radiocarbon date for Level IV (Upper Solutrean) and six other new dates (5 of them by AMS) for level II (Final Upper Solutrean) allows us to place these two cultural phases between Greenland Stadial (GS) 3 (end of OIS 3) and the end of Greenland Interstadial (GI) 2, with the main occupation of Level II happening after Heinrich Event (H) 2, corresponding with the interstadial that came just before the Last Glacial Maximum (GS 2). The new dates clearly modify the previously reported chronology, making the whole Ambrosio record much older than once thought. In addition, the discovery of cave wall panels decorated with engravings and paintings, covered by Upper Solutrean sediments, allows us to place the art precisely within the Middle Solutrean (Level VI), which must be placed between GI 5 and GI 3. Excavation of "the microstratigraphy sector" within Level II (Final or Evolved Upper Solutrean) has yielded 21 coupled hearth lenses (one of them with a stone feature) and thousands of very typical Solutrean flint implements, including characteristic barbed-stemmed points, shouldered points, and leaf points. Our analyses suggest that some of them may have been arrowheads propelled with bows.

When H. Breuil and F. de Motos were digging in 1911 in Ambrosio, a remote site in the southeast of the Iberian Peninsula, they probably had no idea that almost 100 years later this huge cavity would still contain remnant levels of human occupation. Even the work carried out by E. Ripoll in the 1960s did not complete the stratigraphic sequence, and the eight long excavation campaigns directed by S. Ripoll from 1981 to 2002 still did not reach bedrock.

Journal of Anthropological Research, vol. 71, 2015

http://dx.doi.org/10.3998/jar.0521004.0071.403

GEOARCHAEOLOGY

The site is located on the southeast edge of the foothills of the Betic Mountains in the northeastern corner of the province of Almeria (Andalucia) (Figure 1). The Neogene materials into which the cave opens are limestone rocks of the Upper Burdigalian–Lower Langhian, formed of soils made of biomicrites—sometimes loamy—that are rich in fossil remains; they surface in east-to-west belts and are superimposed, although they are not intruded upon by any other stratigraphic units.

The cave of Ambrosio (actually a deep rockshelter) is located at the head of the Moral arroyo; its elevation is 1,060 m above present sea level. It is located on the edge of the Sierra de Maria, some 60 km from the present Mediterranean shore. The limestone rock in which it is formed is affected by deep fracturing, which affects its geometry and the erosive processes acting on it. The orientation of the cave is south-southwest and it is a maximum of 15 m in height at the entrance and 17 m deep from the overhang to the rear wall.

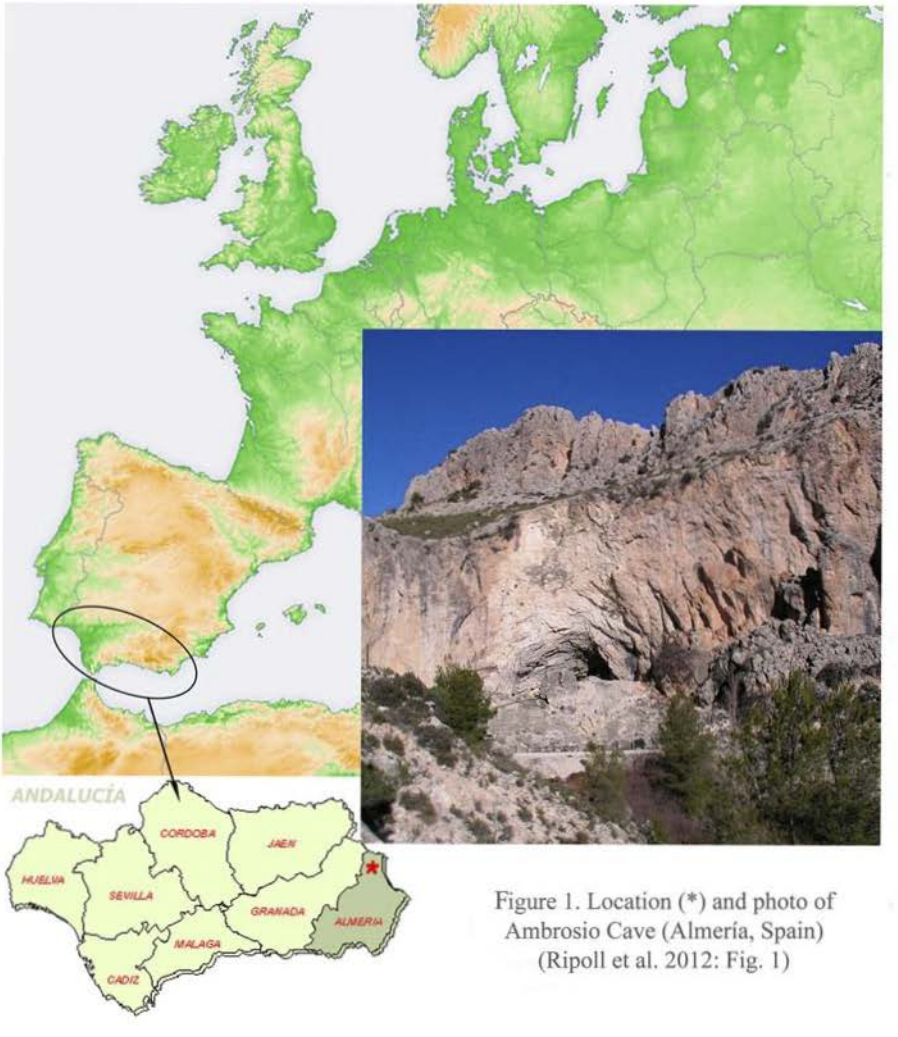

Figure 1. Location (*) and photo of Ambrosio Cave (Almería, Spain) (Ripoll et al. 2012: Fig. 1)

CHRONOSTRATIGRAPHY

The Pleistocene deposits consist of two clear lithostratigraphic units (Jordá and Carral 1988). The lower one is made up of thin, sterile sediments deposited by a mud-flow from the inside of the karst and constitutes the initiation of the cavity's sedimentation, although we have not yet reached bedrock. The upper unit is made up of high-energy deposits resulting from gelifraction processes with the addition of materials mainly from human activity related to the Solutrean occupation levels of the shelter: Ambrosio II—Upper or Evolved Solutrean; Ambrosio IV—Upper Solutrean; and Ambrosio VI—Medium Solutrean. This sequence is capped by alternating high-energy sands and conglomerates, and it ends in a cemented fracture that has subsequently been dismantled.

In order to place the Ambrosio sequence in a wider chronostratigraphic framework, the new radiocarbon dates have been calibrated to 2 sigma (95% probability) using the calibration curve of CalPal 2007 Hulu, included in the program CalPal (Weninger et al. 2007). In addition to placing it in the chronostratigraphic and archaeological contexts of the Late Pleistocene in the southern Iberian Peninsula, we have integrated our dates with those from other sites with a similar chronology—between 27,000 and 19,000 BP. We have considered 30 valid dates calibrating using the CalPal 2007 Hulu curve (Weninger et al. 2007) from sites in the Spanish Mediterranean (from Valencia: Malladetes, Parpalló, Cova Beneito, Ratlla del Bubo, Cendres [Villaverde 2001; Villaverde et al. 1998, 1999], from Andalucia: Nerja and La Pileta [Aura et al. 2006; Sanchidrián et al. 2001]), and from the Portuguese Atlantic (Buraca Grande, Vale Boi, Caldeirão, Lagar Velho, Salemas, Lapa da Rainha, Vale Almoinha and Vale Boi [Bicho 2004; Cascalheira et al. 2012; Pettitt et al. 2002]). Problems arise when comparing the three first dates of the Ambrosio sequence done by the conventional ^{14}C method (Ripoll, ed. 1988) with the eight recently obtained assays—three conventional ones and five AMS ones, some of which have already been published (Ripoll et al. 2006). The original, conventionally derived dates are markedly more recent than the newly obtained AMS and conventional dates, as can be seen in Table 1.

The oldest of the three original dates (Gif-7277) is clearly inaccurate, so it is excluded in this analysis; as for the other two, they are consistent with one another, although they do not match with the dates obtained recently. We opted to use the recently obtained dates since they come from archaeological contexts that are better defined and better recorded than those that had been done some twenty years earlier (Figure 2).

One of the eight recently obtained dates (GifA-A-II.9) is clearly anomalous, so it is not considered further. The other six dates for Level II were obtained in a microstratigraphy composed of overlapping prehistoric bonfires, and among them slight reversals can be seen, probably because the charcoal samples, unfortunately, were not analyzed anthracologically before being dated. However, as it can be seen in the graphs of cumulative probability of the calibrated dates, they present meaningful clusters; therefore they can be considered as a whole to correctly date the Ambrosio Upper/Evolved Solutrean.

Table 1. Radiocarbon dates from Ambrosio Cave.

Level	Period	Material	Method	Lab No.	^{14}C Date (BP)	cal BP Range (2 σ; 95% prob.)	Reference
Ambrosio II	SSE	Charcoal	Conventional	Gif-7276	16500 ± 280	20500–19140	Ripoll 1988
Ambrosio IV	SS	Charcoal	Conventional	Gif-7275	16620 ± 280	20540–19260	Ripoll 1988
Ambrosio VI	SM	Charcoal	Conventional	Gif-7277	16590 ± 1400	23180–17020	Ripoll 1988
Ambrosio II Generic	SSE	Charcoal	Conventional	Gif-9883	19250 ± 70	23570–22490	Ripoll et al. 2006
Ambrosio II Layer 1	SSE	Charcoal	AMS	GifA-95576?	20150 ± 200	24550–23550	Ripoll et al. 2006
Ambrosio II Layer 1	SSE	Charcoal	AMS	GifA-95577	19950 ± 210	24320–23400	Ripoll et al. 2006
Ambrosio II Layer 2	SSE	Charcoal	AMS	GifA-A-II.2	19170 ± 190	23630–22310	Jordá et al. 2012
Ambrosio II Layer 4	SSE	Charcoal	Conventional	Gif-A-II.4	19110 ± 90	23450–22330	Jordá et al. 2012
Ambrosio II Layer 6	SSE	Charcoal	AMS	GifA-A-II.6	19300 ± 190	23680–22440	Jordá et al. 2012
Ambrosio II Layer 9	SSE	Charcoal	AMS	GifA-A-II.9	13740 ± 140	ANOMALOUS	Jordá et al. 2012
Ambrosio IV	SS	Charcoal	Conventional	Gif-9884	21520 ± 120	26270–25230	Ripoll et al. 2006

SS = Upper Solutrean
SM = Middle Solutrean
SSE = Upper/Evolved Solutrean

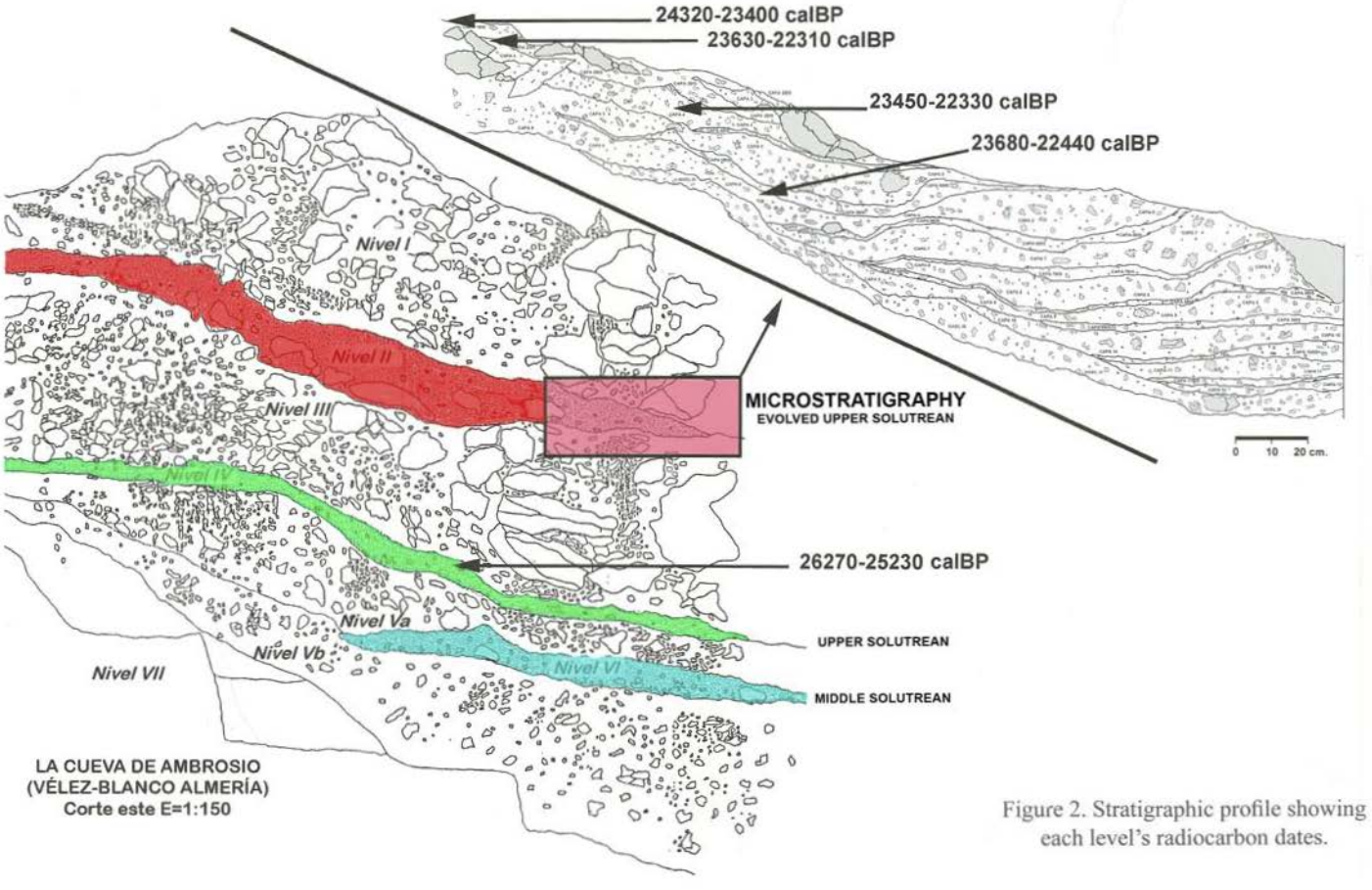

Figure 2. Stratigraphic profile showing each level's radiocarbon dates.

The date from Level IV is not problematic and allows for a precise dating of the Upper Solutrean. Unfortunately, in this new dating series we do not have any results for the lower cultural level, Ambrosio IV, which contains materials from the Middle Solutrean.

Ambrosio Level IV—Upper Solutrean—corresponds to the beginning of the Greenland Stadial 3 (GS 3) cold stage (Björck et al. 1998), when the temperature of the nearby Sea of Alboran fluctuated between 11 and 14° C (Cacho et al. 1999, 2001), during the first half of the Heinrich (H) 2 event. At a regional scale, Ambrosio IV (Fortea and Jordá 1976) is placed between the date for the Upper Solutrean of Malladetes (Valencia) and the most ancient layer of the Middle Solutrean in the Vestíbulo of Nerja Cave (NV.9) in Málaga.

Ambrosio II—Upper/Evolved Solutrean—developed during the second half of GS3 and H2, when the Alboran Sea experienced its lowest temperatures during the Late Upper Pleistocene, around 10° C, and ended during the warm inter-stage of Greenland Interstadial 2 (GI 2) (Björck et al. 1998), with western Mediterranean surface temperatures of 12° C (Cacho et al. 1999, 2001). Regionally, this level is bracketed by the direct AMS dates of Solutrean artistic representations in Nerja and La Pileta caves in Málaga (Sanchidrián et al. 2001) and the dates for the Upper Solutrean occupation in Nerja on the southern Mediterranean coast (Aura et al. 2006) and for other Portuguese (Bicho 2004; Pettitt et al. 2002) and Valencian (Villaverde 2001; Villaverde et al. 1998, 1999) sites.

MEDITERRANEAN SHOULDERED POINTS

Ambrosio and Parpalló caves articulate the technological sequence of the extra-Cantabrian Spanish Solutrean as they are the only sites with abundant lithic assemblages and especially Solutrean projectiles (Muñoz 2000).

In the Middle Solutrean—Level VI—the Solutrean tools are marked by the consolidation of the bifacial knapping technique, with laurel leaf points outnumbering unifacial ones. At the end of this period, a tendency to stem the laurel leaves began, as their morphologies started to transition between Smith's (1966:53) subtype H points and the classic stemmed points of southern Iberia. Bifacial Solutrean pieces are detected in the archaeological record for the first time in Level VI. These are unfinished laurel leaf blanks.

In the Upper Solutrean—Level IV—unifacial points still occur, although rarely. The laurel leaves, characterized by invasive retouch, become smaller and thinner and sometimes have a rectilinear edge. The idea of barbed-stemmed points (possibly arrowheads)—first hinted at toward the end of the Middle Solutrean—took hold in this period, and these artifacts are found together with Mediterranean-type (i.e., backed) shouldered points.

In the Upper/Evolved Solutrean—Level II—flat, invasive retouch loses its preeminence in favor of backing retouch. Laurel leaves are still present, in significantly reduced numbers. Although the barbed (or "winged") stemmed points are still important, the most prominent projectile type in this period is the Mediterranean shouldered point, outnumbering all other types in the Solutrean

tool group. In addition, the subtype of small laurel leaves displays a remarkable increase relative to its minor presence in the former period.

Functional and experimental research on barbed-stemmed points and abruptly retouched shouldered points suggests their use as arrowheads, which means that the appearance of the bow and arrow technique could be traced back to the beginning of the Upper Solutrean in the extra-Cantabrian regions of the Iberian Peninsula (Muñoz 2000; Muñoz and Márquez 2006; Muñoz et al. 2012) (Figure 3).

TAPHONOMY AND ARCHAEOZOOLOGY

According to the traditional interpretation that all the taxa associated with lithic artifacts in an archaeological site are the consequence of human activity, Ambrosio would be considered a location for the specialized hunting of lagomorphs (*Oryctolagus cuniculus*) since they make up more than 90% of the identified individual animals.

However, taphonomic research by Yravedra Sainz de los Terreros (2006, 2008) shows that the rabbit remains were the result of varied contributions made by birds, carnivores, and humans. A small number of lagomorphs even died of natural causes when blocks fell from the shelter´s ceiling. Given these circumstances, and the limited amount of meat they could actually have contributed to the site inhabitants' diet, it turns out that Ambrosio was not a location of specialized rabbit hunting—other, much larger mammals, namely horse, ibex, and red deer, provided much more meat.

The faunal analyses (Yravedra Sainz de los Terreros 2006, 2008) indicate that all the ungulates, as well as foxes, were processed for meat at the site by humans. After humans left the site, carnivores would occupy the shelter, scavenging whatever carcass parts were left, as shown by the presence of gnaw marks on some bones. This shows that human occupation of the cave was not continuous.

The overall ungulate procurement strategy was split among the triad of ibex, horse, and red deer. However, the analysis of seasonality has allowed us to suggest the existence of different hunting strategies through time: diversified hunting of all three main ungulates occurred during the warm seasons in the Middle and Upper Solutrean, whereas hunting was focused on ibex during winter occupations. Something similar occurred in the Upper/Evolved Solutrean, when people also started to hunt aurochs, while killing fewer boar. The fundamental duality of the hunting strategies seems to have been conditioned by each resource's availability. The ibex would be the chief animal hunted in winter because its adaptability to a variety of habitats allowed it to live in the immediate (relatively low, but steep and rocky) environment around Ambrosio during the coldest weather of the year. On the other hand, the deer and horses went to even lower valleys in winter, but during the warmer seasons they ascended to areas near Ambrosio to take advantage of mid-mountain pastures.

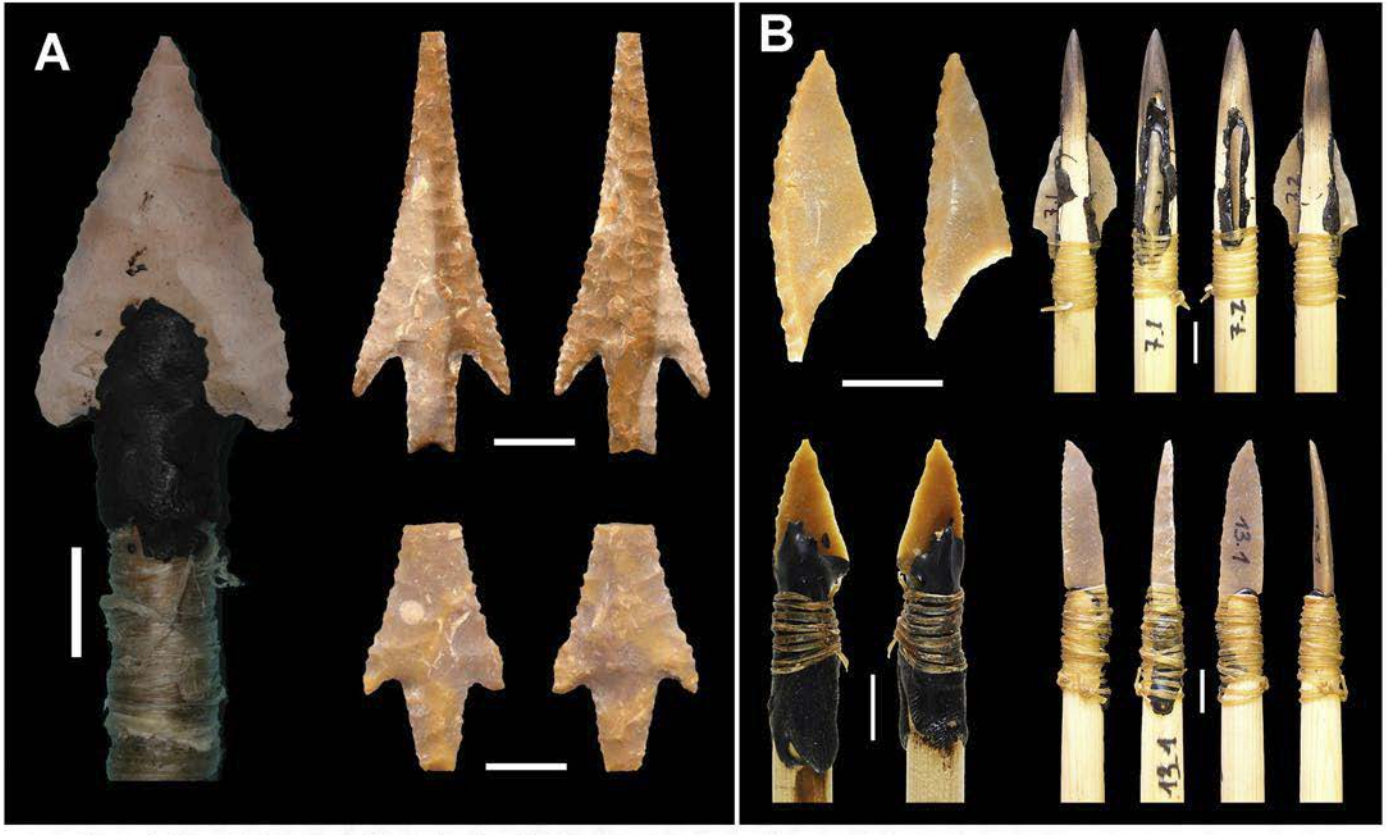

Figure 3. Upper Solutrean and Upper/Evolved Solutrean Points. A: Barbed and stemmed points with a hypothetical hafting solution as arrowheads. B: Abruptly retouched shouldered points with a hypothetical hafting solution as an arrowhead.

PREHISTORIC ROCK ART

We were very surprised in 1992 when we found the first engraved figures as we were cleaning a smooth surface of the cave wall, where the 0 datum point is placed. Since then we have identified 35 representations of engraved and/or painted images, mainly zoomorphic—including Equidae, although there are also a bird, a bovine, and some other designs (Figure 4). The most remarkable figures are the striking horse image painted in red ochre (left-oriented and with a length of 92 cm) and a very realistic, engraved and painted human face.

At the time of the discovery, no one imagined that a rockshelter in the southeast of the Iberian Peninsula would exhibit parietal representations; in addition they were covered with sediments of various archaeological levels. Indeed, parietal representations are rarely covered by archaeological levels that enable rather precise dating, but this is the case for Ambrosio. Although today Panel I is exposed, until recently it was covered by intact levels that extended only a few centimeters to the left (i.e., toward the exterior of the shelter) and that had been removed by looters, as well as by the natural wall collapse of the trenches dug by E. Ripoll in the 1960s (Figure 5).

Figure 4. A (above). Art Panel II, where we have identified 35 engraved and painted figures. The red ochre horse is in the upper-middle part of the photograph. (Ripoll et al. 2012: Fig. 5)

Figure 4. B (left). Drawing of the horse's head. (Ripoll et al. 1996)

The shelter fill reached a total thickness of 4.97 m and covered all the decorated wall surfaces. The top of Panel IA was covered by Terminal Pleistocene deposits, as well as by Levels I—sterile, II—Upper/Evolved Solutrean with an updated date between 19,250 and 20,150 cal BP, and III—sterile, but corresponding to the topmost living floor of Level IV—Upper Solutrean, with a new date of 21,520 ± 120 cal BP.

On the other side of the shelter, Panels IB, II, and III, which are lower than Panel IA, were covered by Level IV (Upper Solutrean) and Level V (sterile) and would have been decorated during the much older Middle Solutrean cultural horizon with a radiocarbon age between 23,180 and 17,120 cal BP at 2σ.

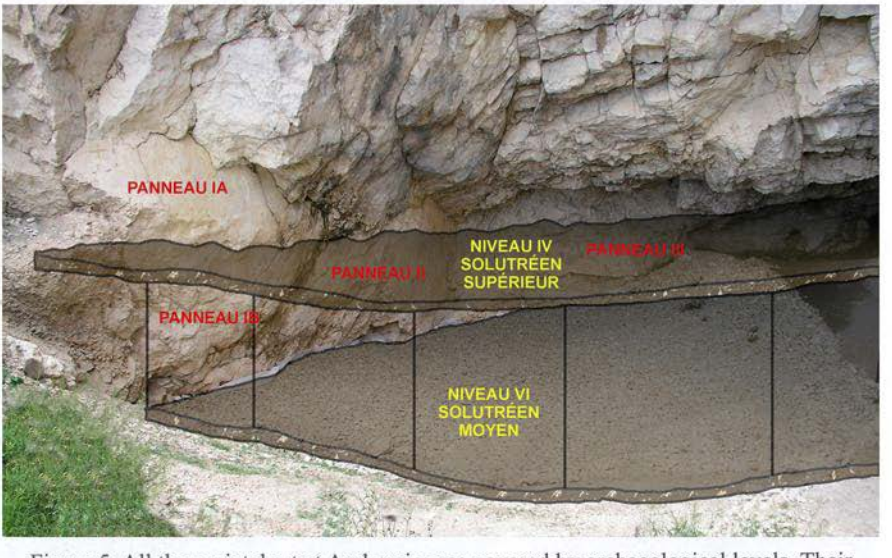

Figure 5. All the parietal art at Ambrosio was covered by archaeological levels. Their well-established stratigraphic position allows for the precise dating of the ensemble to two different cultural horizons. Panel IA corresponds to the Upper Solutrean; Panels IB and II match up with the Middle Solutrean. (Ripoll et al. 2012: Fig. 14)

In a region where Paleolithic paintings are very rare, these representations are surprisingly classic. The Cave of Ambrosio is one of the few places with parietal Paleolithic art in the Iberian Peninsula that is absolutely dated. It is located in the Mediterranean region, where the large collection of portable engraved stone slabs from Parpalló Cave (Valencia) (Pericot 1942; Villaverde 1994) has long been the key reference for Upper Paleolithic art. In addition, the Ambrosio figures are in an open shelter with natural light, not in a deep cave. These parietal figures are of great interest because of their independent chronometric dating, their artistic quality, and their unusual location in the Spanish Southeast.

The discovery of these figures fills a geographic void in the distribution of Iberian Upper Paleolithic cave art, the only other art site of such age in Almeria being the open-air locality of Piedras Blancas with a pecked equid image (Martínez 1986/1987).

In Europe, only five Paleolithic sites have similar stratigraphic and absolute dating of art representations. One is the rockshelter of La Viña (Asturias), where some naturalistic representations were covered by Middle and Upper Cantabrian Magdalenian levels (Fortea 1981; Fortea et al. 1990). In 2001, the discovery of several parietal representations in Parpalló Cave (Valencia) was announced (Beltrán 2002). Although these figures are now well above the post-excavation ground surface, soon after their creation they were covered by the archaeological levels excavated in the 1930s (Pericot 1942); they include an equid, an ibex, and several lines, as well as an unidentified quadruped in red ochre located above the area where Pericot´s Middle and Upper Solutrean levels had been. In the cave of El Mirón (Cantabria), non-figurative engravings have been found on the once-interior face of a block that had fallen from the ceiling onto a Lower Magdalenian level (which has been dated) and was then covered by levels dating to the Middle and Upper Magdalenian (García et al. 2012; González and Straus 2000). In the cave of La Tête du Lion in Ardêche, France (Combier 1972, 1977), pictorial representations were not actually covered by the strata, but the systematic excavation carried out at the base of the paintings yielded the "pencils" and charcoals used to make the artworks that were dated to the Solutrean. In 1990, in Le Placard Cave (Charente, France), a radiocarbon date of 19,970 ± 250 BP was obtained from a bone found in a wall crack that had been covered by Upper Solutrean deposits, which also covered "signs" marked on the wall. Since there were no older Upper Paleolithic occupations in the cave, the rock art is assumed to have been Solutrean in age (Clottes et al. 1990, 1991). Ambrosio is now added to this short list of stratigraphically dated Upper Paleolithic rock art sites.

The frequent discoveries of Upper Paleolithic art either at outdoor locations or in archaeological living sites, as in the present case, call into question previous assumptions about the geographical distribution of such art. Old ideas concerning the "normal" locations of Upper Paleolithic art—both geographically within Europe and spatially (i.e., dark parts of caves being seen as the norm; sunlit or open-air locations being seen as rare exceptions)—are now challenged by new discoveries such as that of Ambrosio, as well as those of the major open-air rock art complexes of Côa, Domingo Garcia, and Siega Verde in western Iberia. So too is it now becoming abundantly clear that H. Breuil's scepticism about Solutrean-age rock art was seriously misplaced, as long ago argued by the late F. Jordá.

THE SOLUTREAN IN THE SOUTHERN IBERIAN PENINSULA

The polymorphism in artifacts from the Solutrean in the Iberian Peninsula is reflected in remarkable differences between the Cantabrian and the extra-Cantabrian regions. These two areas can be separated by an imaginary line extending from central Portugal to the southeast of France via Madrid. The main differences are essentially technological and typological, since in other aspects, such as art, they have many points in common. The differences arise at the end of the Solutrean, with the respective presence or absence of invasive retouch on shouldered points, as well as barbed-stemmed points, which begin to appear in the

Upper Solutrean in Ambrosio and the Middle Solutrean in Parpalló.

The Catalonian Solutrean at such sites as L'Arbreda, Reclau Viver, El Cau de les Goges, and Davant Pau displays a certain degree of local originality, including invasive retouch on shouldered points as well as other points with incipient stems together with features such as narrow, asymmetrical laurel leaves. Thus it could be considered different from the rest of the Spanish Mediterranean Solutrean, but at the same time it is difficult to fit it into the classic Solutrean sequence (Soler 1986).

The fauna in almost every archaeological site in Mediterranean Spain, plus Portugal, is numerically dominated by lagomorphs relative to ibex, red deer, and equids, as well as other medium to large mammals. However, the relative frequencies of the various species within assemblages vary depending on local habitats and seasons of human residence.

Traditionally, the Solutrean has been considered one of the best-known periods in the cultural sequence of the Spanish Mediterranean Paleolithic. However, although many archaeological sites have easily identifiable Solutrean points, only a few have produced analyzed artifact and faunal assemblages that are large and representative enough to provide precise information on the age and nature of the human occupations. This is the case for Parpalló and Ambrosio, as well as Nerja (Málaga). Nevertheless, it is clear that southern Iberia was a major and culturally distinctive refugium for human populations during the Last Glacial Maximum, an important, though still perhaps less-known, part of the wider Solutrean phenomenon of southwest Europe.

NOTE

The text was extensively edited by L. G. Straus, who invited us to participate in the UISPP Congress symposium on Solutrean human adaptations to the Last Glacial Maximum in Burgos, September, 2014.

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