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The Middle-to-Upper Palaeolithic transition in Cova Gran (Catalunya, Spain) and the extinction of Neanderthals in the Iberian Peninsula

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ABSTRACT

The excavations carried out in Cova Gran de Santa Linya (Southeastern PrePyrenees, Catalunya, Spain) have unearthed a new archaeological sequence attributable to the Middle Palaeoloithic/Upper Palaeolithic (MP/UP) transition. This article presents data on the stratigraphy, archaeology, and ^{14}C AMS dates of three Early Upper Palaeolithic and four Late Middle Palaeolithic levels excavated in Cova Gran. All these archaeological levels fall within the 34–32 ka time span, the temporal frame in which major events of Neanderthal extinction took place. The earliest Early Upper Palaeolithic (497D) and the latest Middle Palaeolithic (S1B) levels in Cova Gran are separated by a sterile gap and permit pinpointing the time period in which the Mousterian disappeared from Northeastern Spain. Technological differences between the Early Upper Palaeolithic and Late Middle Palaeolithic industries in Cova Gran support a cultural rupture between the two periods. A series of 12 ^{14}C AMS dates prompts reflections on the validity of reconstructions based on radiocarbon data. Thus, results from excavations in Cova Gran lead us to discuss the scenarios relating the MP/UP transition in the Iberian Peninsula, a region considered a refuge of late Neanderthal populations.

Introduction

The appearance of the Upper Palaeolithic across Western Eurasia is the subject of intense debate (Mellars, 1999, 2004, 2006; Zilhão and d'Errico, 1999; Klein, 2000; Jöris and Adler, 2008; Roebroeks, 2008). The Iberian Peninsula plays a fundamental role in these discussions, since it is considered one of the last refuges of Neanderthals during the spread of anatomically modern humans across Europe. In the Iberian Peninsula, this discussion has focused on the notion of in situ evolution versus rupture on the basis of the variations observed in stone tools and in radiometric data provided essentially by ^{14}C AMS dates. The notion of evolution defines a long-term process that assumes that the Iberian Upper Palaeolithic is contiguous with the local substrate of the Middle Palaeolithic. However, other authors propose there was a distinct break between the periods, and that the Upper Palaeolithic is associated with the appearance of anatomically modern *Homo sapiens* and the extinction of the Neanderthals. The prolonged survival of *Homo neanderthalensis* in the Iberian Peninsula implies that the two species may have coexisted, a scenario that generates a complex mosaic panorama for the Middle Palaeolithic/Upper Palaeolithic (MP/UP) transition.

This article presents the sequence of Cova Gran de Santa Linya (Southeastern PrePyrenees, Catalonia), a new site in the Iberian Peninsula that contains a Late Middle Palaeolithic (LMP) and Early Upper Palaeolithic (EUP) sequence. After discussing the chronostratigraphy of the EUP in Iberia, we look at the geometry, stratigraphy, and resolution of the archaeological levels from Cova Gran (Fig. 1). These contextual indicators lead us to discuss the role of depositional and post-depositional processes and their impact on the homogeneity of the archaeological levels. Secondly, the technology of the Middle and Upper Palaeolithic levels is compared, with special emphasis on the lithic assemblage of the most recent LMP unit (S1B) and the first EUP level (497D). Finally, a series of ^{14}C AMS dates of the LMP and EUP archaeological units is presented and discussed within the Iberian regional context.

Cova Gran provides contextual, techno-typological, and radiometric elements that contribute to the debate on the MP/UP transition and an understanding of the Neanderthal extinction. Given the paucity of well contextualised transitional levels in Iberia, the Cova Gran record fills a gap in the regional sequence. The Cova Gran LMP-EUP record demonstrates dating ambiguities usually affecting sites situated in the Middle to Upper Palaeolithic time period, and suggests a technological rupture between the Middle and the

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Fig. 1. Cova Gran de Santa Linya (Southeastern PrePyrenees; Photo: Jesus Jordá).

Upper Palaeolithic with no elements of cultural continuity. In sum, results from excavations in Cova Gran make it possible to discuss the emergence of the Upper Palaeolithic in the Iberian Peninsula and to reflect on the possible coexistence of Neanderthals and modern humans.

The origins of the upper Palaeolithic: a perspective from Iberia

The available archaeological record indicates that the Neanderthals inhabited broad areas of Europe and the Middle East throughout the upper Pleistocene until the MIS3/MIS2 boundary. During the interval between 40–30 ka, the Middle Palaeolithic lithic techno-complexes disappear. This disappearance has been interpreted as the result of expansion of modern humans through the European continent within a precise chronological time span (Mellars, 2006). However, it has also been proposed that the Aurignacian, considered the first Upper Palaeolithic manifestation in Western-central Europe, may not be a direct import from the Near East and could derive from earlier EUP techno-complexes (Laplace, 1966; Bon, 2002; Teyssandier, 2008).

This observation is relevant when examining the appearance of the Upper Palaeolithic in the Iberian Peninsula. The archaeological work undertaken in recent years promotes various alternatives that draw a complex panorama. Some authors propose an in situ MP/UP transition scenario in the north of the Iberian Peninsula (Cabrera et al., 2001, 2006), while others support a radical change that entails the sudden arrival of a new contingent of population, as proposed through the evidence from l'Arbreda, (Bischoff et al., 1989; Maroto et al., 1996).

It has also been claimed that the protracted coexistence of the Neanderthals and *Homo sapiens* led to the appearance of a mosaic landscape (Straus, 1996, 2005), in which some Neanderthal populations would have been integrated into the *H. sapiens* clade (Zilhão and Trinkaus, 2002; Zilhão, 2006a). This model contemplates the survival of Neanderthal populations in much of Iberia beyond the 40 ka chronological boundary and depicts a spatial segregation of techno-complexes assumed to be associated with different human species (Zilhão, 2006a,b). The climatic conditions at the end of MIS 3 would have led to the progressive isolation of the Neanderthal populations in the south of the Iberian Peninsula (d'Errico and Sanchez Goñi, 2003; Sepulchre et al., 2007), while the "Ebro frontier" model explains the significant number of late Middle Palaeolithic assemblages (Zilhão, 2000). Despite this prolonged temporal coexistence, no "transitional" techno-complexes—the result of the interaction between Neanderthals and modern humans according to Mellars (1989, 1999; contra d'Errico et al., 1998)—have been found in the southern Iberian Peninsula.

The hypothesis of an extended Neanderthal survival in southern Iberia has received support from a series of ^{14}C AMS dates from Gorham's Cave (Finlayson et al., 2006, 2008; although see Zilhão and Pettitt, 2006), which has supplemented previous claims made for the age of Zafarraya (Hublin et al., 1995), currently questioned by the excavators (Barroso (ed.), 2003). This situation is not exclusive to the south of the Iberian Peninsula, and several 40–30 ka Mousterian assemblages are referred to in Portugal, the Meseta, the Cantabrian area, and the southern Pyrenees (Vaquero et al., 2006; Zilhão, 2006a).

In the Iberian Peninsula, the traditional approach based on typological indicators has in recent years turned towards a study of technical systems (see contributions in Bon et al., 2003; Le Brun-Ricalens, 2005). Other possible indicators, such as certain bone tools (e.g., split-base points) or stone tools (carinated scrapers and Dufour bladelets—Dufour subtype) make it possible to carry out chrono-stylistic seriation within the Aurignacian (Le Brun-Ricalens, 2005; Zilhão, 2006a; Teyssandier, 2008). Font-Yves points and Dufour straight bladelets define the Proto-Aurignacian, a tradition that could trace a pioneer dispersal of *H. sapiens* through Western Europe (although see Teyssandier, 2008) following a northern Mediterranean route (Broglio et al., 2005; Mellars, 2006; Zilhão, 2006b), which in the Iberian Peninsula is documented in the Cantabrian-Pyrenean area in Labeko Koba (Arrizabalaga et al., 2003), Morín (Maillo, 2005; Cabrera et al., 2006), the Western Mediterranean in l'Arbreda and Reclau Viver (Bischoff et al., 1989; Maroto et al., 1996; Ortega Cobos et al., 2005), and Zafarraya in Andalucia (Barroso et al., 2003; although see Zilhão, 2006a). Although the chronological validity of these artefacts as fossils directeurs in the EUP should be verified by the direct dating of diagnostic bone tools (e.g., split-base points) or other artefacts made on bone and shell, such as it has been propossed by Higham et al. (2006).

Obtaining a chronostratigraphic framework for the 40–30 ka period in the Iberian Peninsula presents a number of problems, which include, amongst others, the limited number of stratigraphic sequences containing both LMP and EUP series (Vaquero, 2006; Vaquero et al., 2006; Zilhão, 2006a). Furthermore, some of the few Iberian sites that include both LMP and EUP, such as Castillo and l'Arbreda, have seen their radiometric series questioned on the grounds of poor stratigraphic resolution (Zilhão and d'Errico, 1999, 2003; Zilhão, 2006a); recently questioned (Bernaldo de Quiros et al., 2008; Soler Subils et al., 2008). In fact, according to Zilhão (2006a), Labeko Koba is the only well-contextualized sequence excavated with modern methods that contains both techno-complexes.

It is in this context that we present Cova Gran, a new Iberian site in which LMP and EUP levels have been identified. The current excavations in Cova Gran, a large rockshelter in the foothills of the Eastern PrePyrenees of Catalonia, provide contextual, techno-typological, and radiometric information that will contribute to the debate on the extinction of Neanderthals and the emergence of EUP in the Iberian Peninsula.

The MP/UP archaeological stratigraphy of Cova Gran

Cova Gran (x = 318635, y = 4644081, UTM H31 N ED50) is located at 385 m a.s.l in the Marginal-Exterior Sierras of the Eastern PrePyrenees (Northeast of the Iberian Peninsula). This rockshelter, which has an area of more than 2,500 m^2, is located in a limestone bar of the Bona Formation (upper Cretaceous), in the contact between the Triassic and the Cretaceous, in a small valley surrounded by medium height mountains (500–800 m). A now inactive stream flows through this valley into the Noguera-Pallaresa,

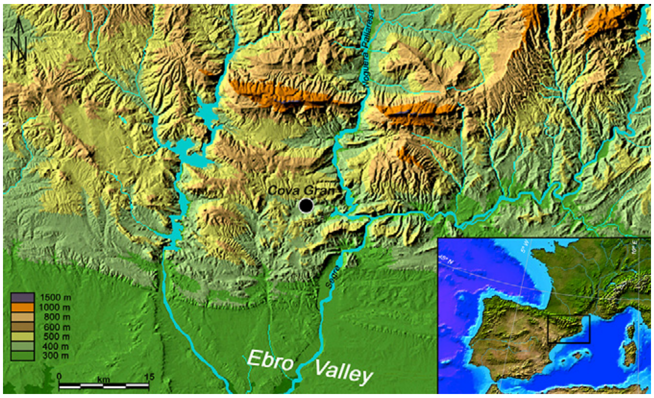

Fig. 2. Location of Cova Gran de Santa Linya, in the contact between the Ebro basin and the Southeastern PrePyrenees of Catalunya (Spain).

a tributary of the river Segre, the principal watercourse of the northeastern side of the Ebro Valley (Fig. 2).

Given the large extension of sediments at Cova Gran, which began to be explored in 2004, the full extent of the archaeological stratigraphy is still unknown. The LMP/EUP levels are located in the western part of the shelter, on a lateral platform with an area of 200 m^2 and a subhorizontal slope (15°). An approximate area of 40 m^2 has been excavated, in which three consecutive levels are attributed to the EUP and four to the LMP (Fig. 3).

Lithostratigraphically, the archaeological levels are positioned in two different sedimentary units. The lower unit consists of sands and small and medium-sized angular limestone clasts. The thickness of the lower unit is at present 1.5 m, in which four LMP levels and the lowermost of the EUP have been detected in a succession of geometrically irregular beds with granular sediments composed of gravitational angular blocks of variable sizes, limestone gravels, and sands from the weathering of the bedrock (Fig. 4). These phenomena of mechanical alteration are associated with cold climatic conditions and lack of circulating water. In contrast, the sedimentation of the upper unit, which is 0.5 m thick and contains two levels attributed to the EUP, consists of granular sediments affected by surface runoff water, suggesting possibly warmer environmental conditions than those of the lower unit (Benito et al., 2009). Apparently, no erosive processes or heavy postdepositional disturbances have influenced the lower and upper lithostratigraphic units.

The EUP assemblages—497A, 497C, and 497D—are levels with limited vertical dispersion, indicating well separated occupations. These levels present a subhorizontal slope eastwards until they disappear as the slope flattens out. The LMP levels—S1B, S1C, S1D, S1E—slope in the opposite direction from the levels of the upper unit. The LMP levels have an average thickness of 10–15 cm and are also truncated by the erosion of the slope in the eastern part of the excavated area (Fig. 5). The succession of different archaeological levels that are separated by sterile layers suggests episodic visits to the rockshelter followed by periods with out human presence at the site.

The horizontal and vertical geometry of occupations 497D and S1B, the oldest EUP level and the most recent LMP level, respectively, are key to the discussion (Fig. 6). Horizontally, these levels are distributed over uneven surfaces; approximately 40 m^2 of level 497D has been excavated, while in S1B about 50 m^2 has been exposed (although for the latter there are still deposits preserved to the west, south, and north of the excavated area). These archaeological levels are superimposed over an approximate area of 20 m^2, and the vertical plotting of the artefacts indicates the distribution of S1B below 497D across more than 6 m. Between the two levels there is a sterile layer of 20–50 cm; this includes large blocks that seal off and prevent the vertical migration and mixing of materials between the two archaeological units.

This sedimentary geometry of archaeological layers is particularly relevant to the discussion of the MP/UP transition in Cova Gran. The limited thickness of the levels suggests that the archaeological assemblages make up homogeneous entities and reveals no evidence of mixing between layers, either by percolation of materials, cryoturbation, or deficient recording of items. Two distinct archaeostratigraphic entities are clearly defined, and the similarities or differences between levels S1B and 497D cannot be attributed to postdepositional processes or inadequate excavation methods.

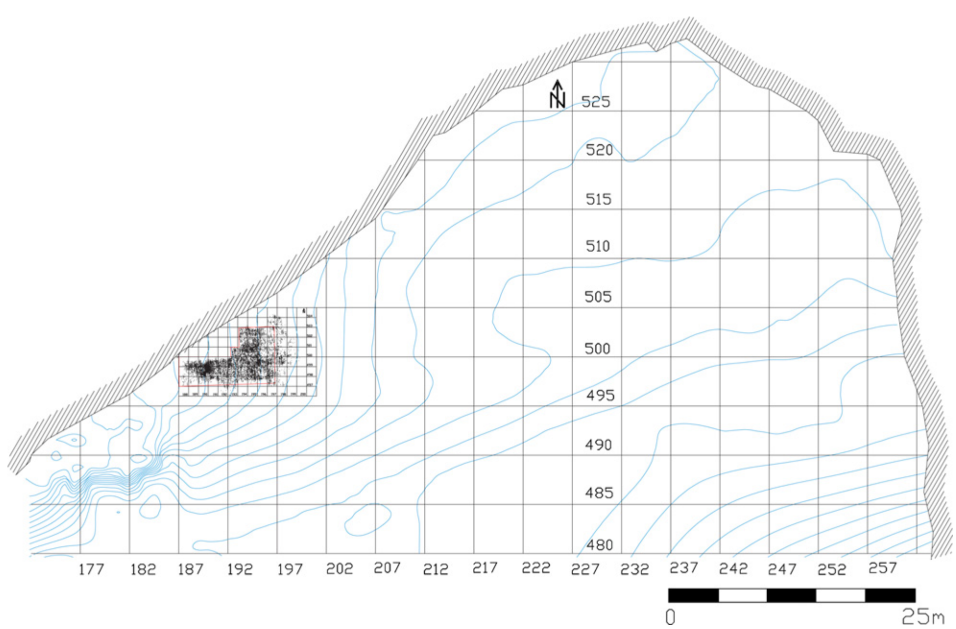

Fig. 3. General plan of Cova Gran with the area containing the MP/UP transition in the western sector. Equidistance between curves = 0.5 m.

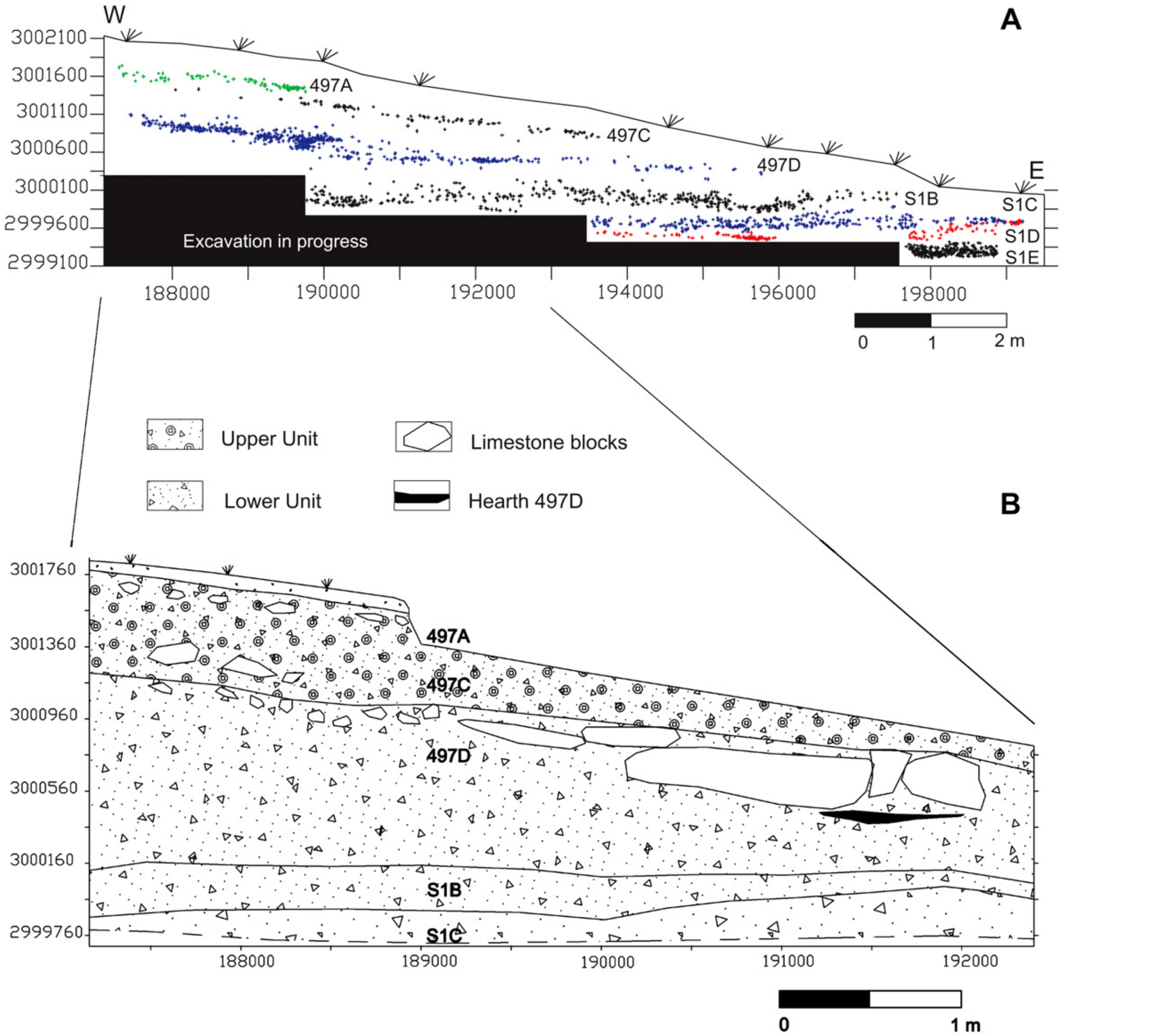

Fig. 4. Archaeostratigraphy and vertical plot of EUP and LMP levels (A) and lithostratigraphic section (B) in the axis y = 499000-499500. The earliest EUP level (497D) and all LMP levels (S1B, S1C, S1D) are included in the Lower Unit.

The middle palaeolithic assemblages

The Middle Palaeolithic sequence in Cova Gran consists of a 1.5 m thick homogeneous sedimentary series, in which no lithological changes are observed (Table 1). Although the bedrock has not yet been reached, four archaeological levels (S1B-S1E), containing hearths associated with stone tools and bone remains have been recorded.

These levels have an average thickness of 10–15 cm and represent palimpsests shaped by different events (see Fig. 5). The MP levels contain a high density of artefacts. All the knapping elements are documented, such as hammerstones, abundant microdebitage, flakes, cores, and retouched tools (Table 1).

The number of identifiable species (NISP) and minimum number of individuals (MNI) according to species and level are still in progress. However, a preliminary analysis of the faunal remains indicates the presence of *Stephanorhinus sp*., *Bos sp*., *Equus caballus*, *Equus cfr. hydruntinus*, *Cervus elaphus*, *Capra pyrenaica*, and *Oryctolagus cuniculus*. Although the bone sample is abundant, fossils are not well preserved and their cortical surfaces show abrasions and calcium deposits that make it difficult to identify perimortem modification (cutmarks or carnivore marks). In any case, the presence of long bone diaphyses with fresh breaks, impact scars, and fire alteration suggests prey were transported, processed, and consumed by humans.

In this article we focus on the attributes of the lithic assemblage from S1B, of which an area of 50 m^2 has been excavated so far. From this area, 3,400 artefacts have been recovered, including all the elements of the chaîne opératoire (hammerstones, cores, flakes, retouched pieces, and <1.5 cm microdebitage). Siliceous rocks (92%) are the most common raw materials, although metamorphic rocks of variable grain size and requiring different skills to knap have also been identified. Preliminary analysis of raw materials suggests that the various types of flint come from two upper Cretaceous and Oligocene outcrops nearby, whereas the metamorphic rocks come from the Noguera-Pallaresa Basin. Both types of raw material are located within a radius of less than 5 km (Mora et al., 2008).

The cores are aimed at obtaining flakes, mainly using knapping systems close to the Levallois recurrent centripetal method (sensu Boëda, 1993; but see Casanova et al., 2009; Fig. 7). There are large flakes (over 10 cm) on metamorphic rocks for which cores are absent, so it is likely that such flakes were produced outside the

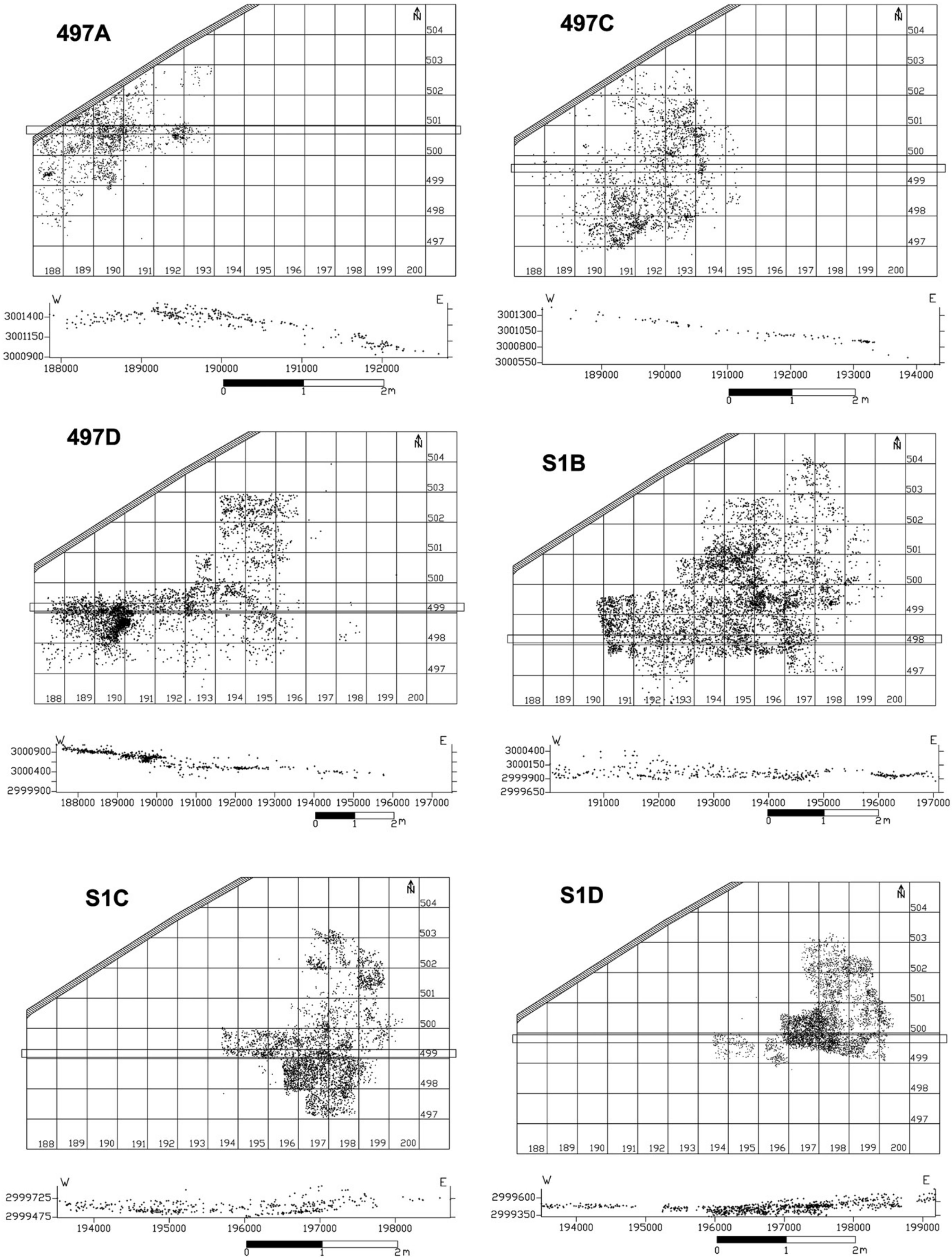

Fig. 5. Horizontal and vertical plots of EUP (497A, 497C, 497D) and LMP levels (S1B, S1C, S1D) in Cova Gran.

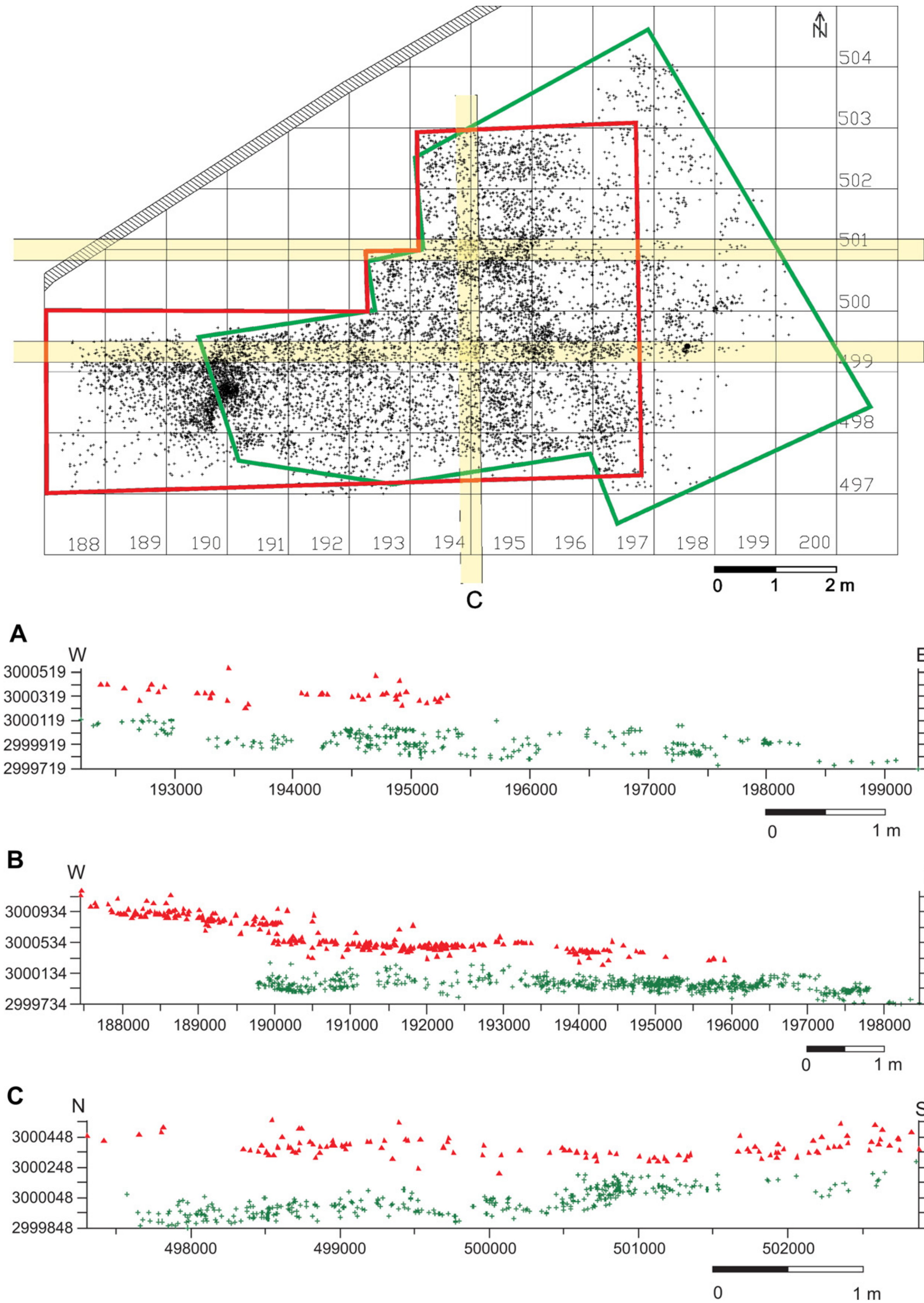

Fig. 6. Upper plot) Horizontal plot of the surface excavated in 497D (red grid) and S1B (green grid). Lower three plots) Vertical plot of 497D (red) and S1B (black) in the axis x = 500.900–501.100 (A), x = 499.600–499.800 (B), and y = 194.900–195.100 (C). In some parts of the excavated area, the stratigraphic distance between level 497D (earliest EUP) and S1B (last LMP) is >20 cm. This consistent sterile gap indicates rare vertical migration between the EUP and the LMP levels.

Table 1
Main features of the Late Middle Palaeolithic levels in Cova Gran

Level	Excavated surface (m^2)	Thickness (cm)	Total artefacts	Cores	Retouched tools
S1B	53	10–15	3047	34	181
S1C	21	10–15	2848	46	175
S1D	13	10–15	4546	56	349
S1E	7	10	2468	37	159

site. There seems to be an intentional selection of metamorphic rocks to obtain large, standardised flakes, given that similar blanks could have been produced from local flint. This pattern differs from that described in other assemblages, in which finished artefacts made from exotic raw materials were transported (Geneste, 1985; Féblot-Augustins, 1993).

Some small flint cores are flaked following a unidirectional or centripetal system from orthogonal platforms (Fig. 7). These expedient methods do not follow the typical bifacial reduction schemes of the Levallois method and suggest a diversity of technical options, as seen in nearby Middle Palaeolithic sites (Mora et al., 2008; Casanova et al., 2009) and elsewhere (Wallace and Shea, 2006).

The flakes show some morphological variation; oval or rectangular blanks with dorsal faces and centripetal extractions predominate, while points and blades are scarce. The few elongated blanks were not obtained through typical blade production and are technologically and morphologically different from the artefacts that appear in the EUP levels of Cova Gran. The striking platforms of flakes display a variety of shapes and are in general thick, which indicates the systematic application of direct percussion with a hard hammerstone, the use of organic hammers not having been identified (Fig. 8).

In S1B there are a total of 181 retouched tools: notches and denticulates (102) outnumber sidescrapers (61), and no pieces with Charentian retouch have been identified (Fig. 8). Standardised flakes tend to be selected for producing retouched tools. All these technological attributes make it possible to ascribe levels S1B, S1C, S1D, and S1E to the Middle Palaeolithic, since they present similar features to other nearby Mousterian sites with MIS 3 occupations, such as Tragó and Roca dels Bous (Mora et al., 2004; Casanova et al., 2009).

The Early Upper Palaeolithic assemblages

The Early Upper Palaeolithic (EUP) sequence of Cova Gran consists of three archaeological units separated from each other by sterile sediments (Table 2). In some parts of the excavated area, the thickness of each level is < 5 cm, which suggests they are the result of brief visits to the site (see Fig. 5). Like the Middle Palaeolithic units, the hearths in the EUP levels are elements of microstratigraphic classification, since the superimposition of hearths within each level indicates that the levels were formed from more than one occupation event (see Martínez-Moreno et al., 2004). The hearths in the Upper Palaeolithic levels display morphological attributes that differ from those of the LMP levels. They are usually small hearths (0.50 m diametre) dug out on the ground (pit-hearths), contrasting with those observed in the Mousterian sequence in which flat hearths with a diametre of 1 m are common. This contrast could indicate differences in the use of fire between the Middle Palaeolithic and the Upper Palaeolithic, as proposed elsewhere (e.g., Binford, 1996).

As in the underlying sequence, in levels 497A, 497C, and 497D, the predominant raw material is still flint, which represents more than 99% of all the knapped artefacts and is obtained from the same outcrops as those exploited in the Middle Palaeolithic. Even so, important changes are seen in the management of lithic materials compared with the Mousterian levels. In levels 497A, 497C, and 497D, knapping is designed to obtain elongated blade products with some variability of blanks, which range from large broad and thick blades, to micro-bladelets < 2 cm. Likewise, interassemblage variations can be seen in the products: in level 497A production is focused primarily on obtaining bladelets, whereas in the underlying EUP levels large blanks are also abundant.

The characteristics of the lithics in level 497D, the oldest of the EUP, are clearly distinctive from those in the LMP assemblage of S1B. The main aim is to obtain elongated products of various sizes, from large blades to bladelets that are flaked from pyramidal cores. This technology is based on unidirectional knapping of barely prepared cores. This produces cores with irregular edges and frequent steps, which restricts the systematic reduction of core volume (Fig. 9). Usually, there is a selection of blocks with suitable natural angles that are discarded after flaking three or four blades, suggesting an expedient core reduction. In these cores intensive volumetric preparation of the core and its exploitation from a central crest, an important feature of blade production (Pigeot, 1991), is absent. Neither are specific chaînes opératoires for obtaining blades or bladelets differentiated; the dimension of products depends on the size or volume of the core, not the application of different methods. Therefore, morphologically the blade and bladelet cores do not show any differences, and the aim of reduction is to obtain rectilinear blanks, whereas no curved or twisted bladelets have been documented.

Of the 2,100 lithic artefacts recovered from level 497D, 20% are blade/bladelet products. On a total of 380 complete blanks, 53 blades/bladelets have been counted, while amongst the fragments (approximately 1,600) the percentage of blade/bladelet products increases (40%). This relative scarcity of blade/bladelet blanks (despite the cores showing laminar reduction) is a pattern recognised in other EUP assemblages of Western Europe and the Near East (Belfer Cohen and Bar-Yosef, 1981; Kuhn and Stiner, 1998).

Amongst the 216 retouched artefacts, pieces with denticulate edges and side scrapers (143) predominate. These generally occur on blade fragments and to a lesser extent on flakes; in spite of this, technical and typological attributes differ from those in the LMP levels (Fig. 10). Retouched blades, end scrapers, burins, and truncations produced on blades, plus backed points and backed bladelets represent 20% of the retouched pieces. These microlithic tools might suggest the use of composite artefacts associated with hunting tools (Kuhn, 2002; Bon, 2005) and are exclusive to the EUP levels. Nothing similar is found in the underlying LMP units of Cova Gran.

Some backed tools resemble elongated rectilinear points and bladelets, typical of the Mediterranean Proto-Aurignacian (Bischoff et al., 1989; Kuhn and Stiner, 1998; Mellars, 2006), although they can also appear in the evolved Aurignacian (Zilhão, 2006a). However, backed tools in Cova Gran lack any metrical and morphological standardisation as reported for Fumane (Broglio et al., 2005) or Arbreda (Ortega Cobos et al., 2005), so typological parallels are difficult to establish. In Cova Gran, end scrapers on blades or with lateral retouch are documented, but no carinated scrapers typical of the early Aurignacian appear. Neither are the types of side and transversal burins from Cova Gran exclusive to the Aurignacian.

Therefore, the stylistic attributes of the EUP retouched pieces from Cova Gran do not conform to fossils directeurs in strictly typological terms (Demars and Laurent, 1992) that would enable these pieces to be ascribed to a particular techno-complex within the Aurignacian. Technical indicators are not conclusive either; in the Cova Gran EUP levels the same production system for obtaining

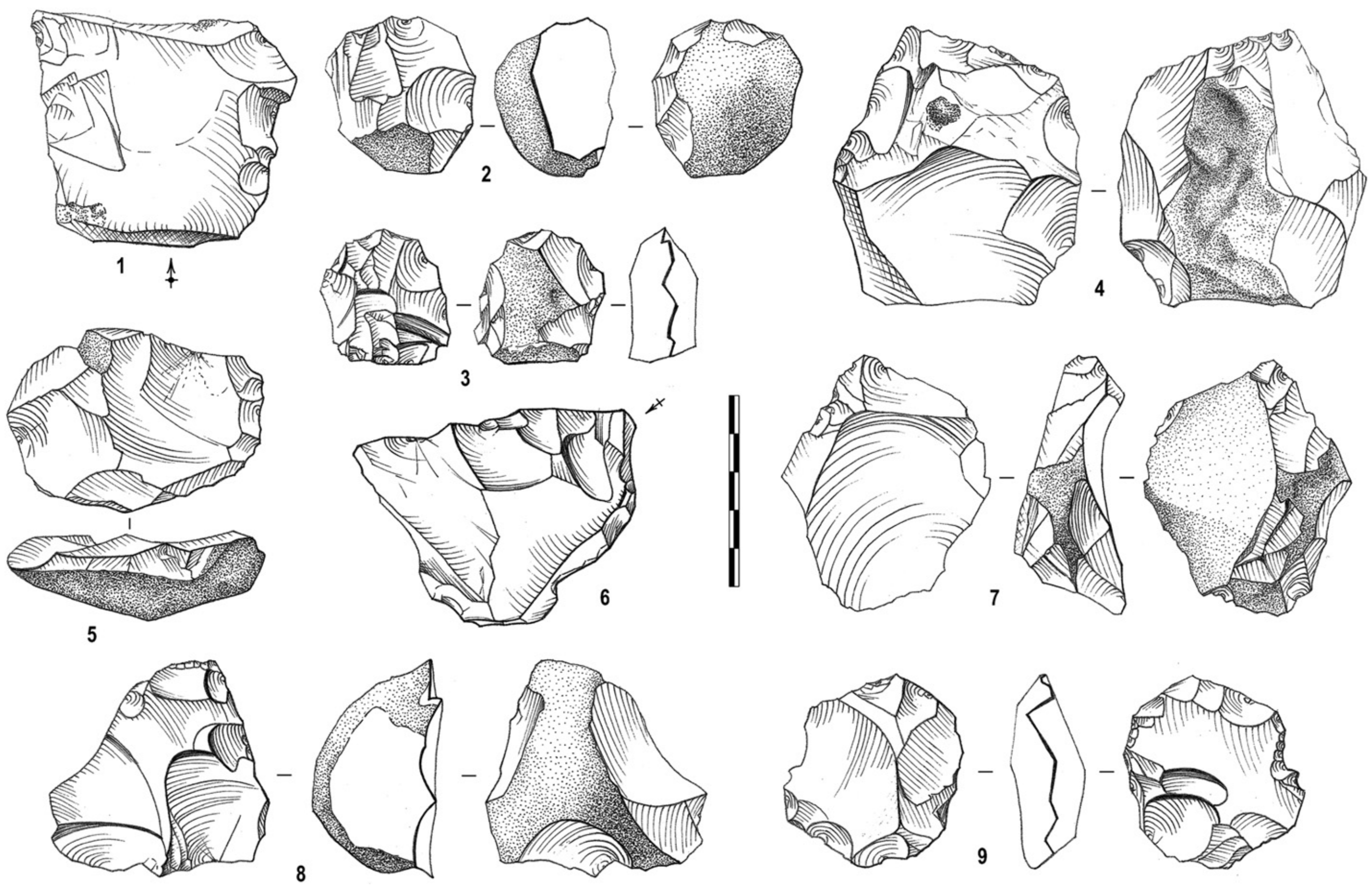

Fig. 7. Technological variability of cores in S1B: preferential Levallois (3, 4, 7); recurrent centripetal Levallois (2, 8, 9); expedient cores on flake (centripetal unifacial 5; abrupt unifacial 1, 6). Drawings: Mónica López Prat.

blades and bladelets is applied. Rectilinear blanks typical of the Proto-Aurignacian (Bon, 2002; Bon et al., 2003; Le Brun-Ricalens, 2005) are abundant, whereas curved bladelets are absent. Because of all of this, it seems prudent to provisionally assign level 497D to an indeterminate Early Upper Palaeolithic.

To date, no bone tools have been recovered from the EUP sequence, although this cannot be attributed to poor preservation of organic material; in level 497D there are remains of *Stephanorhinus* sp. (possibly *S. hemitoechus*), *Equus caballus*, *Cervus elaphus*, and *Capra pyrenaica*. If bone tools had occurred in the assemblage, they would probably have been preserved, since diaphyses and teeth, materials habitually used to make artefacts and ornaments in the EUP, are relatively abundant.

Marine shell ornaments have been documented in level 497D: three *Nassarius sp. (incrassatus* or *pygmaea)* and one *Antalis sp*. Two *Nassarius* are naturally perforated, while the third has an ancient fracture (Fig. 11). It is likely that these shell ornaments were transported from the Mediterranean, which in the upper Pleistocene was more than 150 km distant from Cova Gran. Perforated marine shell ornaments are a classic indicator of the appearance of the Upper Palaeolithic and the dispersal of modern humans (d'Errico et al., 2003), in Western Europe there are few EUP contexts in which marine shells have been found (Vanhaeren and d'Errico, 2006; Álvarez Fernández and Jöris, 2008).

The Cova Gran ornaments follow the tendency recognised in other EUP assemblages of southern Europe, where marine shells were selected in preference to other organic and inorganic materials (Vanhaeren and d'Errico, 2006). In the upper levels of the EUP (497A and 497C) 30 similar adornments have been recovered, but none have appeared in the LMP, which is another element of differentiation between the LMP and the EUP at Cova Gran.

^{14}C AMS dating of Cova Gran

So far 12 radiometric dates have been obtained using ^{14}C AMS for the LMP and EUP levels of Cova Gran. Most of the samples were processed by Beta Analytic and are charcoals recovered from hearths, except for two fragments of marine shells from the EUP levels 497A and 497C. These samples provide dates with low σ (around or below 1% of the central tendency), which suggests chronometric ranges with little temporal dispersion (Table 3).

A charcoal sample from level 497D (CG-497D-49) was dated in the Desert Laboratory of the University of Arizona, being split and processed by applying three treatments: acid only (A), acid/base/acid (ABA), and ABOX (acid/base/oxidation). These are protocols to remove contaminants from the organic fraction as a preliminary step prior to isotopic measurement of the sample. The University of Arizona Desert Laboratory's ABA treatment corresponds with the standard washing procedure, AAA (acid/alkaline/acid), used by Beta Analytic (2006). ABOX is a method designed to overcome certain problems such as contamination, which increases with sample age (Bird et al., 1999; Turney et al., 2006; Pigati et al., 2007).

The samples processed using methods A and ABA by the University of Arizona Desert Lab (CG-7D-49a/AA-68834 and CG-7D-49b/AA-68834 respectively) produced results that were fairly similar to those obtained on the sample from 497D processed by Beta (Beta-207578; $<$ 0.5 ka), displaying a broad chronometric spread in its radiometric dispersion to 1σ. However, the central

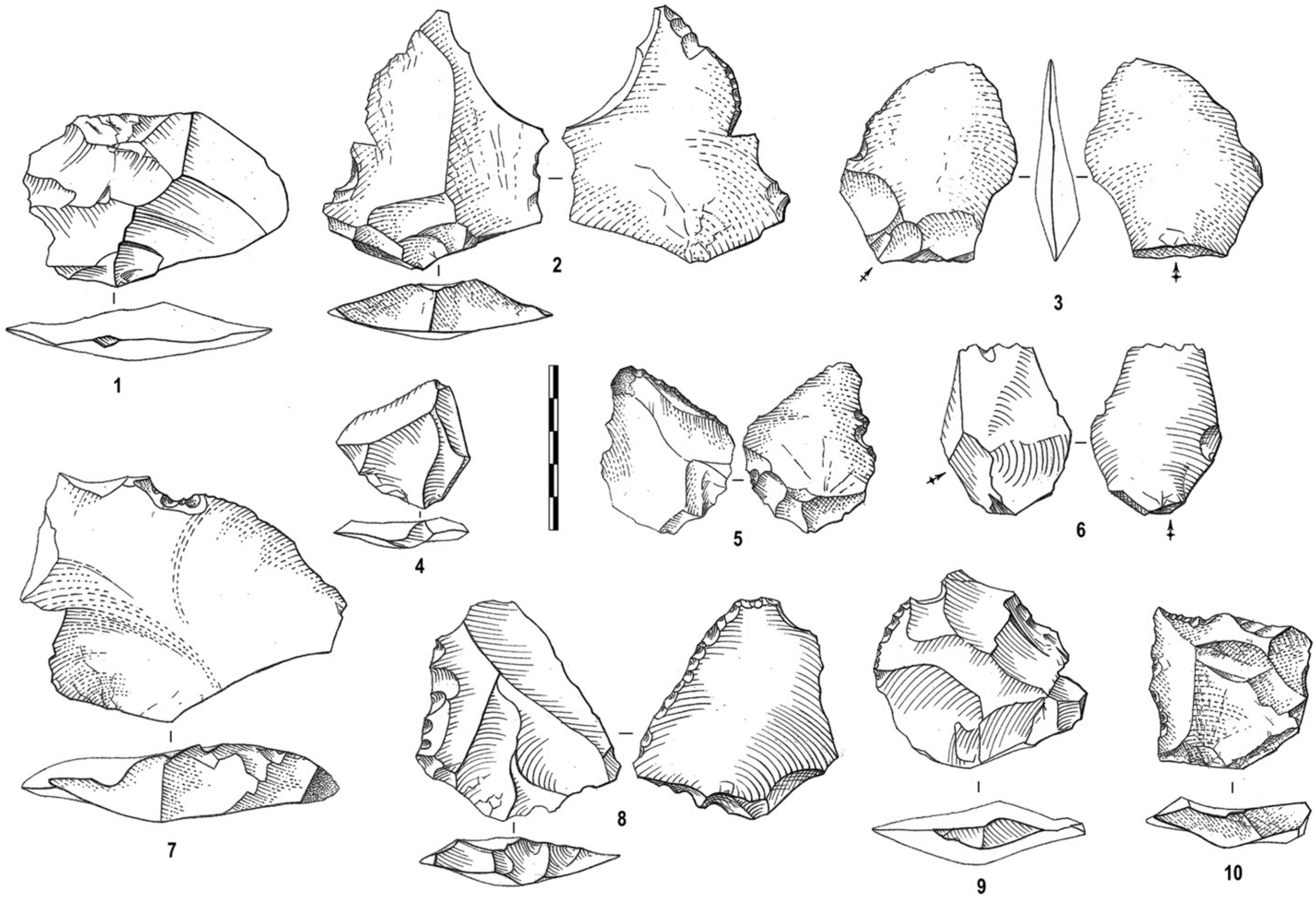

Fig. 8. Lithic artefacts from S1B. Centripetal flakes (1, 4), Kombewa flake (6); side-scrapers (2, 3, 5, 8, 9, 10); notched pieces (5, 7). 2 and 7 are made on large metamorphic blanks. Drawings: Mónica López Prat.

tendency of the sample processed with ABOX is slightly older (> 1.5 ka).

A series of apparently optimum charcoals from all the EUP and LMP levels was sent to the Desert Laboratory, but apart from the sample mentioned (CG-7D-49c/AA 68834), they did not withstand the oxidation phase of the ABOX protocol. The analysts suggest that these charcoals have undergone some kind of diagenetic alteration (Jay Quade, pers. comm.). Recently, a similar phenomenon has been described on observing that: "much of the material extracted by alkaline treatment of poorly preserved wood charcoal samples may actually be the original charcoal itself, but in a more degraded form. If this is not contaminated with other carbon sources, it should provide a reliable date. The problem, however, is that such charcoal-derived 'humic substances' may not be distinguishable from soil-derived humic substances" (Cohen-Ofri et al., 2006: 438).

Accepting this inference would mean that a significant number of ^{14}C dates used in the discussion of the MP/UP transition could have structural problems similar to those detected in the Cova Gran samples. This possibility needs to be taken into consideration in relation to the LMP/EUP transition in Iberia. The dating of Cova Gran prompts a discussion of the notion of "radiometric synchrony" and, together with contextual and techno-typological observations, a reconsideration of some of the scenarios proposed for the MP/UP transition in the Iberian Peninsula.

Table 2
Main features of the Early Upper Palaeolithic levels in Cova Gran

Level	Excavated surface (m^2)	Thickness (cm)	Total artefacts	Cores	Retouched tools
497A	21	5–10	1035	18	82
497C	35	5–10	1580	47	217
497D	39	10–15	2788	31	216

The chronometric framework of the LMP/EUP transition in Cova Gran

The results shown in Table 3 reopen a key question in the discussion of the LMP/EUP transition: how to determine the validity of a radiocarbon date? (Pettitt et al.,2003) This question is essential for evaluating the notion of continuity or rupture, as well as the temporal distance between the Middle and Upper Palaeolithic.

Some inconsistencies are detected in the Cova Gran radiometric series. The most recent date of the sequence has been obtained in the lowermost level of the LMP sequence (S1E), indicating that this sample has been affected by some kind of contamination, probably because the dating was obtained from an aggregate of organic sediment and not from charcoal or bone. In fact, the $\Delta^{13}C$ content could not be calculated in the laboratory, indicating possible problems of contamination. At the same time, the dates of levels EUP 497A and 497C, obtained from marine shell, are stratigraphically consistent, but could be considered minimum ages; the post-depositional inclusion of inorganic carbonate may cause the

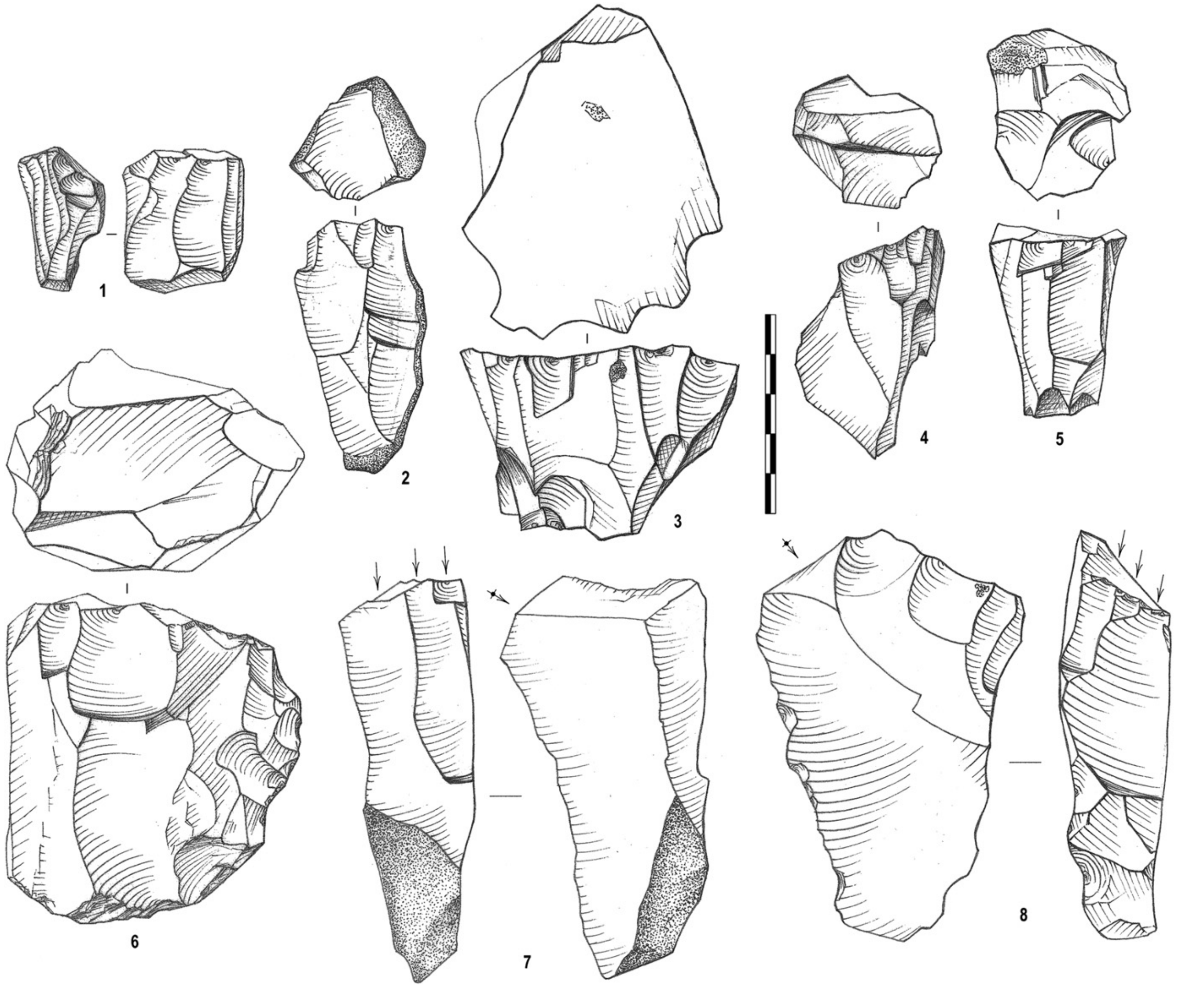

Fig. 9. Level 497D cores. Single platform cores (1, 2, 6); cores with two opposite platforms (3, 4, 5); cores on thick flakes with lateral burin blows (7, 8). Drawings: Mónica López Prat.

rejuvenation of dates obtained from this kind of sample (Pigati, 2002; Douka et al., 2008).

It is relevant that the four dates of the first level of EUP (497D) and the four from LMP levels S1C and S1D have very similar central tendencies and fall within the 34–32 ka BP time span. However, the date obtained in level S1B (38.6 ± 0.4 ka BP), although it agrees stratigraphically with 497D, is older (5 ka in the central trend) than those of the underlying levels S1C and S1D. These results need to be discussed. Firstly, the dates from S1D and S1C are homogeneous. The three dates of S1D come from a level with a limited thickness (15 cm) and their results are internally consistent, showing a considerable chronological overlap in their radiometric dispersions at 1σ. Furthermore, the S1C date is not a long way from the temporal tendency of S1D, which suggests a nearby chronometric band that does not contradict the contextual information available (see Figs. 4 and 5). Neither are any variations detected in the $\Delta^{13}C$ values that would suggest contamination.

Nevertheless, the S1B dating could call into question the validity of the dates from the underlying levels, since according to their stratigraphic position a more recent date would be expected. The existence of inconsistent ^{14}C dates in relation to stratigraphic position is a common phenomenon in a number of sites (e.g., l'Arbreda [Bischoff et al., 1989], Geissenklösterle [Conard and Bolus, 2003], and Fumane [Giaccio et al., 2006]), and underlines the difficulties of obtaining a reliable radiometric frame for this time span (Jöris et al., 2003; Jöris and Street, 2008). On the other hand, to consider that because its age is apparently too recent the S1B date is erroneous while those of S1C and S1D are correct would mean inferring that the LMP levels and the first EUP level (497D) are synchronic. This notion of "radiometric synchrony" would imply accepting the sudden arrival of the Upper Palaeolithic and the immediate disappearance of the Middle Palaeolithic in Cova Gran.

However, other problems must be taken into consideration: the variations observed in the central tendencies of the level 497D dates, obtained from the same sample (CG-497D-49a, b, and c), are small (less than 1.5 ka) and indicate that as the decontamination protocols become more stringent, older dates are obtained. If this were true, it would be appropriate to consider Cova Gran dates minimum ages (Turney et al., 2006) and not precise chronometric distributions. According to Pigati et al. (2007: 13), "geochronologists widely recognize that the reliability of ^{14}C dating quickly degrades as the measured ^{14}C age exceeds 40 ka. For example, Bird and co-workers (…) have clearly demonstrated that ^{14}C ages of old samples that are obtained using standard chemical and extraction

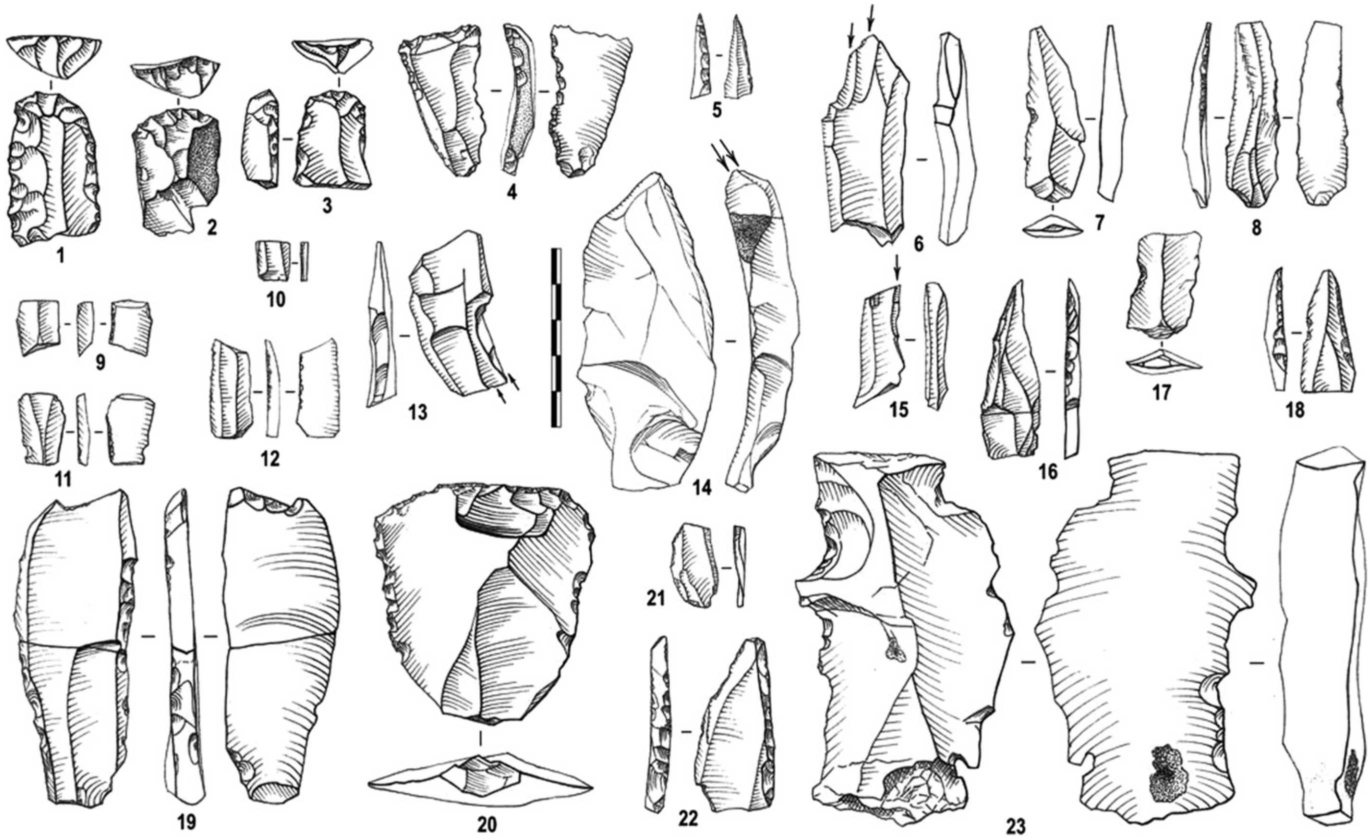

Fig. 10. Lithic artefacts from 497D. End-scrapers (1, 2, 3); Burins (6, 13, 14, 15); broken bladelets with inverse and marginal retouch (9, 10, 11, 12); bladelets with marginal retouch (7, 8, 17, 21); pointed backed bladelets (5, 16, 18); retouched blades (4, 19, 22, 23), and side-scraper on a large flake (20) 16 and 19 are refitted pieces. Drawings: Mónica López Prat.

techniques often underestimate true ^{14}C ages by 8–10 ka or more." Thus, researchers have been urged "to exercise extreme caution when interpreting published ^{14}C ages in excess of 40 ka BP. While we are not suggesting that all reported ^{14}C ages in excess of 40 ka are erroneous, without such caution, interpretations of the timing of geological or archaeological events may, in fact, be based on measured levels of contamination, rather than sound chronological data."

This warning can be extended to dates with ages that exceed the fifth half-life due to the lower ^{14}C content, in which contamination

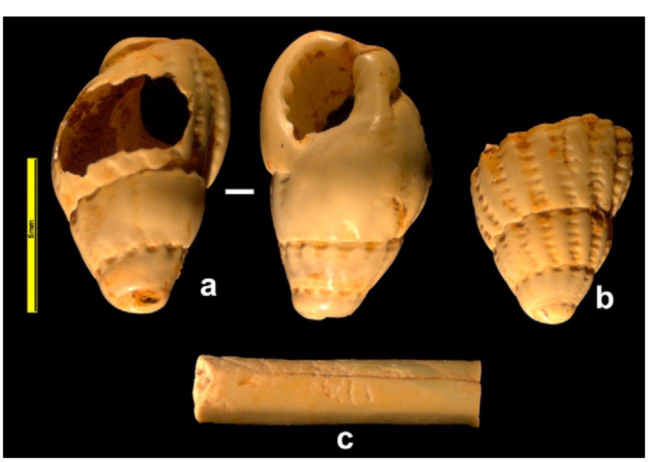

Fig. 11. Marine shell ornaments from 497D (scale tool bar = 5 mm). *Nassarius sp.* (a and b) and *Antalis sp.* (c). All items show use wear.

by various physicochemical processes (Bischoff et al., 1989; Jöris et al., 2006; Cohen-Ofri et al., 2007), even in radiocarbon laboratories (Gillespie and Hedges, 1984), is difficult to detect.

Similar observations are inferred from the dating of bone collagen by the ultrafiltration technique (Higham et al., 2006). This indicates that advances in the purification protocols of samples will enable temporal inferences to be made with greater accuracy (Bronk Ramsey, 2008). On the other hand, the improvement in the calibration curve for ^{14}C dates that are older than 26 ka BP—the limit established by the IntCal04 model (Reimer et al., 2004, but see Van Andel, 2005)—will permit conversion of dates up to 60 ka BP to calendar years (Hughen et al., 2006; Tzedakis et al., 2007; Weninger and Jöris, 2008). Even so, the reliability of this chronometric range will depend on obtaining uncontaminated samples or using purification protocols that have eliminated this bias as far as possible. Equally important will be the determination of stratigraphic anchors or isochronous marks (Blockley et al., 2008), resulting from natural events within discreet time spans such as the identification of tephra layers (e.g., Campanian Ignimbrite eruption) in MP to UP sequences (Giaccio et al., 2006; Anikovich et al., 2007; Fedele et al., 2008; Hoffecker et al., 2008).

Cova Gran: contextualising the techno-typological change

According to the ^{14}C dates above, the first EUP level (497D) in Cova Gran is found *at least* around the 34–33 ka BP interval, while the LMP levels can be provisionally dated to at least between 33–32 ka BP, assuming that these time intervals could underestimate the chronometric range of these events in magnitudes of up to 8–10 ka (Pigati et al., 2007).

Table 3
^{14}C AMS dates of the EUP and LMP levels at Cova Gran

Level	# Sample	# Lab	^{14}C AMS	1σ	%σ	^{13}C	Sample	Laboratory pretreatment	Cultural attribution
497A	CG-7A-461	Beta-207576	21690	120	0.5	1.0	marine shell	A	EUP
497C	CG-7C-491	Beta-207577	26220	220	0.8	2.0	marine shell	A	EUP
497D	CG-7D-50	Beta-207578	32630	450	1.3	−22.7	isolated charcoal	AAA	EUP
497D	CG-7D-49a	AA-68834	32368	241	0.7	–	isolated charcoal	A	EUP
497D	CG-7D-49b	AA-68834	33068	261	0.8	–	isolated charcoal	ABA	EUP
497D	CG-7D-49c	AA-68834	34179	247	0.7	–	isolated charcoal	ABOX	EUP
S1B	CG-1B-1269	Beta-224299	38640	440	1.1	−24.2	isolated charcoal	AAA	LMP
S1C	CG-1C-974	Beta-195430	32000	300	0.9	−23.5	isolated charcoal	AAA	LMP
S1D	CG-1D-60	Beta-187423	32180	430	1.3	−24.0	isolated charcoal	AAA	LMP
S1D	CG-1D-1657	Beta-195431	33090	350	1	−22.9	isolated charcoal	AAA	LMP
S1D	CG-1D-2492	Beta-207575	32260	490	1.5	−23.0	isolated charcoal	AAA	LMP
S1E	CG-1E-63	Beta-195429	19500	90	0.4	NA	burned sediment	AAA	LMP

Stratigraphically, all the EUP levels in Cova Gran are superimposed upon and therefore are more recent than the LMP assemblages. Contextual information is available on the stratigraphic superimposition of the oldest EUP level (497D) over the most recent LMP (S1B) across an area of 20 m^2 and 6 linear m extending from east to west (see Fig. 5). Scatter plots show two archaeological units separated by a sterile interval 20–40 cm thick, sealed by blocks that prevent admixture of the two levels. Cova Gran follows the pattern seen in the rest of the Iberian Peninsula where, with the possible exception of Güelga Cave (Menéndez et al., 2005), no techno-typological inversion or interstratification between LMP and EUP is documented (Zilhão, 2006a; Zilhão et al., 2008).

The LMP and EUP lithic assemblages in Cova Gran denote a clear technological rupture that is not related to factors such as the availability of raw material, since lithic resources were obtained from the same outcrops in both the LMP and in the EUP. Despite coming from the same raw material, certain changes can be observed in the selection of blanks on the basis of the reduction methods. In the EUP levels, large globular blocks (+ 10 cm) are selected in order to obtain elongated blanks. During the LMP there is no preferential selection of blocks with particular shapes, and they are generally smaller than those of the EUP. Another difference is the absence of metamorphic rocks in the EUP assemblages, a raw material usually selected for producing retouched tools on large standardised Levallois and pseudo-Levallois flakes in the LMP levels.

The knapping methods in the LMP and EUP levels show a clear technological rupture. In the LMP levels technical methods are based on obtaining flakes of variable sizes and shapes. Cores are reduced either by bifacial recurrent systems (Levallois, Discoid) or unifacial expedient methods. Some cores show unidirectional exploitation of elongated flakes. However, the similarities between these products and blades are morphological rather than technical, and in Cova Gran they cannot be considered forerunners of bladelet production systems, as suggested, for example, in the Middle Palaeolithic of Castillo and Morin (Cabrera et al., 2001, 2006).

In the EUP of Cova Gran there is a technological rupture associated with blade production systems. Laminar flaking is to some extent expedient, with no crested blades or core rejuvenation tables that would allow volumes to be reactivated. The same system is used to obtain all laminar products irrespective of the size, from large blades to micro bladelets, no carinated scrapers for producing bladelets being documented (Bon, 2002; Le Brun-Ricalens, 2005).

Changes in the retouched tools are also detected. In the LMP assemblages, retouch is limited to flakes with denticulate and continuous edges that shape notches, denticulates, and side-scrapers. Quantitatively, these tool types are also abundant in the EUP levels, although in this case produced on blades and not only on flakes. In fact, denticulates and side scrapers are common in the EUP assemblages of Western Europe, but until now little attention has been paid to them because of their poor taxonomic resolution (Bon, 2002; Teyssandier, 2006). In addition, in the EUP levels of Cova Gran a panoply of new artefacts appears that are absent in the LMP levels, such as truncations, split pieces, end scrapers, burins, backed bladelets, and backed points.

Some trends in the knapping systems and tool types are similar to those described in the Proto-Aurignacian. However, the absence of classical fossils directeurs makes it difficult to assign level 497D (or the upper ones) to the Proto-Aurignacian, which has been given a seminal role in the appearance of the Upper Palaeolithic (Zilhão, 2006a; Teyssandier, 2008). Another option, however, could be to accept that the EUP assemblages, rather than representing single, monothetical traditions—a view that comes from a restrictive typological approach—display a certain amount of variability. Factors such as the availability/quality of raw materials or site/function influence the composition of lithic assemblages (Tartar et al., 2006). Therefore, the EUP techno-complexes could be polymorphic and the composition of assemblages might reasonably be expected to display some variation (Teyssandier, 2006).

Hence, at the moment it seems safer to ascribe the three upper levels of Cova Gran to an indeterminate EUP. Overall, the technical features of these assemblages suggest that the Upper Palaeolithic is not rooted in the Pyrenean Middle Palaeolithic and indicate a rupture with the earlier local tradition. This observation in Cova Gran coincides with the pattern described in much of the European archaeological record (see various contributions in Conard (Ed.), 2006).

The archaeological stratigraphy of the LMP levels indicates recurrent occupation of the site, in which no evolutionary trends or "transitional industries" are observed. In Cova Gran, the LMP technical systems are very similar to those of other Middle Palaeolithic assemblages of the area such as Trago and Roca dels Bous (Mora, 1988; Casanova et al., 2009). Neither do the LMP levels at Cova Gran show any sign of symbolic or bone tools such as those described in the Castillo LMP (Cabrera et al., 2001, 2006; although see Zilhão and d'Errico, 2003), and the marine shell ornaments are restricted to the EUP levels. In short, the archaeological differences between the LMP and EUP levels in Cova Gran mean that no technical and cultural connection can be established between the two periods.

Cova Gran and the LMP/EUP transition in the Iberian Peninsula

Cova Gran shares the same problems identified in other Iberian sites in which the LMP/EUP transition has been recorded, and provides new elements to reflect on the disappearance of the Neanderthals (Pettitt, 1999; Zilhão, 2000, 2006a).

Zilhão's (2000) "Ebro frontier" model suggests spatial segregation between two biological populations represented by different techno-complexes over a long period of time. Although Zilhão (2006a) emphasises the existence of an ecological barrier that would separate the two populations, if Neanderthal survival in the southern peninsular refuge is accepted, it is not impossible that there were cases in which the "last" Neanderthals coexisted with *Homo sapiens* in marginal areas of the Pyrenean valleys, the Cantabrian area, or Iberia's central Meseta. The coexistence of species in the same region lies behind the mosaic landscape that defines the MP/UP transition (Straus, 1996, 2005). Moreover, the survival of isolated Neanderthal populations in geographical areas in which EUP, techno-complexes are found over the same time span does not necessarily imply interaction between Neanderthals and modern humans. On the other hand, if the interpretation of the Lagar Velho human remains is accepted (Zilhão and Trinkaus, 2002), then the notion of a complex space/time mosaic scenario could also have a biological dimension.

The possibility of the coexistence of Neanderthals and modern humans is based on two principles: assuming that distinct techno-complexes (LMP and EUP respectively) are produced by different human species and accepting the notion of temporal synchrony (and the concomitant spatial segregation) on the basis of considering ^{14}C dates as absolute chronological indicators. The first issue is beyond the scope of this article and is still the subject of great debate among anatomists, with authors stressing the ambiguity of the EUP palaeoanthropological record (Churchill and Smith, 2000) and others supporting that anatomically modern humans were the authors of all EUP lithic techno-complexes, excepting the Chatelperronian (Bailey et al., 2009).

Focusing on archaeological issues, the fact is that the chronostratigraphic panorama of the MP/UP transition, despite recent improvements (Jöris and Street, 2008), continues to raise numerous questions, at least in the Iberian Peninsula. On this point we agree that it is necessary to screen radiometric dates (Zilhão, 2006a,b; Zilhão and d'Errico, 1999) since many of the radiocarbon dates that support the notion of "radiometric synchrony" produce an effect criticised years ago: the risk of becoming blind in a cloud of data (Pettitt and Pike, 2001), a risk that has similarities with attempts to visualise "waves of modern human advance" based on an excessively pragmatic use of ^{14}C dates (Bocquet-Appel and Demars, 2000). Various discussions of the radiometric record of the MP/UP transition in the Iberian Peninsula have highlighted the problem of radiocarbon dates not associated with archaeological contexts, (Bischoff et al., 1994), associated with materials that are not significant, samples recovered without accurate stratigraphic control or samples processed using conventional ^{14}C (see Zilhão and d'Errico, 1999; Jöris et al., 2003; Vaquero, 2006; Vaquero et al., 2006; Zilhão, 2006a). These problems indicate the ambiguity inherent in producing a chrono-stratigraphic picture for the MP/UP transition in Iberia.

An example is the sites considered indicators of prolonged Neanderthal survival in geographical areas in which they would coexist with EUP techno-complexes, as proposed in Gorham's Cave (Finlayson et al., 2006, 2008; but see Zilhão and Pettitt, 2006). This situation is not exclusive to the south of the Iberian Peninsula and could also be traced north of the "Ebro frontier." In the Cantabrian area, Esquilleu contains Middle Palaeolithic levels with consistent ^{14}C AMS dates of 34.4 and 36.5 ka, which could indicate late survival of Neanderthals in the area (Baena et al., 2005). Despite some attempts to cast doubts on its dating (Zilhão, 2006b), according to Vaquero (2006; Vaquero et al., 2006), Esquilleu provides solid evidence of the prolonged survival of Neanderthals in the north of the Iberian Peninsula. At the same time, in Güelga Cave, also in the Cantabrian region, the existence of Châtelperronian assemblages overlying Aurignacian levels has been proposed (Menéndez et al., 2005). Should these chrono-stratigraphic data prove to be correct (although see Zilhão, 2006a for a critique), Esquilleu and Güelga cave would support the prolonged survival of isolated residual Neanderthal populations in mountainous areas, while an Aurignacian with older chronologies appears in adjacent locations, such as La Viña (Fortea, 1999).

A similar situation may have occurred in Cova Gran if the dates for levels S1C and S1D are accepted, which would place Neanderthals in the eastern Pyrenees around 33–32 ka. This Neanderthal endurance in the Pyrenean valleys, like the survival proposed in the Cantabrian valleys (Baena et al., 2005), would run parallel to a sudden appearance of the EUP, which in the case of the Cova Gran region would be represented by the Aurignacian evidence of l'Arbreda about 100 km away. In any case, this is a scenario supported by ^{14}C dates whose contextual and radiometric validity have been called into question (Zilhão and d'Errico, 1999; Zilhão 2006a).

These varied scenarios suggest a complex panorama, or rather, a mosaic landscape in which alternative trajectories could explain the MP/UP transition. Assuming that Cova Gran shares similar gaps and problems to other sites, it also contributes reflections with which to evaluate the MP/UP transition. The techno-typological change recognised between the oldest EUP (497D) and most recent MP levels (S1B), is a relevant proxy for tackling the notion of transition with a precise contextual and stratigraphic definition; when characterising this process, we observe a clear break and are unable to detect the origin or influence of the LMP substrate on the EUP.

In order to evaluate this temporal span we propose some chronological ranges rather than a precise datum, which should be treated as minimum ages. The AMS dates of Cova Gran warn us that using radiometric results out of context could be one of the reasons for the lack of definition of the MP/UP transition in the Iberian Peninsula. Other problems relate to the inadequate recording of archaeological contexts, which need to be overcome on the basis of analysing site formation processes and consistency of the archaeological assemblages. Others, such as depositional and post depositional contamination of dating samples, are more difficult to detect and could explain the aforementioned phenomenon of "radiometric synchrony" in the Iberian Peninsula.

The radiometric frame of Cova Gran indicates the need to be cautious when producing scenarios based exclusively on a restrictive interpretation of radiocarbon data. We think some caution is necessary in the use of ^{14}C for reconstructing historical processes as ancient as the MP/UP transition, since the timing of archaeological events may, in fact, be based on measured levels of contamination rather than sound chronological data (Pigati et al., 2007), given that the ^{14}C presents major limitations for samples that exceed the fifth half-life (Pettitt et al., 2003).

This perspective weakens the importance given to ^{14}C as "smoking guns," and although we share the notion of filtering radiometric dates (Zilhão and d'Errico, 1999), the fact that accepting or rejecting certain dates obeys preconceived expectations, rather than a reasoned discussion of the arguments in favour of or against their inclusion within a chronometric table (see f.ex. table S1 in Banks et al., 2008), should also be considered (Vaquero, 2006; Jöris and Street, 2008). Future advances on ^{14}C dating will give us a well-reasoned approximation in order to analyse the temporal dimension of the MP/UP transition (Bronk Ramsey, 2008).

As Van Andel (2005) reminds us, the chronometric frame is only one of the many aspects involved in this debate. It is necessary to present precise information on the contexts in which the MP/UP transition is documented, since this makes it possible to evaluate the incidence of depositional/post-depositional factors involved in shaping the archaeological assemblages (Vaquero, 2006; Zilhão, 2006a). All of this will create a reliable taphonomic and radiometric frame that will enable us to evaluate the archaeological contexts used as the basis for interpreting historical phenomena such as the Neanderthal demise and its possible connection with the appearance of the Upper Palaeolithic.

Conclusions

The Middle to Upper Palaeolithic transition sequence in Cova Gran contributes to the discussion of the Neanderthal extinction and the dispersion of modern humans throughout the Iberian Peninsula. Firstly, Cova Gran fulfils the need for more sites with EUP sequences just overlaying LMP that have been excavated using modern methods, until now very scarce in the Iberian Peninsula (Zilhão, 2006a). Careful excavation of levels at Cova Gran has made it possible to register the archaeological record in detail and study site formation processes involved (Benito et al., 2009).

If the chronostratigraphic consistency of most of the AMS dates of Cova Gran is accepted, Neanderthals were living to the north of the so-called "Ebro Frontier" (Zilhão, 2000, 2006a) at a late date, around 34–32 ka. This would support the model proposed by Baena et al. (2005), which depicts the survival of Neanderthal populations in the mountainous inland areas of the north of Iberia when Aurignacian groups had already occupied the region.

All of this, of course, is subject to accepting the notion of "radiometric synchrony" discussed in the previous sections. This inference is questionable; the dates of Cova Gran provide radiometric synchrony for stratigraphically superimposed levels which, therefore, are diachronic. However, dates of Cova Gran sound a cautionary note for those historical reconstructions based exclusively on the radiometric record. If the S1C and S1D dates are isolated from their archaeostratigraphic context, they could be used to support a scenario of coexistence between Neanderthals and modern humans. However, the archaeological evidence in Cova Gran is clear: stratigraphically the Upper Palaeolithic lies above the Middle Palaeolithic and radiometric synchrony is an artefact of the limits of the radiocarbon method. There is no doubt that this notion of radiometric synchrony could affect some of the models depicting the coexistence of Neanderthals and modern humans if further well-established archaeological contexts were available.

Finally, it is important to emphasise that Cova Gran indicates a clear disjunction between the Middle Palaeolithic and the Upper Palaeolithic. The archaeological record of Cova Gran clearly defines two traditions that represent different technical behaviours. In short, Cova Gran opens up interesting perspectives for analysing the Neanderthal demise in the Iberian Peninsula and furnishes new elements of reflection with which to analyse this question in the future.

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