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Abrigo de la Quebrada Level IV (Valencia, Spain): Interpreting a Middle Palaeolithic Palimpsest from a Zooarchaeological and Lithic Perspective

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Abstract

The Abrigo de la Quebrada (Chelva, Valencia) stratigraphic succession comprises nine Middle Palaeolithic levels. Human selection of this rock shelter for occupation owes to its favourable location—at the gates of a blind valley where the trapping of large herbivores would have been practicable. The immediate environment is varied, with both abrupt and flat terrain, and would have supported a wide range of prey animals. Radiocarbon-dated charcoal samples from level IV, which is characterised by a high density of lithic (> 18,000) and bone (> 100,000) remains, yielded results of 43,930 ± 750 BP (Beta-244002) and > 51,6 ka BP (OxA-24855). There is no evidence of modification by carnivores or birds of prey, so this level's faunal remains must be anthropogenic in the main. Relative to the inhabited space, the location of level IV's many combustion features shows little variation. The level's typical palimpsest structure results from frequent, repeated occupations with intense on-site processing in a context of low sedimentation rates. The study of seasonality, carcass exploitation, taphonomy, stone tool refitting and raw material provenience patterns supports the notion that the different occupations subsumed in the level IV deposit were all short term. The comparison of our results with coeval contexts from the central area of Mediterranean Iberia sheds additional light on the adaptations of western Europe's Neanderthal groups.

Keywords Palimpsest · Neanderthal subsistence · Middle Palaeolithic · Iberian Peninsula

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Introduction

The spatial patterning of Eurasian Middle Palaeolithic, Neanderthal-associated settlement sites has been intensely debated (Conard 2001, 2004; Moncel 2003; Delagnes and Rendu 2011; Daujeard et al. 2012). This is because, to a large extent, spatial patterns are one of the key elements in the reconstruction of social and economic behaviours (Rolland 1990; Mellars 1996; d'Errico et al. 1998; Gamble 1998; Vaquero et al. 2001; Burke 2006). The interpretation problems derive from the fact that, in most cases, our unit of analysis (the 'archaeological level') is the result of different occupation events forming what Bailey (2007) has defined as cumulative palimpsests. This raises the need to dissect the palimpsests into the individual occupational events they subsume, or, if possible, into the minimum constituent units of each such event.

To this aim, several approaches have been used—among others: geoarchaeological and archaeo-stratigraphical (Brochier 1999; Canals 1993; Goldberg and Macphail 2006; Mallol et al. 2010; Vallverdú-Poch and Courty 2012); ethnographic comparison (Binford 1978; O'Connell, 1987; O'Connell et al. 1992; Yellen 1977); statistical and mathematical modelling (Carr 1987; Kintigh and Ammerman 1982; Simek 1987; Stapert 1990; Whallon 1984); bone and stone tool refitting (Cziesla 1990; Cziesla et al. 1990; Eixea et al. 2011–2012; Gabucio et al. 2017; Machado et al. 2013; Rosell et al. 2012a; Villa 1982; Vaquero 1999); analyses of artefact density and of the frequency of retouched pieces relative to total lithic assemblage size (Barton and Riel-Salvatore 2014; Clark and Barton 2017); technological analysis of raw material units (RMUs) (Conard and Adler 1997; Adler et al. 2003; Turq et al. 2017; Roebroeks 1988); studies of combustion features (Courty et al. 2012; Henry 2012; Mallol et al. 2013; Vaquero and Pastó 2001); or analyses of the dispersion of archaeobotanical remains (seeds, fruits and charcoals) (Castro-Curel and Carbonell 1995; Chabal 1988; Solé et al. 2013; Thiébault 1995; Vidal-Matutano 2016; Vidal-Matutano et al. 2017). The complementary nature of these methods and techniques allows the synchronisation of activities, upon which occupation events can in turn be individualised, making it possible to arrive at better estimates of group size and occupation length and, hence, at a better understanding of socio-economic strategies.

In the present study, we analyse the lithic and bone data from level IV of Abrigo de la Quebrada, which is a clear example of a cumulative palimpsest (Eixea 2015; Eixea et al. 2011–2012; Villaverde et al. 2008, 2017). The complexity of the accumulation does not allow the subdivision of the finds into discrete sets related to a corresponding unique event. Thus, we consider the deposit's content as whole and look at its spatial structure under a technological and taphonomical perspective to try to better understand the general nature of the different human occupations therein subsumed.

Materials and Methods

The Site

The Middle Palaeolithic rock shelter of Abrigo de la Quebrada (Chelva, Valencia, Spain) lies in an area demarcated by the Tuéjar-Chelva and Turia rivers, between steep mountain formations: the Macizo de Javalambre (part of the Sistema Ibérico) and the

Serra d'Utiel. The site, situated on the left side of the Rambla de Ahillas canyon, corresponds to a sheltered area that, today, is 38 m long and 2–9 m wide (Fig. 1). Originally, the shelter's surface would have been larger, reaching a maximum amplitude of 11 m. Slope erosion processes explain the truncation of the deposit, whose upper reaches, including level IV, were most affected. The site was excavated between 2007 and 2015, over an area of 30 m^2 for the upper levels and of 27 m^2 for the lower ones.

The Quebrada stratigraphic succession spans approximately 4 m and comprises nine units (Table 1). Level I, at the top, is disturbed by penning. Middle Palaeolithic human occupations are recorded in levels II to V and VII to IX; level VI is archaeologically

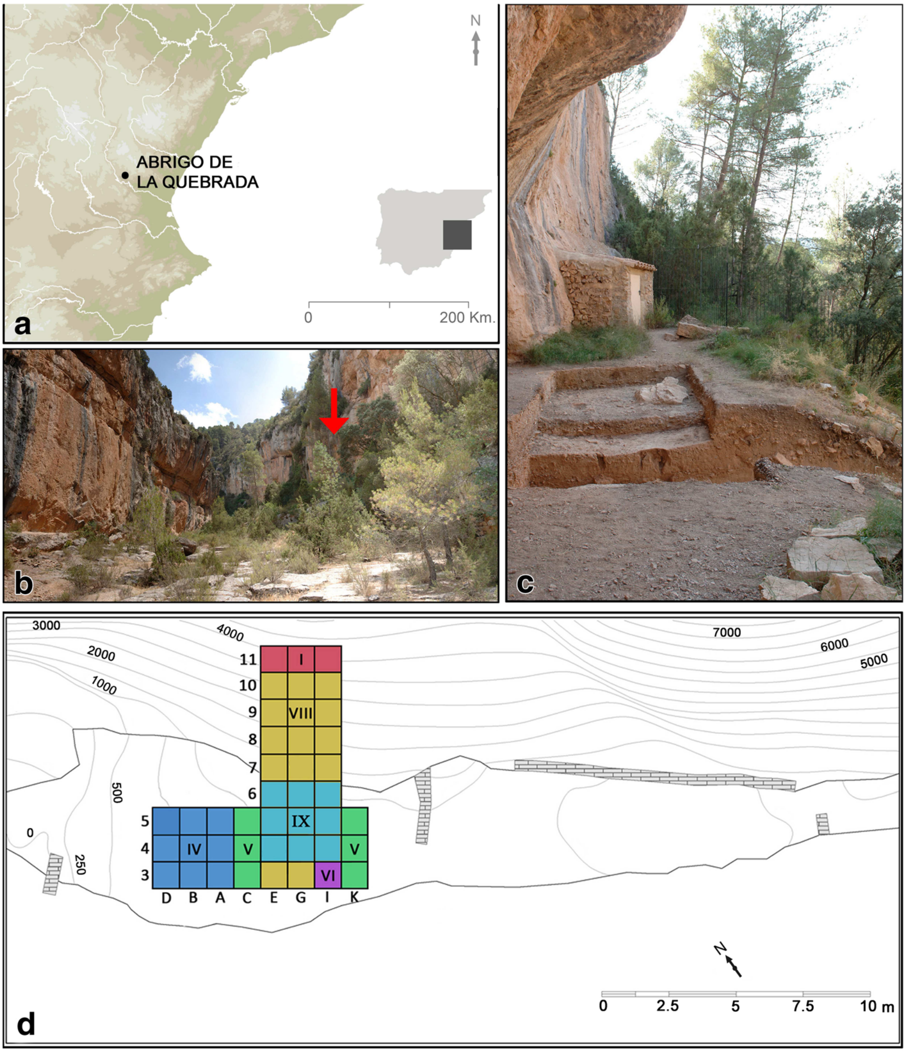

Fig. 1 Abrigo de la Quebrada: location (**a**, **b**); site overview (**c**); excavation trench (the Roman numerals indicate the level reached in each square) (**d**)

sterile. Anthropogenic inputs are especially significant in levels III, IV and V. In the present study, we focus on level IV, dated to the early stages of MIS 3 (see below).

Charcoal analysis of uppermost levels I–IV shows a dominance of Pinus (*Pinus nigra* and *Pinus sylvestris*), *Juniperus* and other gymnosperms. *Quercus*, *Rhamnus* and other dicotyledonous plants were also identified but in low numbers (Badal et al. 2012). These results indicate dry or sub-humid supramediterranean conditions through the entire sequence, with no indication of warm episodes (Badal et al. 2012). This inference is consistent with the phytolith data (Esteban et al. 2015). The few micro-mammalian remains found in the upper levels of MIS 3 age (Table 1) most likely reflect accumulation by small carnivores at times when the site was not occupied by humans (Tormo and Guillem-Calatayud 2015) and their species composition is consistent with the palaeobotanical data.

Methods

Lithic and Refits Analysis

To establish the technological characteristics of each rock (flint, quartzite, limestone and quartz) and their relation to procurement, stone tools were organised into raw material units (RMU) (Conard and Adler 1997; Roebroeks 1988; Vaquero 2008) whose separateness was verified by macro- and microscopic analysis (Eixea et al. 2011, 2014; Prudêncio et al. 2016; Roldán et al. 2015). The technological study was conducted from a *chaîne opératoire* perspective (Boëda et al. 1990; Bourguignon et al. 2004; Faivre 2011; Geneste 1985, 1988; Tixier et al. 1980; Turq 2000), and retouched pieces (including those with macro- and micro-use wear) were classified using the type list of Bordes (1988). The different sequences of the operational chains and the temporality relations of the sample were assessed through refitting. All the finds taken in consideration for the establishment of different kinds of knapping activities—exploitation,

Table 1 Abrigo de la Quebrada. Summary of available archaeological data. The age data consist of radiocarbon dates on charcoal for levels III, IV and V and of luminescence age estimates for level VI. For details of the luminescence dating work, see Suppl. Table 1

Level	Thickness (cm)	Excavated area (m²)	Chronology	MIS	Environment	Fauna (NR)	Lithics (NR)
II	10–15	24	–	4-3	Sub-humid supramediterranean conditions	37,426	3046
III	10–20	30	40,500 ± 530 (Beta-244003)/>-50,800 (OxA-24,854)	4-3		72,191	8498
IV	20–25	30	43,930 ± 750 (Beta-244002)/>-51,600 (OxA-24855)	4-3		10,0909	18,936
V	25–30	21	> 47,100 (OxA-25583)	4-3		78,001	15,580
VI	65–70	23	79 ± 5/82 ± 5 (C-L3898, C-L3900)	5a		–	–
VII	40–45	23	–	5	Study in process	6997	92
VIII	45–50	23	–	5		20,365	522
IX	10–15	9	–	5		302	10

configuration, retouching, fracturing—and the distances between the elements were quantified, as was their location in space (Cziesla 1990; Cziesla et al. 1990; Kvamme 1997; Newcomer and Sieveking 1980; Vaquero et al. 2017).

Archaeostratigraphy and Spatial Analysis

ArcGIS® software was used to assess the existence of breaks in the horizontal and vertical distribution of the remains, potentially indicative of occupational hiatuses that could be used to subdivide the palimpsest into its different components (Canals 1993; Canals et al. 2003; Vaquero et al. 2012a, b). For level IV, the finds were projected on 5–10-cm-thick vertical slices cut across the central area of the excavation trench, which were found to be representative of both the internal and external parts of the inhabited space, preserved in bands 3 to 5 of the excavation grid (Eixea 2015; Eixea et al. 2011–2012; Villaverde et al. 2017).

Faunal Remains

Level IV comprises four excavation spits (6, 7, 8 and 9) (Eixea et al. 2011–2012, 2012; Sanchis et al. 2013; Villaverde et al. 2017). The faunal content of these spits was analysed in its entirety. Taxonomic and anatomical identifications were made against the reference collection of the *Gabinet de Fauna Quaternària* (Museu de Prehistòria de València). The indeterminate fragments for which only an anatomical identification was possible were classified into three groups according to their size: large, medium and small.

The number of remains (NR), the number of identified specimens (NISP) and the minimum number of individuals (MNI) (Lyman 1994, 2008) were calculated. The correlation between the survival index (%ISu) (Brain 1981; Lyman 1994) and the bone density of the best represented taxa (Hillson 1992; Lyman 1985) was assessed via calculation of Pearson's *r*. Age-at-death was established based on dental eruption and wear and epiphysis fusion (Azorit et al. 2002; Hillson 1986; Mariezkurrena 1983; Pérez Ripoll 1988; Serrano et al. 2004; Silver 1980).

Classification of fractures followed Villa and Mahieu (1991). A binocular loupe (Nikon SMZ-10A) was used for the study of surface modifications. Cut mark classification followed the relevant literature (Binford 1981; Bromage and Boyde 1984; Noe-Nygaard 1989; Potts and Shipman 1981; Shipman and Rose 1983). Burnt remains were recorded for colour and localisation of the burning after Nicholson (1993), Stiner et al. (1995) and Théry-Parisot et al. (2004). The assessment of post-depositional modifications followed Lyman (1994).

Luminescence Dating

Two samples were collected from archaeologically sterile unit VI at depths of 1.8 m (C-L3898) and 1.4 m (C-L3900) to provide a *terminus post quem* for the formation of unit IV. The sediment is laminated, which indicates fluvial deposition. Sample preparation and equipment are the same as described in Klasen et al. (2018). We used a single-aliquot regenerative-dose approach (SAR) for all measurements (Murray and Wintle 2000, 2003). Laboratory experiments included a preheat plateau test and a dose recovery test. Multiple grain feldspar aliquots (1 mm) were measured using post-infrared infrared stimulation (pIRIR, Thomsen et al. 2008; Thiel et al. 2011), and we obtained the most appropriate stimulation temperature using a range of different temperatures as well as a dose recovery test. The radionuclide concentration of the surrounding sediments was measured using high-resolution gamma-ray spectrometry. The dose rate was calculated using the conversion factors of Guerin et al. (2011), an assumed water content of 10 ± 3%, an *a* value of 0.07 ± 0.02 as well as an assumed potassium content of 12.5 ± 0.5% (Huntley and Baril 1997). The rubidium concentration was calculated from the potassium concentration (Mejdahl 1987), and the cosmic dose rate was calculated after Prescott and Hutton (1994).

Results

Site Chronology

Radiocarbon accelerator mass spectrometry (AMS) dating of ABA-treated charcoal fragments yielded ages of 40,500 ± 530 BP (Beta-244003) and 43,930 ± 750 BP (Beta-244002) for levels III and IV, respectively (Villaverde et al. 2008). The levels III and IV are also dated by an ABOx-processed sample, which yielded a result of > 50,800 (OxA-24854) and > 51,600 BP (OxA-24855) (Eixea et al. 2011–2012). We present also an unpublished date from level V (Quebrada 2010 G3C11 Sc5), made by an ABOx-processed sample on charcoal fragment (*Pinus nigra/sylvestris)*: > 47,100 (OxA-25583).

The preheat plateau exposed that the quartz OSL signal was saturated, and therefore, quartz was not further measured. According to the laboratory experiments, the most appropriate temperature combination to measure the feldspar samples is $pIR_{80}IR_{290}$ stimulation (Suppl. Fig. 1). The feldspar age estimates (Suppl Tab. 1) of 80.0 ± 4.7 ka (C-L3900) and 83.2 ± 5.4 ka (C-L3898) for level VI, which is archaeologically sterile, provide a maximum age for the Middle Palaeolithic occupations in overlying levels II–V. These results indicate deposition during MIS 3–4 for levels II–V, during MIS 5a for level VI, and, potentially, deposition during earlier phases of MIS 5 for levels VII–VIII, which remain undated but yielded a small mammal assemblage consistent with an Upper Pleistocene chronology (Tormo and Guillem-Calatayud 2015).

The Level IV Lithic Industry

Blanks and Raw Materials

Level IV yielded 18,936 lithic remains. Chips, < 1 cm in length, are the most abundant blanks (87.6%), indicating the high intensity of reduction. Production mostly focused on the extraction of quadrangular flakes, 2–4 cm long and wide and 0.5–1 cm thick (Eixea 2015; Villaverde et al. 2017) (Table 2). Four different rocks have been identified so far: flint, limestone, quartzite and quartz. The local, Domeño-type flint is the most abundant raw material. It occurs in Middle Jurassic formations and is well suited for knapping. The geological stratum where it was first identified outcrops in the hillsides above River Turia, 5–8 km from the site. The allochthonous flints, classified into four subgroups (types 1, 2, 3 and 4), are good-quality raw materials whose macroscopic attributes differ from the Domeño type and match sources located > 100 km away (Eixea et al. 2011; Prudêncio et al. 2016; Roldán et al. 2015). The quartzite and limestone blocks selected for knapping are fine-grained and have a microcrystalline structure. They were likely collected as cobbles in the Ahillas streambed, a few meters away.

Knapping Systems and Tools

Lithics were produced using discoid and recurrent-centripetal Levallois methods. Dorsal scars are mostly centripetal in both knapping systems; a few scars indicate unidirectional and bidirectional reduction sequences. The abundance of cortex-bearing cores and flakes of different sizes indicates that knapping was carried out on site. Flake sizes are small to medium; a significant number—both retouched and unretouched—are smaller than 1.5 cm (Eixea 2015; Villaverde et al. 2008, 2017). Retouched pieces are slightly larger than average.

Table 2 Abrigo de la Quebrada. Stone tool data for level IV. For additional detail, see Eixea (2015), Eixea et al. (2015, 2016) and Villaverde et al. (2012, 2017)

		N	%
Raw materials	Flint	1218	61.39
	Quartzite	419	21.12
	Limestone	345	17.39
	Quartz	2	0.10
Knapping methods	Discoid	663	35.47
	Levallois	519	27.77
	Kombewa	29	1.55
	Laminar	2	0.11
	Indeterminate	656	35.10
Blanks	Flakes	1805	77.43
	Laminar flakes	49	2.10
	Blades and small blades	15	0.64
	Cores	54	2.32
	Thermoclast	390	16.73
	Shapeless	8	0.34
	Cobbles	10	0.43
Tools	Points	35	7.32
	Sidescrapers	247	51.67
	Notches and denticulates	35	7.32
	Upper Palaeolithic group	5	1.05
	Pieces with use-wear	54	11.30
	Other	102	21.34

Table 3 Abrigo de la Quebrada. Faunal data for level IV

	NISP	%NISP	MNI by age				Total MNI
			Young	Subadult	Adult	Senile	
Cervidae	214	15.9	0	1	2	1	4
Caprinae	431	32.0	0	1	2	2	5
Suidae	4	0.3					1
Equidae	275	20.4	2	2	2	1	7
Rhinocerotidae	3	0.2					1
Total ungulates	927	68.9					18
Canidae	1	0.1					1
Felidae	2	0.1					1
Total carnivores	3	0.2					2
Leporidae	136	10.1	1	1	2		4
Testudinidae	275	20.4					3
Birds	4	0.3					
Total determinate	1345	1.3					
Small size	54	2.6					
Medium size	1907	91.9					
Large size	113	5.4					
Total indeterminate	2074	2.1					
> 3 cm	2221	2.3					
< 3 cm	95,267	97.7					
Total unidentified	97,488	96.6					
Grand total	100,907						

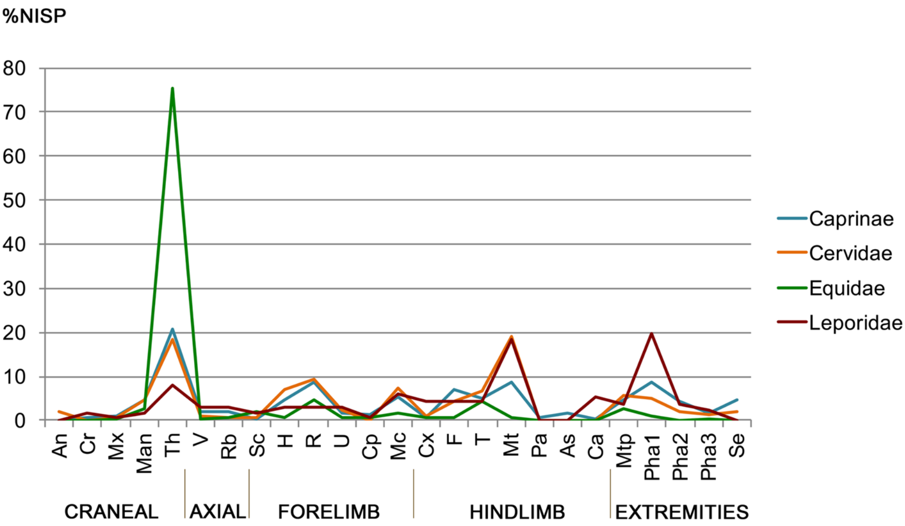

Fig. 2 Body-part representation (%NISP) of the main families identified in the faunal assemblage from level IV of Quebrada. Antler (Ant), cranium (Cr), maxillary (Mx), mandible (Mand), teeth (Th), rib (Rb), scapula (Sc), humerus (H), radius (R), ulna (U), carpal (Cp), metacarpal (Mc), coxal (Cx), femur (F), tibia (T), metatarsal (Mt), patella (Pa), astragal (As), calcaneus (Ca), metapodia (Mtp), first phalange (Pha1), second phalange (Pha2), third phalange (Pha3), sesamoid (Se)

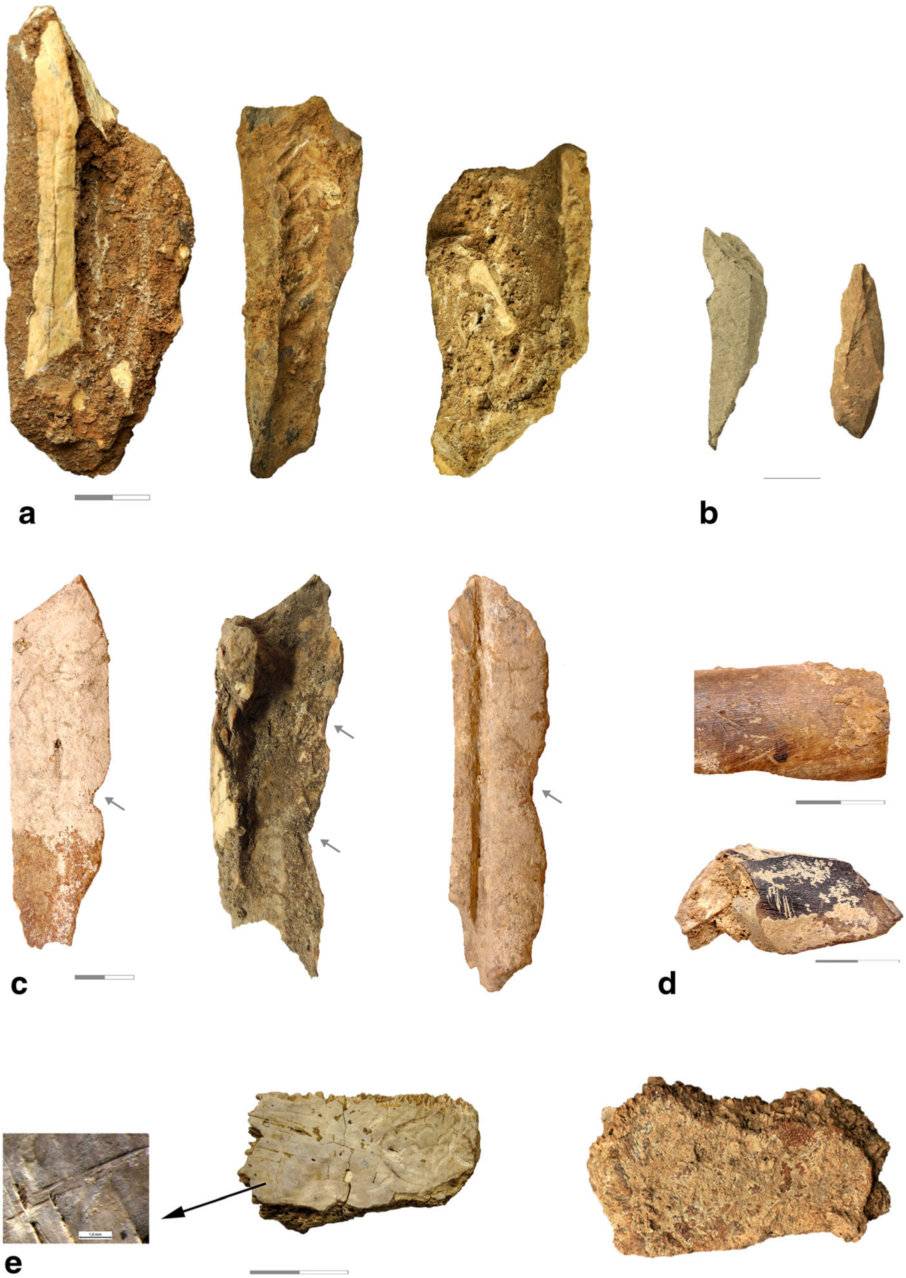

Fig. 3 Anthropogenic modification in faunal remains from level IV of Quebrada: green fractures (**a**); fragments detached by impact (**b**); percussion notches on remains of middle-size prey (**c**); cut marks on the remains of middle-size prey (**d**); *Testudo hermanni* plates, one with a cut mark (**e**)

Retouched tools are 424, and another 54 pieces bear use-wear. Cortex is seen in 34.8% of the sample; lateral overshooting is seen in only four tools. Scrapers with

Table 4 Abrigo de la Quebrada. Anthropogenic modification in the faunal remains from level IV

	Notches NR	Cut marks NR	Burnt %NR
Caprinae	16	3	44.3
Cervidae	9		34.1
Equidae	2		31.6
Leporidae			47.8
Testudinidae		3	74.2
Large size	6	1	34.5
Medium size	22	42	36.7
Small size		7	53.7
Indeterminate		10	37
Total	55	66	

a single modified edge amount to 42.9% of the retouched tools, while those with two or more modified edges are 8.8%. Sixty-two percent of the single scrapers are convex and 20% are transversal-convex; their blanks are mostly Levallois, either recurrent-centripetal or preferential. Cortex is more frequently present in scrapers, often in lateral zones, than in other pieces, so scrapers tend to be naturally backed (Eixea 2015). The simple, continuous and direct types of retouch predominate, often eliminating a sizable proportion of the blank's original edge (Table 2).

There are 28 Mousterian points (5.8% of the formal tools). The primary blanks are both Levallois (50%), mostly of the preferential variety, and discoid (40%); use of the latter results in tools that are thicker and asymmetric (Eixea et al. 2015). Notches and denticulates (not very invasive and mostly laterally located) amount to 7.3% and are made on both discoid (50%) and Levallois (30%) blanks. The number of Upper Palaeolithic-like implements is low (1%): they are all backed knives, four typical and one atypical. The Levallois typological group represents 23% of the formal tools; these are mostly typical Levallois flakes (14.4%), atypical ones (7.7%) and points (1.5%) (Eixea 2015).

The Level IV Faunal Assemblage

Species Composition

The level IV sample totals 100,907 remains (Table 3). Of these, 1.3% have been identified taxonomically; the remainder correspond to fragments that could be identified anatomically and classified by size (2.1%), and to indeterminate fragments (96.6%). The undetermined items are smaller than 3 cm in 97.7% of the cases, and even though some are spongy bones, most (> 80%) are long bone fragments.

The assemblage features a taxonomic diverse range of medium- and large-size ungulates, but carnivores and small game are also present. Eight different families have been identified (Table 3): Bovidae (Caprinae), Equidae, Cervidae, Leporidae,

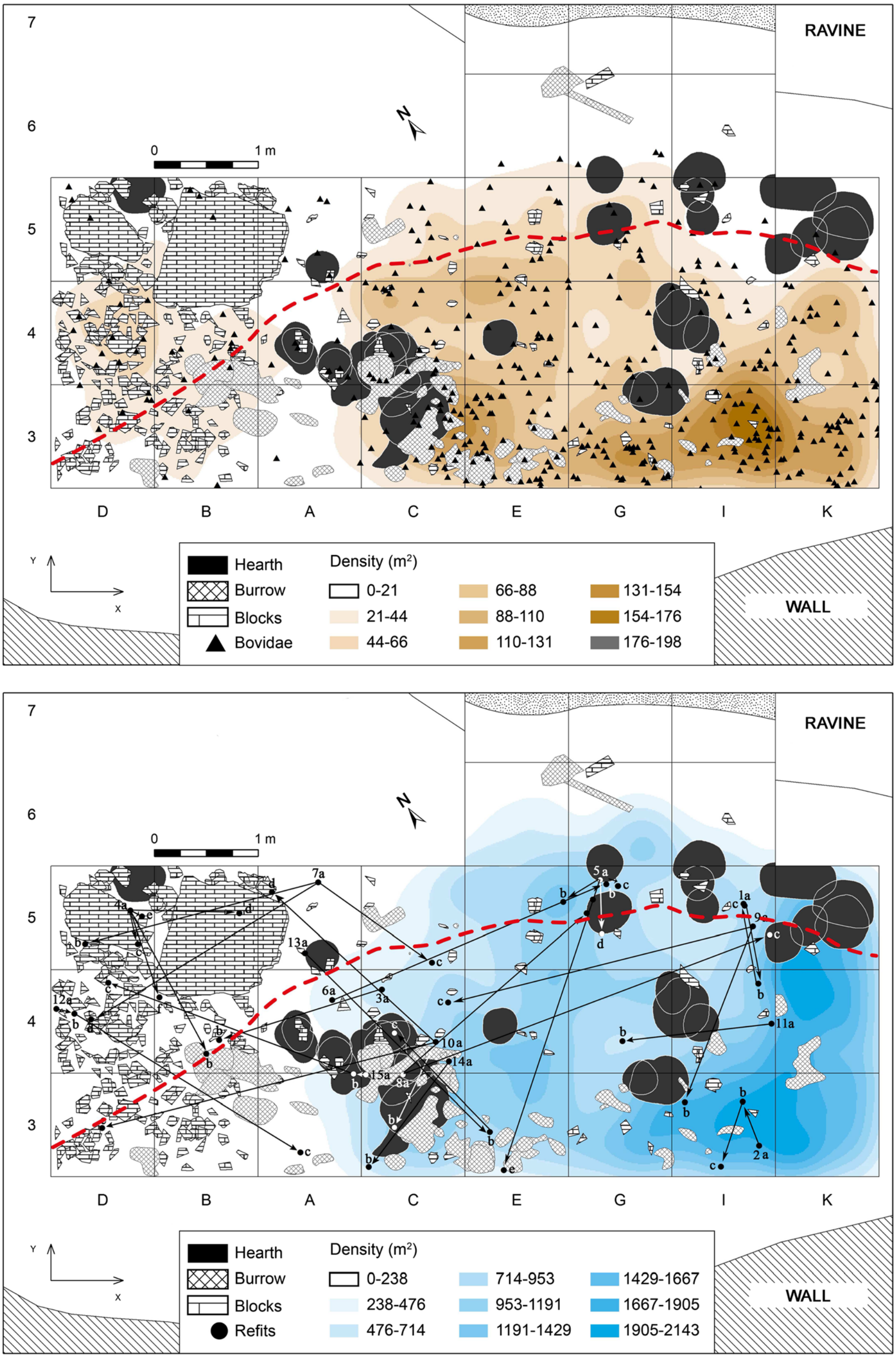

Fig. 4 Spatial patterning in level IV of Quebrada (the dashed red line indicates the position of the extant drip line): the remains of Caprinae against the iso-density plot of the totality of the bone assemblage (**a**); stone tool refit links against the iso-density plot of the totality of the lithic assemblage (**b**)

Testudinidae, Suidae, Rhinocerotidae, Felidae and Canidae (Sanchis et al. 2013). There are also some bird bones.

By NISP, Caprinae (32%), followed by Equidae (20.4%) and Cervidae (15.9%), are the dominant taxa. Using MNI, Equidae are the more important, with seven individuals, leaving behind Caprinae and Cervidae with five and four, respectively (Table 3). As for small game, there is a notable presence of tortoises (*Testudo hermanni*) (20.4%), followed by leporids (10.1%). The eruption and wear of the teeth of Equidae, Caprinae and Cervidae suggests that the shelter was occupied by humans between spring and autumn. Further precision must await the results of forthcoming dental micro-wear analyses (Rivals and Deniaux 2005).

Body Part Representation

Among the four main taxonomic families, all anatomical groups are represented (Fig. 2). Except for the axial group, Caprinae and Cervidae show a generally balanced body part representation. In the case of Equidae, however, there is a bias towards the cranial material, mostly teeth (which stand for 76% of the taxon's remains). Medium-sized prey such as red deer and ibex therefore seem to have been introduced as complete carcasses; the under-representation of their axial elements could be the consequence of intense processing, or of post-depositional fragmentation preventing precise taxonomic identification. The bias seen among the remains of larger prey, namely horse, may be due to differential transport of body parts, even though, given the compact structure of teeth, differential preservation factors cannot be excluded (Real et al., in preparation).

The leporid remains are dominated by bones from the fore limbs and extremities. In the case of tortoises, the best represented parts are the plates. In both cases, given the

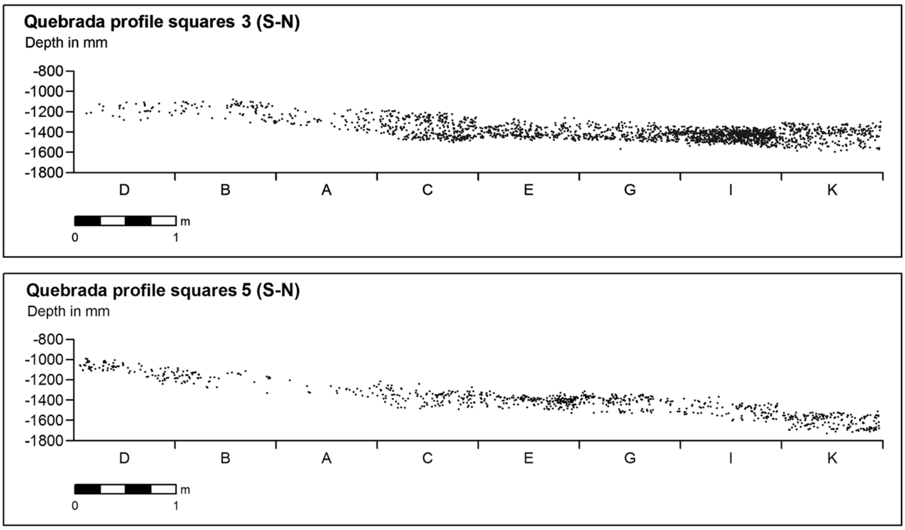

Fig. 5 Vertical distributions within level IV of Quebrada: projection of the finds from rows 3 (above) and 5 (below) of the grid along the shelter's longitudinal (N-S) axis

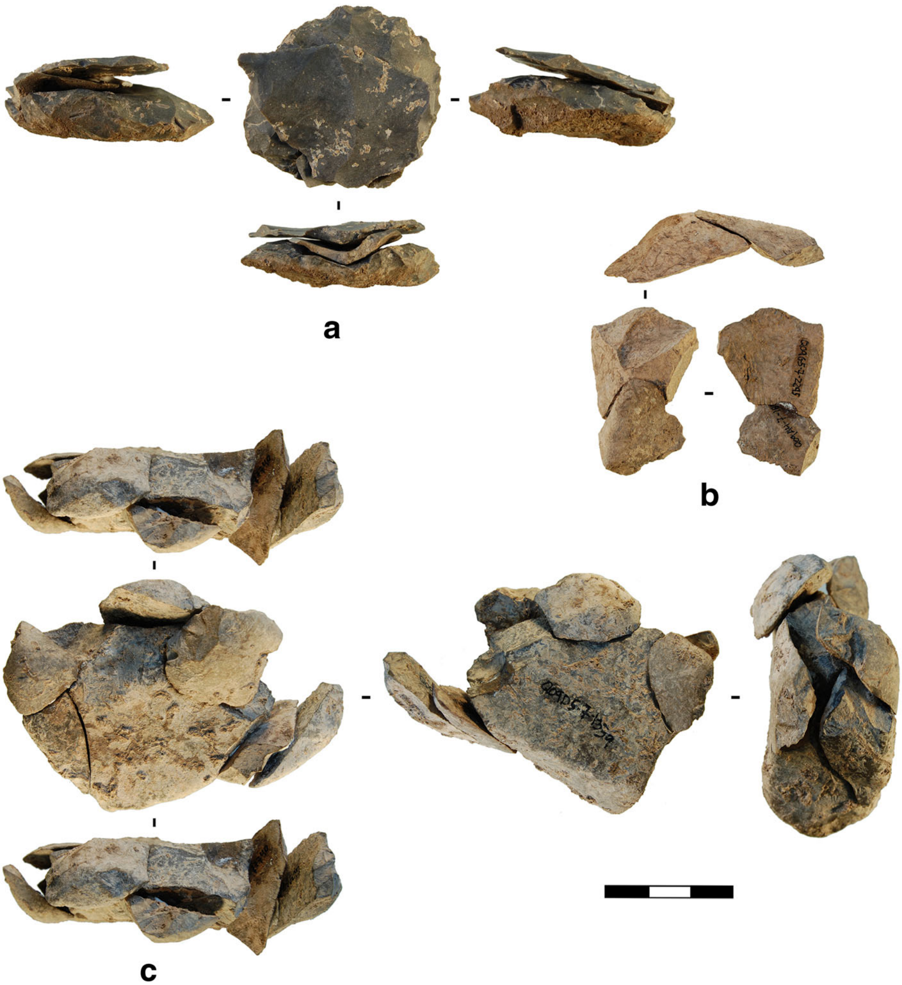

Fig. 6 Refitting evidence from level IV: Levallois (preferential method) flakes refitted on their core (**a**); refitted limestone flakes (discoid method) (**b**); refitted limestone core of the chopping-tool type (**c**)

small size of the prey, it is likely that they were introduced as complete carcasses, and the same for birds (Eixea et al. 2011–2012; Sanchis et al. 2013; Villaverde et al. 2017).

Taphonomy

Digested bones and bones bearing tooth or beak marks indicative of the use of the shelter by carnivores or birds of prey have not been found.

The fragmentation of the sample is very high: only 0.1% of the remains are complete bones. Moreover, only 0.3% of the > 3-cm fragments are also > 5 cm long. Anthropogenic fractures, of which 20% are green bone fractures, are found on 67.6% of the determined bones; some fragments combine shaft and epiphysis. Green fractures predominate in almost all the taxa, reaching percentages as high as 31.5% among Leporidae, 45% among Caprinae and 54.5% among Cervidae. In

Fig. 7 Combustion features in level IV of Quebrada: hearths (**a**–**d**); decapage surface showing both greyish sediments and the reddening produced by later occupations (**e**)

the case of Equidae, the percentage is lower (9%) but, if we exclude the teeth, comparable 38.3%. Among ungulates, long bone shaft fragments without a complete circumference are the most common fracture morphotype (Fig. 3). This type stands for 88.1% of green fractures among Caprinae and for 92.3 and 96.4% of such fractures among Equidae and Cervidae, respectively.

Eighteen fragments could be identified as shatter caused by percussion with a stone tool (Fig. 3), while 55 bear percussion notches and 66 other kinds of anthropogenic modifications (mainly cut marks). These types of modifications are mostly present on the remains of medium-size animals, although a cut mark in the inner side of a completely calcined tortoise plate has also been recorded (Table 4; Fig. 3).

The number of burnt bones is significant: 57% of the identified remains are completely burned (Table 4). Calcined bones predominate, followed by those in the early stages of burning, showing a brown-black colouration. The highest values are found among Testudinidae (74.2%) and Leporidae (47.8%), even though the percentages among Caprinae, Cervidae and Equidae are no less significant (above 30% in all three cases).

The correlation between %ISu and bone density suggests that the sample was affected by post-depositional processes. Indeed, the correlation coefficient—0.58 (Equidae), 0.61 (Cervidae) and 0.76 (Caprinae)—is high for the three main taxonomic groups and so is the positive probability.

Combining the Level IV Data

A synthetic, broader view of the role played by Quebrada in the settlement-subsistence system(s) of the Middle Palaeolithic of the central region of Mediterranean Iberia requires that the different lines of evidence be combined for overall assessment. Thus, in the following, the results from the study of stone tools and faunal remains from level IV are considered alongside the charcoal and phytolith data to address issues of spatial

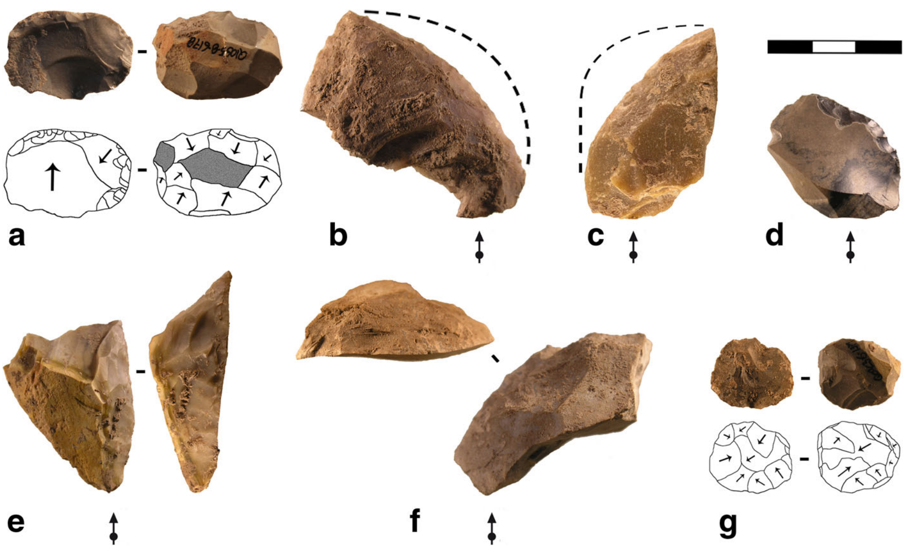

Fig. 8 Stone tool economy in level IV of Quebrada: recycled pieces (**a**, **g**); rejuvenated (edge-resharpened) pieces (**b**, **c**, **e**, **f**) (**d**)

organisation, palimpsest formation, duration of occupation, hunting activity and mobility patterns.

Spatial Analysis

As the distribution of lithic and bone remains well illustrates, the same area of the shelter was repeatedly occupied (Figs. 4 and 5). This is because of the limited space available behind the drip line: about 4 m today, and narrowing as one moves away from the central area of the site. As an example, Fig. 4 shows the distribution of the Caprinae remains (the best represented taxon) against the background of the distribution of all faunal and lithic remains: finds are concentrated in the interior area, corresponding to row 3 of the grid, and especially in columns E, G, I and K (Eixea et al. 2011–2012, 2012), and decrease in density as we move towards row 5 (squares C–K). Note, however, that the centre of each distribution is different: while most lithics come from I3 and K3–5, most faunal remains come from I3 and K3.

In the western zone (squares D, B and A), finds and features are in much lower numbers. Conversely, middle- and large-sized blocks were more numerous in this area. Most hearths are in squares C3, C4 and A4, as if marking a discrete boundary between the two zones. Almost all the other hearths are in squares G-I/5–6 and K5—as if marking the limits of the inhabited space to east and north—and in close association with the densest patches of the distribution of both lithic and faunal remains (Fig. 4).

We compared the degree of bone fragmentation between the two areas of level IV to see if there was any correlation between bone density and degree of fragmentation. Based on the number of identified remains only, the percentage of < 3-cm fragments is higher in the eastern area (33.6%) than in the western one (18.1%). Attempts have been made to compare the number of complete versus incomplete bones, but there are so few of the former that the results are not significant.

No bone refits could be done, due to the high level of fragmentation of the remains and their poor conservation—often thermo-altered and with abundant concretion covering. Stone tool refitting shows that the space available was used in its entirety and that no structure relating to the clustering of activities, or of individual occupation events, survived, or can be discerned (Fig. 6) (Eixea 2015; Eixea et al. 2012). The higher density of finds and features seen in the eastern area correlates with this being also the area in which most refit links plot. Likely, the explanation for both patterns lies in the fact that this is where the distance between drip line and back wall is larger, this being therefore the most protected area of the shelter.

Palimpsest

Level IV features dense lithic and bone scatters and many combustion features forming a continuous distribution, with no sterile lenses, across the entire thickness of the deposit, as is well apparent in vertical projection (Fig. 5). This is due to a slow sedimentation rate and corresponds to a typical palimpsest structure. The superposition of combustion structures indicates that the shelter was used recurrently but, beyond

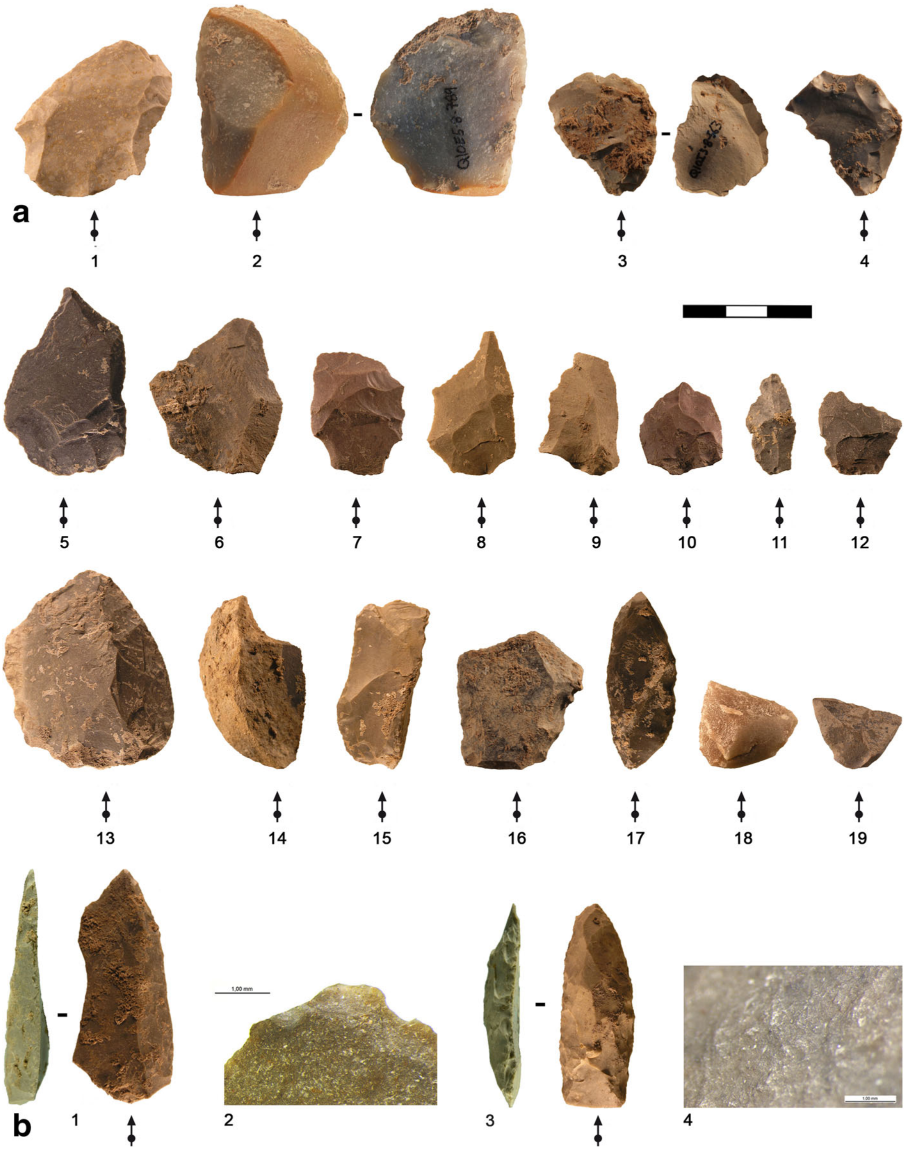

Fig. 9 Stone tools from level IV of Quebrada: transversal-convex sidescraper on Levallois flake, flint (A1); *déjeté* sidescraper on discoid flake, quartzite (A2); Levallois *débordant* flake with macro use-wear on the edge opposite to the *méplat*, flint (A3–A4); Levallois preferential flakes with macro use-wear, flint (A5–A9); Levallois preferential flakes with macro use-wear, flint (A10–A12); Levallois preferential micro-flake with macro use-wear, flint (A13); simple-convex sidescraper on discoid flake, flint (A14); natural backed knife, flint (A15); concave-convex, simple sidescraper opposite to *méplat*, flint (A16); denticulate, flint (A17); Mousterian point, flint (A18); *déjeté* micro-sidescraper, quartzite (A19); micro-pseudo Levallois point with use-wear on edge opposite the *méplat* (B1, B3); point with impact fractures (B2); detail of point with spalling by impact (B2); polish on ventral side of point (B4)

that, the record is not amenable to further precision as to the duration and specific spatial properties of individual occupation events.

The compaction of multiple occupation events into a single, undifferentiated deposit also contributes to explain the high degree of fragmentation of the finds: > 80% of the lithics are chippage and > 90% of the fauna are small fragments. While this may be related to human activity—e.g. on-site knapping and intensive recycling of blanks, in the case of lithics, or carcass processing, in the case of bones—post-depositional processes, namely trampling, clearly play a major role. Note that the charcoal remains are also of a small size—on average, < 2 mm (Badal et al. 2012).

These factors also explain why hearths often lack a clear structure. They may have been dismantled by subsequent activity (Fig. 7), and the distribution of burnt phytoliths includes areas devoid of combustion features, showing that ash scattered across the entire excavation trench. Even though natural agency (e.g. winds) may explain such a pattern to some extent, human agency (e.g. cleaning, trampling) must also be involved (Esteban et al. 2015).

Short Occupations

Individual occupation events seem to have been short, though recurring. Given its position (northwest facing and at the bottom of a narrow, steep gorge), the shelter is characterised by scarce insolation and high exposure to winds, making it unsuitable for use in the winter. Indeed, human presence was restricted to between spring and autumn, according to the ungulate seasonality data (Eixea et al. 2011–2012), or more precisely to between June and October, according to the phytolith data (Esteban et al. 2015). Species such as ibex and red deer are available throughout the year, given their low migratory nature, but in the case of Quebrada, they were hunted on a seasonal basis. Horse, a more migratory species that could have taken advantage of the region's natural corridors for its displacements, seems, however, to have been hunted only in spring.

The reuse of pieces discarded in the shelter during previous occupations, and the recycling of blanks and tools into cores, further supports the notion of recurrent occupation (Rios et al. 2014) (Fig. 8). In turn, the high proportion of unretouched blanks, the small size of the pieces and the predominance of local raw materials (namely, the Levallois reduction of quartzite and limestone, despite the latter's short edge life) support the notion that such recurrent occupations were also short ones. This notion is corroborated by the frequency with which scraper edges were resharpened: 26.9% bear traces of the procedure and, in many, it is also clear that discard happens clearly before the potential for edge rejuvenation was exhausted, suggesting work processes that were not lengthy.

The 29 combustion features identified are related to domestic activities and the time investment involved in their preparation is in all cases small. Each hearth seems to correspond to a separate event; no evidence was found for the simultaneous use of two or more.

Hunting Activities

The Ahillas streambed runs through a canyon that opens onto a wide plain. The bottom of the canyon being a dead end, it is easy to see how this natural trap could be used by hunters and why Quebrada, located at the mouth of the canyon, was selected for shelter. In addition, this location allows access to the different adjacent biotopes: mountain,

Table 5 Find density data for Middle Palaeolithic sites of Mediterranean Iberia (%ID. = % identified to taxon)

		General			Fauna			Lithic		Sources
		Density/m^3	Excavation area (m^2)	Thickness level (cm)	Total	Density/m^3	% Id.	Total/total (without knapping remains)	Density/m^3	
Quebrada	IV	19,973.80	30	20	100,907	16,817.80	1.30	18,936/2331	3156/388.5	Sanchis et al. (2013)
	VIII-1	116.5	23	10	2513	1092.6	1.90	55/31	23.9/13.5	Eixea (2015)
	VIII-2	1641		40	14,714	1599.3	1.03	383/97	41.6/10.5	Villaverde et al. (2017)
	VIII-3	1415.7		10	3170	1378.3	0.40	86/18	37.4/7.8	
El Salt	X	752.5	36	35	6590	523	–	2892/–	229.5/–	Galván et al. (2014a, b)
										Machado and Pérez (2016)
Pastor	IVa	57.4	30	70	114	30.2	18.40	18/–	27.2/–	Machado et al. (2013)
	IVb				159		29.60	522/373		
	IVc				362		40.90	31/–		
Cova Negra	II	566.1	12	15	1012	562.2	32.60	7/4	3.9/2.2	Villaverde et al. (2009)
	IIIa–b	786.1		30	2795	776.4	24.40	35/30	9.7/8.3	Martínez Valle (2009)
	IV	636.4		30	2289	635.8	23.60	2/1	0.6/0.3	Eixea (2015)
Bolomor	IV-1	9042.2	14	13	25,323	7864.3	11.30	3793/1846	1178/573.3	Fernández Peris (2007)
										Sañudo and Fernández-Peris (2007)
	IV-2			20						Blasco (2011)
Beneito	D1 (X)	1221.1	6	30	1476	820	13.80	722/–	401.1/–	Iturbe et al. (1993)
	D2 (X)	3351.5	3	22	1755	2659.1	15	457/–	692.4/–	Martínez Valle (1996)
	D3 (XI)	1081.3		25	476	634.7	18.30	335/–	446.7/–	
	D4 (XII)	5497.5		40	6264	5220	18.30	333/–	277.5/–	
Romaní	H	64.8	220	10	1165	53	13.50	261/186	11.9/8.5	Vaquero (1999)

Table 5 (continued)

		General			Fauna			Lithic		Sources
		Density/m³	Excavation area (m²)	Thickness level (cm)	Total	Density/m³	% Id.	Total/total (without knapping remains)	Density/m³	
										Vallverdú et al. (2005)
										Rosell et al. (2012a)
	I	116.6	195		1719	88.2	12.90	555/542	28.5/27.8	Vallverdú et al. (2005)
	Ja–Jb	176.7	290	30	8460	97.2	–	6916/6353	79.7/73	Rosell et al. (2012b)
	Ja	210.1	290	20	6738	116.2	14.60	5446/4938	93.9/85.1	Vaquero et al. (2012a, b)
	Jb	491.1	65	10	1722	264.9	16.30	1470/1415	226.2/217.7	
	K	156.2	279		2564	91.9	61.70	1794/1206	64.3/43.2	Chacón and Fernández-Laso (2007)
	L	80.5	260		1002	38.5	46.80	1091/982	42/27.8	Vaquero (2008)
										Fernández-Laso et al. (2010)
	M	138.6	247	40	7614	77.1	21.90	6084/5679	61.6/57.5	Chacón (2009)
										Fernández-Laso et al. (2010)
	N	43.6	170	10	200	11.8	–	541/–	31.8/–	Vallverdú et al. (2010)
	Oa–Ob	266.5	271	45	9101	74.6	5.30	23,393/–	191.8/–	Gabucio et al. (2014)
	Oa	24.7		25	486	7.2	–	1185/927	17.5/13.7	Bargalló et al. (2016)
	Ob	107.5		35	8615	90.8		1583/1325	16.7/14	
Roca	N10	–	95	10	–	–	–	3602/–	379.2/–	Martínez-Moreno et al. (2010)
Dels Bous	N12	–	105	20				23,560/–	1121.9/–	de la Torre et al. (2012)
Teixoneres	IIa	170.3	20	40	696	87	98.90	45/33	5.6/4.1	Rosell et al. (2010)
	IIb			45	621	69	98.70			Talamo et al. (2016)
	IIIa	–		27	1585	293.5	96.30	–/156	− 28.9	
	IIIb			30	10,627	1771.2	63.30	–/445	− 74.2	

plains and riverside. From such a home base, Middle Palaeolithic groups could have a good control of the territory and hunt a wide range of prey, as indeed reflected in the taxonomic diversity of the faunal assemblage.

The taphonomic study of the bone remains shows that carcasses were processed for meat and marrow consumption. The evidence consists of longitudinal marks made with stone tools (cut marks and scrapes), linked to the extraction of meat, and of percussion breaks intent on fracturing long bones to access the marrow within (Fig. 3).

Use-wear analysis of the stone tool points revealed the presence of impact fractures and of hafting-related edge scarring (Eixea et al. 2015) (Fig. 9B). Additionally, preliminary use-wear analysis of micro-flakes has shown that, in overlying levels II and III, such items were used for butchering (Villaverde et al. 2012). When accuracy is more important than strength, the small size of these sharp-edge pieces is advantageous.

Mobility Patterns

The data on seasonality and duration of individual occupation events imply the existence of additional points of settlement location, and the sourcing of the dominant Domeño-type flint does show that it would have been procured from areas located 5–8 km away (Eixea et al. 2011, 2014). Given the mobility patterns of prey such as horse, ibex or red deer (Aura et al. 2002), it is only logical to expect that their pursuit be carried out from different sites, the use of which varied as a function of opportunity, target species and time of the year. In the framework of such a settlement-subsistence system, Quebrada would have been mostly occupied to hunt horse herds passing-by in the spring and, possibly, between summer and autumn, too.

The allochthonous, good-quality flints found among the Quebrada lithics match sources located > 100 km away, in the southern parts of the central Mediterranean region, where a significant concentration of sites exists (Eixea et al. 2014; Roldán et al. 2015). For instance, the Serreta-type flint, present in small amounts at Quebrada, is documented at such distant sites as Cova Negra (Xàtiva), Cova de les Cendres (Teulada-Moraira) and El Salt (Alcoi) (Eixea et al. 2011). The exploitation of these raw materials indicates mobility along the natural corridors that traverse the Valencian region from interior to coast and from north to south (Aura et al. 1993). Whether this reflects the mobility of individual Neanderthal groups over long distances or the circulation of raw materials through exchange networks covering vast expanses of Mediterranean Iberia, or both, remains to be clarified. However, the percentages of flint from distant sources and their technological characteristics (low frequency of cortical elements and predominance of items from the final phases of operational chains) support the idea that the patterns reflect the transport of toolkits and, hence, the movement of personnel.

Discussion

Density of Finds

The formation of an archaeological deposit depends on a wide range of factors that cannot always be accurately characterised: territorial mobility patterns, duration of the

Table 6 Site function indicators for Middle Palaeolithic sites of Mediterranean Iberia (the asterisk denotes assemblages for which the percentage of tools is calculated over the totality of the lithic assemblage, chippage included)

		Sedimentation rates	Dominant tool types	Formal tools as a percentage of the lithic assemblage (chippage excluded)	Number of formal tools	Major species (%NISP)	NISP/MNI
Quebrada	IV	Low	Sidescraper	20.5	478	Caprinae (32), Testudinidae (20.4), Equidae (20.4), Cervidae (15.9), Leporidae (10.1), Suidae/Aves/Rhinicerotidae/*Vulpes*/*Lynx*, Perissodactyla (1)	1345/46
	VIII	Rapid	Sidescraper	14.1	74	Leporidae (60.8), Equidae (17.9), Caprinae (12.3), Cervidae (6.2), Aves/Rhinocerotidae/Suidae/ Canidae/Carnivora/Bovidae/*C. lupus*/*V. vulpes* (2.7)	1149/?
El Salt	X	Low	Sidescraper	–	–	Leporidae (54.2), Caprinae (16.8), Cervinae (16.1), Equinae (9), *Lynx*/Carnivora/Testudinidae/Bovinae/Aves/Suinae/Rhinocerotidae/ Canidae/*Cuon*/*Canis*/Pantherinae/Anura (2.8)	1661/14
Pastor	IV	Rapid	Sidescraper	5.1 (IVb)	19	*T. hermanni* (60.4), Caprinae (19.4), Cervinae (6.8), Equinae (4.7), Rhinocerotidae (2.2), Aves/Leporidae/Suinae/Bovinae/Canidae (5.9)	357/11
Cova Negra	II	Rapid	Sidescraper	25	1	*O. cuniculus* (36), Aves (21.4), *Hemitragu*s sp. (16.7), Caprinae (13.6), *C. elaphus*/*C. pyrenaica*/*Dama* sp./Bovinae/*Equus* sp./Carnivora (12.4)	420/?
	IIIa-b	Rapid	Sidescraper	26.7	8	*O. cuniculus* (46.5), Aves (26.3), *Hemitragus* sp. (7.7), Caprinae/*C. pyrenaica*/Cervinae/*C. elaphus*/*Dama*/*C. capreolus*/Bovinae/*Equus* sp./*Dicedorinus*/*S. scrofa*/*Casto*r/Carnivora (19.5)	930/?
	IV	Rapid	Sidescraper	100	1	*O. cuniculus* (56.4), Aves (17.5), *Equus* (6.2), Cervinae (5.5), Caprinae (4.3), *Hemitragus* sp. (3.7), *C. elaphus* (2), Bovinae/*C. lupus*/Hiaeninae/*Sus* (2.9)	653/62
Bolomor	IV	Low	Denticulate	21.3	394	*O. cuniculus* (27.5), *C. elaphus* (22.6), *T. hermanni* (18.4), *B. primigenius* (7.4), Aves (6.4), *H. cedrensis* (4.2), *S. scrofa* (4), *Dama* (3.2), *E. ferus*/*H. amphibius*/*E. hydruntinus*/Carnivora/*P. antiquus*/*P. leo*/*C. lupus*/*V. vulpes*/*L. pardina*/*U. arctos*/*Macaca*/Salmonidae (6.3)	2864/99

Table 6 (continued)

		Sedimentation rates	Dominant tool types	Formal tools as a percentage of the lithic assemblage (chippage excluded)	Number of formal tools	Major species (%NISP)	NISP/MNI
Beneito	D1 (X)	–	Denticulate/Upper Pal.	10.4*	75	*O. cuniculus* (71.7), *C. pyrenaica* (11.3), Aves (8.5), *C. elaphus* (4.6), *E. caballus/S. scrofa/B. primigenius/R. rupicapra/C. lupus/C. crocura/Lynx*/Bovidae/D. sp./*L. capensis* (4.2)	1856/?
	D2 (X)	–	Denticulate/Upper Pal.	10.9*	50		
		D3 (XI) N	–	Sidescraper	11.6*		
D4 (XII)		–	Sidescraper	18.3*	61	Y (n = 1)	
Romaní	H	Rapid	Denticulate	7.5	14		
	I	Rapid	Denticulate	2.2	12	Cervidae, Bovidae, Equidae	–
	Ja–Jb	Rapid	Denticulate	1.8	117	*C. elaphus* (46.9), *E. ferus* (38.7), *B. primigenius* (8.1), *S. hemitoechus* (4.7), *R. pyrenaica*/Carnivora/*Lynx* sp./*C. lupus/Ursus* sp./*Crosuta* sp./*V. vulpes* (1.6)	1265/15
	Ja	Rapid	Denticulate	1.8	89		
	Jb	Rapid	Denticulate	2	28		
	K	Rapid	Denticulate	3	36	*C. elaphus* (82.5), *E. ferus* (13.8), *B. primigenius* (3.7)	406/13
	L	Rapid	Denticulate	3.3	32	*C. elaphus* (90.6), *E. ferus* (32.1), *B. primigenius* (5.7)	106/12
	M	Rapid	Denticulate	0.7	40	*C. elaphus* (85.7), *E. ferus* 810.1), *B. primigenius* (3.7), *U. spaleaus* (0.1), *C. crocuta* (0.1)	830/20
	N	Rapid	Denticulate	–	–	Cervidae, Bovidae, Equidae, Leporidae	ca. 200/-ca. 3
	Oa-Ob	Rapid	Denticulate	–	–	*C. elaphus*, *F. silvestris*, *B. primigenius*, *E. ferus*, *O. cuniculus*, *S.* hemitoechis, Aves, *Ursus* sp., *Rupicapra* sp.	528/21
	Oa	Rapid	Denticulate	1.8	17		
	Ob	Rapid	Denticulate	5.7	75		
	N10	Low	Denticulate	4*	145	–	–

Table 6 (continued)

		Sedimentation rates	Dominant tool types	Formal tools as a percentage of the lithic assemblage (chippage excluded)	Number of formal tools	Major species (%NISP)	NISP/MNI
Roca Dels Bous	N12	Low	Sidescraper	–	–	–	–
Teixoneres	II	Rapid	–	–	–	*C. elaphus* (38.7), *E. ferus* (20.7), *O. cuniculus* (15), *Bos/Bison/S. scrofa*/Carnivora/Caprini/*Hystrix* sp./ Rhinocerotidae (25.6)	406/43
	IIIa	Rapid	Sidescraper	7.3	44	*O. cuniculus* (44.1), *E. ferus* (19.4), *C. elaphus* (16.3), *U. spelaeus* (8.6), *Bos/Bison* (4.4), *C. spelaes/*Caprini/ Carnivora/*Hystrix* sp./Rhinocerotidae/*S. Scrofa/M. meles/C. lupus/Castor* sp. (7.7)	710/49
	IIIb					*C. elaphus* (44.5), *O. cuniculus* (29.6), *E. ferus* (10.8), *Bos/Bison* (3.4), Carnivora/*R. rupicapra/U. spelaeus/E. Hydruntinus/Lynx* sp./*C. spelaea/Lepus*/Rhinocerotida/ *V. vulpes/S. scrofa*/*Hyxtrix* sp./*M. mesles/Castor* sp./ Proboscidea (11.7)	1236/59

	Game taxa (small/large)	Anthropogenic modification of bone remains	Non-anthropogenic modification of bone remains	Seasonality	Hearths (yes/no)	Sources
Quebrada	3/7	Cut marks (1.9%), percussion marks (1.6%)	0	Spring-autumn	Y ($n = 29$)	Eixea (2015); present work
	2/10	Cut marks (1%), percussion marks (2.5%)	Tooth marks and digestions (1.6)	–	Y ($n = 18$)	Eixea (2015); present work
El Salt	3/9	Cut marks (8.9%) and percussion marks (2.3%)*	Tooth marks and digestions (1.4)*	Spring-summer	Y ($n = 46$)	Galván et al. (2014a, b), Machado and Pérez (2016), Pérez et al. (2015, 2017)

Table 6 (continued)

	Game taxa (small/large)	Anthropogenic modification of bone remains	Non-anthropogenic modification of bone remains	Seasonality	Hearths (yes/no)	Sources
Pastor	3/7	Cut marks (1.9%) and percussion marks (2.02%)	Tooth marks and digestions (1.44)	?	Y ($n = 6$)	Machado et al. (2013), Pérez et al. (2017), Sanchis et al. (2015)
Cova Negra	2/8	0.2	6.4	Summer	N	Eixea (2015), Martínez Valle (1996), Villaverde et al. (2009)
	3/12	12.2	8.4	?	Y (n=/)	
	2/8	Cut marks and tooth marks (2.8)	Digested bones, carnivore marks (6.0)	Summer-spring	Y (n=/)	
Bolomor	6/12	cut marks (7.18%), percussion scars, tooth marks	tooth marks, digestions (0.56)	?	Y ($n = 3$)	Blasco et al. (2013), Fernández Peris (2007), Cuartero (2007)
Beneito	3/10	Cut marks (1.4%)	Tooth marks (1.8)	?	Y ($n = 1$)	Iturbe (1991), Martínez Valle (1996)
					N	
					N	
					Y (n = 1)	
Romaní					Y ($n = 10$)	Vaquero (1999)
	–	Cut marks, bone breakage	1.5		Y ($n = 23$)	Vallverdú et al. (2005)
	0/10	Cut marks (< 4%), percussion marks	Tooth marks (0.9, 0.2)	Spring, autumn	Y ($n = 60$)	Marín et al. (2017), Rosell et al. (2012b), Vaquero et al. (2012a, b)
					Y ($n = 36$)	
					Y ($n = 24$)	
	0/4	Cut marks (4.7%), percussion marks	Tooth marks (2.8)	Summer	Y (n=/)	Chacón and Fernández-Laso (2007), Marín et al. (2017)
	0/3	Cut marks (6.7%), percussion marks (3.4%)	Tooth marks (0.8)	Spring	Y ($n = 23$)	Marín et al. (2017), Vaquero (2008)
	1/4	Cut marks (6.7%), percussion marks (3.7%)	Tooth marks (0.3)	Autumn-early winter	Y ($n = 37$)	Chacón (2009), Marín et al. (2017)
	–	26%	–	–	Y ($n = 19$)	Vallverdú et al. (2010)

Table 6 (continued)

	Game taxa (small/ large)	Anthropogenic modification of bone remains	Non-anthropogenic modification of bone remains	Seasonality	Hearths (yes/no)	Sources
	3/7	Cut marks (4.9%), percussion marks	Digestions, tooth marks (36 restos)	–	Y ($n = 63$) Y (n=/) 75	Bargalló et al. (2016), Gabucio et al. (2012, 2014, 2017)
Y (n=/)						
Roca Dels Bous	–	–	–	–	Y ($n = 20$)	Mora et al. (2008, 2011–2012)
	–	–	–	–	Y ($n = 22$)	
Teixoneres	3/11	5.6 (IIa), 5.7 (IIb)	8.8 (IIa), 8.1 (IIb)	Winter-summer	N	Sánchez-Hernández et al. (2014), Talamo et al. (2016)
	3/8	Cut marks (1.6), percussion marks	Digestions, tooth marks (25.5)	Multi-season	N	Rosell et al. (2010, 2016), Sánchez-Hernández et al. (2014), Talamo et al. (2016)
	4/11	Cut marks (3.3), percussion marks	Digestions, tooth marks (6.8)	Multi-season		

occupations, group size, availability of prey, raw material exploitation, seasonal environmental variation and human demography. These factors converge to produce modes of site use that, based on the composition of the archaeological assemblages that have been analysed in our region (Gabucio et al. 2017; Machado and Pérez 2016; Machado et al. 2013; Rosell et al. 2012a), are often reduced to two types: residential occupations ('camp sites'), and hunting or passing-by stands. When assigning specific occupations to one of these types, the density of finds has been considered a relevant indicator. However, samples of a large size and featuring a high density of finds—of which there are numerous examples in Mediterranean Iberia, e.g. Abric Romaní, Teixoneres, Cova Beneito, Cova del Bolomor or El Salt (Blasco and Fernández-Peris 2012b; Gabucio et al. 2014; Iturbe et al. 1993; Machado and Pérez 2016; Rosell et al. 2010, 2012a, b)—can also be an artefact of the intensity of specific activities or of post-depositional modification, namely of recurrent use in the context of low sedimentation rates. When the degree of fragmentation is high, an additional problem is whether the cause lies in anthropogenic, natural (e.g. carnivore activity) or post-depositional processes.

If we focus on the bone assemblages, the differences between sites are drastic (Table 5). For example, level IV of Quebrada yielded 16,817 bone remains per m^3, compared to $< 100/m^3$ in all the Abric Romaní levels for which data have been published (e.g. levels H, I, K, M). Breakage patterns underpin this difference to a significant extent. In the case of Quebrada IV, the correlation between %ISu and bone density suggests that the primary cause for the fragmentation resides in the palimpsest formation processes rather than in the intensity of human activities.

As ought to be expected, differences in the percentage of identified bones correlate well with differences in their degree of fragmentation. Compared to Bolomor IV, Beneito X or XII, Pastor IVb and Cova Negra II, in which the percentage of identified remains ranges between 11 and 30%, the values are extremely low in Quebrada: 1.3% in level IV and 1–2% in level VIII. In some assemblages, identification reaches 40% (Pastor IVc, Abric Romaní L) to 60% (Abric Romaní K, Teixoneres IIIb), and even > 90% (Teixoneres IIa, IIb and IIIa). However, these higher values may reflect the non-anthropogenic, at least in part, nature of the accumulations, as is clearly the case at Teixoneres, where carnivores are a significant contributor of complete remains (Rosell et al. 2010).

The relative abundance of stone tools is a good indicator that a given archaeological deposit is largely anthropogenic. In this respect, level IV of Quebrada stands out among the other Middle Palaeolithic contexts of Valencia and Mediterranean Iberia as that featuring the highest density of lithic remains: excluding knapping debris, $388.5/m^3$. However, many of the Quebrada lithics are chippage, of which a large part may be thermal and hence a post-depositional alteration product secondarily generated by fire use rather than primarily generated by stone tool knapping. Bearing this in mind, we can exclude such elements from the comparisons, but doing so does not much change the picture; only Bolomor IV features comparable numbers (Table 5). Based on this indicator alone, one might conclude that Quebrada was a major residential site, but the associated evidence shows otherwise. Thus, even though reliable where it comes to assess the anthropogenic nature of a deposit, the number and density of stone tool finds is, in and of itself, insufficient and may be even misleading, where it comes to assess the type, duration and intensity of a site's human occupation.

The comparison with Abric Romaní is particularly striking and highlights the need to consider the general context and nature of the sites involved in find density comparisons. In cases such as Quebrada, the small size of the sheltered space implies repeated use of the same area through the different occupation events, thereby generating high find densities. The opposite is the case at the Abric Romaní, where the much larger space available for settlement makes for the spatial segregation of consecutive occupation events. Such differences in site topography are compounded by potential differences in the economy of the debitage (raw material procurement, degree of fragmentation of the operational chains, reduction of stone tools via edge rejuvenation, intensity of blank recycling) and in the mode of exploitation of the faunal resources (seasonality, targeted prey, body part selection, transport and consumption patterns). Correct interpretation of find density numbers requires adequate consideration of all these factors.

Site Function

Depending on available data, site function can be approached in terms of the permanency of the stays and of the nature of the activities, often expressed as a dichotomy between residential and non-residential camps (e.g. knapping sites, hunting or observation stands, procurement localities, travelling stops), or in terms of the duration of individual occupation events and the size of the group of occupants (Binford, 1980; Kelly, 1983, 2013). Here, under the assumption that group size is usually stable and features little variation (Bocquet-Appel and Degioanni 2013; Cucart-Mora et al. 2017; French 2016; Hassan 1979; Hockett and Haws 2005; Sørensen 2011; Zubrow 1989), we focus our discussion on length of occupation.

Such contexts as Abric Romaní (Gabucio et al. 2017; Rosell et al. 2012a), El Salt X (Machado and Pérez 2016; Pérez et al. 2015) and Bolomor IV (Sañudo and Fernández-Peris 2007) have been classified as structured residential places because of the presence of hearths and the spatial distribution of faunal and lithic remains (Table 6), mainly a by-product of domestic tasks such as stone tools knapping or the processing and consumption of prey. In addition, as has been shown at Abric Romani (Vallverdú et al. 2010), rest and waste-management areas also exist. In all these sites, the hearths are the focal points structuring the inhabited space and around which similar activities are carried out after consecutive occupation event. Mostly, such occupations have been defined as short and recurrent, but it has been proposed that level J of Abric Romaní reflects longer residency.

The patterns observed at Quebrada, Beneito, Pastor and Roca dels Bous are slightly different. The area excavated at Beneito (3 m^2; Table 5) is too small to assess spatial patterns, but we note the high density of finds reflecting the exploitation of a broad ecosystem (Iturbe 1991; Iturbe et al. 1993). This is consistent with what we see at the other three sites, in which occupation is seasonal, focused on basic subsistence activities such as the processing of the hunt and the production of stone tools, and organised around hearths (Eixea et al. 2011–2012; Machado et al. 2013)—even though, for Roca dels Bous (Mora et al. 2008, 2011–2012), the corroborating faunal evidence is still lacking. All of this, however, seems to take place, each time, around a single hearth, without the spatial segregation of specific activities seen at the Abric Romaní.

Cova Negra and Teixoneres form a third category of contexts, ones characterised by short duration and taking place between significant intervals of abandonment. Alternating with periods of exclusive carnivore use (evident in the number of carnivore remains and the percentage of bones bearing non-anthropogenic modifications; Table 6), the otherwise spatially restricted find scatters excavated at these sites probably reflect limited occupation by small-sized task groups (Talamo et al. 2016; Villaverde et al. 2009). This accords well with the significant fragmentation of the lithic operational chains, implying that stone tool knapping would have been carried out in exterior, non-excavated areas of the caves or elsewhere in the landscape.

Subsistence

In all sites, hunting is the dominant subsistence activity and focuses on medium-sized (Caprinae, Cervidae) and large (Bovinae, Equidae) prey (Table 6). Access to the carcasses is primary (even though, at Bolomor, carnivores were also partly involved in the accumulation of ibex; Sanchis and Fernández-Peris 2008), but body part transport patterns show some variation. Species such as red deer and ibex were transported complete to Quebrada or Abric Romaní. In other sites, transport is more selective, as observed at El Salt or, in the case of horse, Quebrada. Carcass processing is intensive, as shown at by the high fragmentation and extensive burning of the faunal remains.

As for small prey, leporids, birds or tortoises are also present, but the agent of accumulation is not always the same. None of the small prey assemblages is 100% anthropogenic, and only at Quebrada has no evidence of modification by other predators been positively identified. Here, however, the exploitation of small prey was not frequent (Salazar-García et al. 2013). Even though the NISP of tortoise is quite high and cut-marked tortoise plates have been found, the MNI of the taxon is small (Sanchis et al. 2013, 2015); besides, its presence in the assemblage cannot be unambiguously related to human activity, as is also the case with leporids.

At Cueva Antón (Sanchis 2012; Zilhão et al. 2016), El Salt (Machado and Pérez 2016), Bolomor (Blasco and Fernández-Peris 2012a, b; Sanchis 2012), Beneito (Martínez Valle 1996), Teixoneres (Rosell et al. 2010; Rufà et al. 2014) and Abric Romaní (Gabucio et al. 2017; Rosell et al. 2012b), modification of small animal remains by terrestrial carnivores and birds of prey, documenting primary access or the scavenging of human leftovers, is well established; in most cases, these non-anthropogenic accumulations are of leporids (e.g. at Cueva Antón, El Salt or Bolomor). However, in some Bolomor levels, there is clear evidence that leporids were, alongside tortoises, being consumed by humans (Blasco 2008; Blasco and Fernández-Peris 2012a; Sanchis 2012) and likewise at El Salt and Abric del Pastor (Pérez 2014; Sanchis et al. 2015). However, the contribution of small prey to diet was in general small and the observed inter-site variation may relate to the duration and intensity of the occupations (Sanchis 2012), as proposed for the Upper Palaeolithic (Aura et al. 2002; Fa et al. 2013; Hockett and Haws 2009; Stiner 2001; Rillardon and Brugal 2014; Villaverde et al. 1996).

Conclusion

By combining the evidence from the study of its stone tool and faunal assemblages, we have shown how the human groups responsible for the accumulation of the remains retrieved from level IV of Quebrada exploited the different resources offered by the environment in planned and flexible manner. These short-lived occupations display little investment in the structuration of the space, the pursuit of a limited number of prey taxa and a significant degree of fragmentation of the operational chains, with few refit links and a lot of tool re-sharpening and blank recycling. The large size of the assemblage relative to the area and volume of the excavation is misleading: it results from palimpsesting processes, not from the length of occupations or the intensity of activities. Comparison with other sites from the same area and period shows how this type of site occupancy is widespread, even though often masked under assemblage size and find density numbers that apparently suggest otherwise. As our results and discussion hopefully have shown, such indicators need to be assessed in the context of the associated evidence, namely that pertaining to seasonality, site function, mode of introduction and processing of prey carcasses, and economy of the debitage.

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References

Adler, D. S., Prindiville, T. J., & Conard, N. J. (2003). Patterns of spatial organization and land use during the Eemian Interglaciar in the Rhineland: new data from Wallertheim, Germany. *Eurasian Prehistoy, 1*(2), 25–78.

Aura, E., Fernández, J., & Fumanal, M. P. (1993). Medio físico y corredores naturales: notas sobre el poblamiento paleolítico del País valenciano. *Recerques del Museu d'Alcoi, 11*, 89–107.

Aura, E., Villaverde, V., Pérez Ripoll, M., Martínez-Valle, R., Guillem, P. M. (2002). Big game and small prey: Paleolithic and Epipaleolithic economy in the Spanish Mediterranean façade. *Journal of Archaeological Metod and Theory*, Special Issue "Advances in Paleolithic Zooarchaeology", 1–57.

Azorit, C., Analla, M., Carrasco, R., Calvo, J. R., & Muñoz-Cobo, J. (2002). Teeth eruption pattern in red deer (*Cervus elaphus hispanicus*) in southern Spain. *Anales de Biologia, 24*, 107–114.

Badal, E., Villaverde, V., & Zilhão, J. (2012). Middle Paleolithic wood charcoal from three southern Iberian sites: biogeographic implications. Wood and charcoal. Evidence for human and natural history. *Saguntum Extra, 13*, 13–24.

Bailey, G. (2007). Time perspectives, palimpsests and the archaeology of time. *Journal of Anthropological Archaeology, 26*, 19–223.

Bargalló, A., Gabucio, M. J., & Rivals, F. (2016). Puzzling out a palimpsest: testing an interdisciplinary study in level O of Abric Romaní. *Quaternary International, 417*, 51–65.

Barton, C. M., & Riel-Salvatore, J. (2014). The formation of lithic assemblages. *Journal of Archaeological Science, 46*, 334–352.

Binford, L. R. (1978). *Nunamiut ethnoarchaeology*. New York (NY): Academic.

Binford, L. R. (1980). Willow smoke and dogs' tails: hunter-gatherer settlement systems and archaeological site formation. *American Antiquity, 45*, 4–20.

Binford, L. R. (1981). *Bones: ancient men and modern myths*. New York: Academic.

Blasco, R. (2008). Human consumption of tortoises at level IV of Bolomor Cave (Valencia, Spain). *Journal of Archaeological Science, 35*, 2839–2848.

Blasco, R. (2011). La amplitud de la dieta cárnica en el Pleistoceno medio peninsular: una aproximación a partir de la Cova del Bolomor (Tavernes de la Valldigna, Valencia) y del subnivel TD10–1 de Gran Dolina (Sierra de Atapuerca, Burgos). PhD (unpublished). Universitat Rovira i Virgili, Tarragona.

Blasco, R., & Fernández-Peris, J. (2012a). Small and large game: human use of diverse faunal resources at level IV of Bolomor Cave (Valencia, Spain). *C. R. Palevol, 11*, 265–282.

Blasco, R., & Fernández-Peris, J. (2012b). A uniquely broad spectrum diet during the Middle Pleistocene at Bolomor Cave (Valencia, Spain). *Quaternary International, 252*, 16–31.

Blasco, R., Rosell, R., Fernández-Peris, J., Arsuaga, J. L., Bermúdez de Castro, J. M., & Carbonell, E. (2013). Environmental availability, behavioural diversity and diet: a zooarchaeological approach from the TD10-1 sublevel of Gran Dolina (Sierra de Atapuerca, Burgos, Spain) and Bolomor Cave (Valencia, Spain). *Quaternary Science Reviews, 70*, 124–144.

Boëda, É., Geneste, J.-M., & Meignen, L. (1990). Identification de chaînes opératoires lithiques du Paléolithique ancien et moyen. *Paléo, 2*, 43–80.

Bocquet-Appel, J.-P., & Degioanni, A. (2013). Neanderthal demographic estimates. *Current Anthropology, 54*, S202–S213.

Bordes, F. (1988). *Typologie du Paléolithique Ancien et Moyen*. Paris: CNRS.

Bourguignon, L., Faivre, J.-P., & Turq, A. (2004). Ramification des chaînes opératoires: une spécificité du moustérien. *Paléo, 16*, 37–48.

Brain, C. K. (1981). *The hunters or the hunted? An introduction to African cave taphonomy*. Chicago: Chicago Press.

Brochier, J. E. (1999). Couche archéologique, sol archéologique et distributions spatiales: quelques réflexions (géo) archéologiques sur un vieux problème. In V. M. Roselló (Ed.), *Geoarqueologia I Quaternari Litoral: Memorial Maria Pilar Fumanal* (pp. 91–95). Valencia: Universitat de Valencia.

Bromage, T. G., & Boyde, A. (1984). Microscopic criteria for the determination of directionality cut-marks on bone. *American Journal of Physical Anthropology, 65*, 359–366.

Burke, A. (2006). Neanderthal settlement patterns in Crimea: a landscape approach. *Journal of Anthropological Archaeology, 25*, 510–523.

Canals, A. (1993). Méthode et téchniques archéostratigraphiques pour l'étude des gisements archéologiques en sédiment homogène: application au complexe CIII de la Grotte de Lazaret, Nice (Alpes Maritimes). Ph.D. dissertation.

Canals, A., Vallverdú, J., & Carbonell, E. (2003). New archaeo-stratigraphic data for the TD6 level in relation to Homo Antecessor (lower Pleistocene) at the site of Atapuerca, North-central Spain. *Geoarchaeology, 18*, 481–504.

Carr, C. (1987). Method and theory for activity area research. An ethnoarchaeological approach. In I. S. Kent (Ed.), *Dissecting intrasite artifact palimpsests using Fourier methods* (pp. 236–291). New York: Columbia University Press.

Castro-Curel, Z., & Carbonell, E. (1995). Wood pseudomorphs from level I at Abric Romaní, Barcelona, Spain. *Journal of Field Archaeology, 22*, 376–384.

Chabal, L. (1988). Pourquoi et comment prélever les charbons de bois pour la période antique: les méthodes utilisées sur le site de Lattes (Hérault). *Lattara, 1*, 187–222.

Chacón, M. G. (2009). El Paleolítico medio en el suroeste europeo: Abric Romaní (Capellades, Barcelona, España), Payre (Rompón, Ardèche, Francia) y Tournal (Bize, Aude, Francia). Análisis comparativo de los conjuntos líticos y los comportamientos humanos. PhD dissertation. Universitat Rovira i Virgili, Tarragona. Muséum National d'Histoire Naturelle de Paris, Paris.

Chacón, M. G., & Fernández-Laso, M. C. (2007). Modelos de ocupación durante el Paleolítico Medio: el nivel K del Abric Romaní (Capellades, Barcelona, España). *Complutum, 18*, 47–60.

Clark, G. A., & Barton, C. M. (2017). Lithics, landscapes & la Longue-dureé—curation & expediency as expressions of forager mobility. *Quaternary International, 450*, 137–149.

Conard, N. J. (2001). *Settlement dynamics of the Middle Paleolithic and Middle Stone Age I*. Tübingen: Kerns Verlag.

Conard, N. J. (2004). *Settlement dynamics of the Middle Paleolithic and Middle Stone Age II*. Tübingen: Kerns Verlag.

Conard, N. J., & Adler, D. S. (1997). Lithic reduction and hominid behavior in the Middle Palaeolithic of the Rhineland. *Journal of Anthropological Research, 53*, 147–176.

Courty, M. A., Carbonell, E., Vallverdú-Poch, J., & Banerjee, R. (2012). Microstratigraphic and multi-analytical evidence for advanced Neanderthal pyrotechnology at Abric Romani (Capellades, Spain). *Quaternary International, 247*, 294–312.

Cuartero, F. (2007). Tecnología lítica en Cova del Bolomor nivel IV. ¿Una economía de reciclado? *Saguntum, 39*, 27–44.

Cucart-Mora, C., Lozano, S., & Fernández-López de Pablo, J. (2017). Bio-cultural interactions and demography during the Middle to Upper Palaeolithic transition in Iberia: an agent-based modelling approach. *Journal of Archaeological Science, 89*, 14–24.

Cziesla, E. (1990). On refitting of stone artifacts. In E. Cziesla, S. Eickhoff, N. Arts, D. Winter (Eds.), The big puzzle. International symposium on refitting stone artefacts (pp. 9-44). Studies in Modern Archaeology 1, Holos, Bonn.

Cziesla, E., Eickhoff, S., Arts, N., Winter, D. (1990*).* The big puzzle. International Symposium on Reffiting Stone Artefacts. Studies in Modem Archaeology, 1. Bonn.

Daujeard, C., Fernandes, P., Guadelli, J. L., Moncel, M. H., Santagata, C., & Raynal, J. P. (2012). Neanderthal subsistence strategies in southeastern France between the plains of the Rhone Valley and the mid-mountains of the Massif Central (MIS 7 to MIS 3). *Quaternary International, 252*, 32–47.

Delagnes, A., & Rendu, W. (2011). Shifts in Neandertal mobility, technology and subsistence strategies in western France. *Journal of Archaeological Science, 38*, 1771–1783.

d'Errico, F., Zilháo, J., Baffier, D., Julien, M., & Pelegrin, J. (1998). Neandertal acculturation in western Europe? A critical review of the evidence and its interpretation. *Current Anthropology, 39*, S1–S44.

de la Torre, I., Martinez-Moreno, J., & Mora, R. (2012). When bones are not enough: lithic refits and occupation dynamics in the Middle Palaeolithic level 10 of Roca dels Bous (Catalonia, Spain). In K. Seetah & B. Gravina (Eds.), *Bones for tools—tools for bones: the interplay between objects and objectives* (pp. 13–23). Cambridge: McDonald Institute for Archaeological Research.

Eixea, A. (2015). Caracterización tecnológica y uso del espacio en los yacimientos del Paleolítico medio de la región central del Mediterráneo Ibérico. Universitat de Valèencia. Ph.D. dissertation.

Eixea, A., Villaverde, V., & Zilhão, J. (2011). Aproximación al aprovisionamiento de materias primas líticas en el yacimiento del Paleolítico medio del Abrigo de la Quebrada (Chelva, Valencia). *Trabajos de Prehistoria, 68*, 65–78.

Eixea, A., Villaverde, V., Zilhão, J., Sanchis, A., Morales, J. V., Real, C., & Bergadà, M. (2011–2012). El nivel IV del Abrigo de la Quebrada (Chelva, Valencia). Análisis microespacial y valoración del uso del espacio en los yacimientos del Paleolítico medio valenciano. *Mainake, XXXIII*, 127–158.

Eixea, A., Villaverde, V., Zilhão, J., Bergadà, M., Sanchis, A., Morales, J. V., Real, C., & Martínez, J. A. (2012). Variation in the use of space through time at Abrigo de la Quebrada (Chelva, Valencia). The case of Middle Paleolithic levels IV and VII. In A. García, J. García, A. Maximiano, & J. Rios (Eds.), *Debating spatial archaeology: international workshop on landscape and spatial analysis in archaeology* (pp. 153–166) **Santander**.

Eixea, A., Villaverde, V., Roldán, C., & Zilhão, J. (2014). Middle Palaeolithic Flint procurement in central Mediterranean Iberia: implications for human mobility. *Journal of Lithic Studies, 1*(1), 103–115.

Eixea, A., Giner, B., Jardón, P., Zilhão, J., Villaverde, V. (2015). Elementos líticos apuntados en el yacimiento del Paleolítico medio del Abrigo de la Quebrada (Chelva, Valencia): caracterización tecno-tipológica y análisis de las macrofracturas. Espacio, Tiempo y Forma. Serie I, Prehistoria y Arqueología*,* 8, 78–109.

Eixea, A., Villaverde, V., & Zilhão, J. (2016). Not only flint: Levallois on quartzite and limestone at Abrigo de la Quebrada (Valencia, Spain): Implications for neandertal behavior. *Journal of Anthropological Research 72*(1), 24–57.

Esteban, I., Albert, R. M., Eixea, E., Zilhão, J., & Villaverde, V. (2015). Neanderthal use of plants and past vegetation reconstruction at the Middle Paleolithic site of Abrigo de la Quebrada (Chelva, Valencia, Spain). *Archaeological and Anthropological Sciences*. https://doi.org/10.1007/s12520-015-0279-7.

Fa, J. E., Stewart, J. R., Lloveras, L., & Vargas, J. M. (2013). Rabbits and hominin survival in Iberia. *Journal of Human Evolution, 64*(4), 233–241.

Faivre, J.-P. (2011). *Organisation techno-economique des systèmes de production dans le Paleolithique moyen récent du nord-est aquitain*. Oxford: BAR.

Fernández-Laso, M. C., Rivals, F., & Rosell, J. (2010). Intra-site changes in seasonality and their consequences on the faunal assemblages from Abric Romaní (Middle Palaeolithic, Spain). *Quaternaire, 21*, 155–163.

Fernández Peris, J. (2007). La Cova del Bolomor (Tavernes de la Valldigna, Valencia). Las industrias líticas del Pleistoceno medio en el ámbito del Mediterráneo peninsular. *Trabajos Varios del SIP* 108, Valencia.

French, J. C. (2016). Demography and the palaeolithic archaeological record. *Journal of Archaeological Method & Theory, 23*, 150–199.

Gabucio M. J., Cáceres I., Ardèvol J. R. (2012). Evaluating post-depositional processes in level O of the Abric Romaní archaeological site. N Jb Geol Pal.ont (Abh), 265(2), 147–163.
Gabucio, M. J., Cáceres, I., Rosell, J., Saladié, P., & Vallverdú, J. (2014). From small bone fragments to Neanderthal activity areas: the case of level O of the Abric Romaní (Capellades, Barcelona, Spain). *Quaternary International, 330*, 36–51.
Gabucio, J., Fernández-Laso, M. C., & Rosell, J. (2017). Turning a rock shelter into a home. Neanderthal use of space in Abric Romaní levels M and O. *Historial Biology.* https://doi.org/10.1080/08912963.2017.1340470.
Galván, B., Hernández, C. M., Mallol, C., Machado, J., Sistiaga, A., Molina, F. J., Pérez, L., et al. (2014a). El Salt. The Last Neanderthals of the Alicante Mountains (Alcoy, Spain). In R. Sala (Ed.), Pleistocene and Holocene hunter-gatherers in Iberia and the Gibraltar Strait: the current archaeological record. University of Burgos and Atapuerca Foundation, Burgos (pp. 380–388).
Galván, B., Hernández, C. M., Mallol, C., Mercier, N., Sistiaga, A., & Soler, V. (2014b). New evidence of early Neanderthal disappearance in the Iberian Peninsula. *Journal of Human Evolution, 75*, 16–27.
Gamble, C. (1998). Palaeolithic society and the release from proximity: a network approach to intimate relations (human social evolution). *World Archaeology, 29*, 426–449.
Geneste J.-M. (1985). Analyse lithique d'industries moustériennes du Périgord: une approche technologique du comportement des groupes humains au Paléolithique moyen. PhD. Université de Bordeaux.
Geneste J.-M. (1988). Les industries de la grotte Vaufrey: technologie du débitage, économie et circulation de la matière première lithique. In J.-Ph. Rigaud (Dir.), *La grottre Vaufrey; Paléoenvironnement, Chronologie, activités humaines* (pp. 441–517). Mémoire de la société préhistorique française.
Goldberg, P., & Macphail, R. I. (2006). *Practical and theoretical geoarchaeology.* Oxford: Blackwell.
Guerin, G., Mercier, N., & Adamiec, G. (2011). Dose-rate conversion factors: update. *Ancient TL, 29*, 5–8.
Hassan, F. (1979). Demography and archaeology. *Annual Review of Anthropology, 8*, 137–160.
Henry, D. O. (2012). The palimpsest problem, hearth pattern analysis, and middle paleolithic site structure. *Quaternary International, 247*, 246–266.
Hillson, S. (1986). *Teeth*. Cambridge University Press.
Hillson, S. (1992). Mammal bones and teeth: an introductory guide to methods of identification. Londres, University of London.
Hockett, B., & Haws, J. A. (2005). Nutritional ecology and the human demography of Neanderthal extinction. *Quaternary International, 137*, 21–34.
Hockett, B. S., & Haws, J. A. (2009). Continuity in animal resource diversity in the Late Pleistocene human diet of Central Portugal. *Before Farming*, (2).
Huntley, D., & Baril, M. (1997). The K content of the K-feldspars being measured in optical dating or in thermoluminescence dating. *Ancient TL, 15*, 11–13.
Iturbe, G. (1991). Cova Beneito (Muro del Comtat-Alicante) y su aportación al conocimiento del Paleolítico Medio y Superior del Levante español. Unpublished PhD. Dissertation, Universidad de Zaragoza, Zaragoza.
Iturbe, G., Fumanal, M. P., Carrión, J. S., Cortell, E., Martínez, R., Guillem, P. M., Garralda, M. D., & Vandermeersch, B. (1993). Cova Beneito (Muro, Alicante): Una perspectiva interdisciplinar. *Recerques del Museu D'Alcoi, 2*, 23–88.
Kelly, R. L. (1983). Hunter-gatherer mobility strategies. *Journal of Anthropological Research, 39*, 277–306.
Kelly, R. L. (2013). *The lifeways of hunter-gatherers: the foraging spectrum*. Cambridge.
Klasen, N., Kehl, M., Mikdad, A., Brückner, H., & Weniger, G. C. (2018). Chronology and formation processes of the Middle to Upper Palaeolithic deposits of Ifri n' Ammar using multi-method luminescence dating and micromorphology. *Quaternary International, 485*, 89–102.
Kintigh, K., & Ammerman, A. (1982). Heuristic approaches to spatial analysis in archaeology. *American Antiquity, 47*(1), 31–63.
Kvamme, K. L. (1997). Patterns and models of debitage dispersal in percussion flaking. *Lithic Technology, 22*, 122–138.
Lyman, R. L. (1985). Bone frequencies: differential survivorship of fossil classes. *Journal of Archaeological Science, 12*, 221–236.
Lyman, R. L. (1994). *Vertebrate taphonomy. Cambridge manuals in archaeology.* Cambridge: Cambridge University Press.
Lyman, R. L. (2008). *Quantitative paleozoology.* Cambridge University Press.
Machado, J., Hernández, C. M., Mallol, C., & Galván, B. (2013). Lithic production, site formation and Middle Palaeolithic palimpsest analysis: in search of human occupation episodes at Abric del Pastor stratigraphic unit IV (Alicante, Spain). *Journal of Archaeological Science, 20*, 2254–2273.
Machado, J., & Pérez, L. (2016). Temporal frameworks to approach human behavior concealed in Middle Palaeolithic palimpsests: a high-resolution example from El Salt stratigraphic unit X (Alicante, Spain). *Quaternary International, 417*, 66–81.

Mallol, C., Hernández, C. M., Cabanes, D., Sistiaga, A., Machado, J., Rodríguez, Á., Pérez, L., & Galván, B. (2013). The black layer of Middle Palaeolithic combustion structures. Interpretation and archaeostratigraphic implications. *Journal of Archaeological Science, 20*, 2515–2537.

Mallol, C., Cabanes, D., & Baena, J. (2010). Microstratigraphy and diagenesis at the upper pleistocene site of Esquilleu cave (Cantabria, Spain). *Quaternary International, 214*, 70–81.

Mariezkurrena, K. (1983). Contribución al conocimiento del desarrollo de la dentición y el esqueleto post-craneal de *Cervus elaphu*s. *Munibe, 35*, 149–202.

Marín, J., Saladié, P., Rodríguez-Hidalgo, A., & Carbonell, E. (2017). Ungulate carcass transport strategies at the Middle Palaeolithic site of Abric Romaní (Capellades, Spain). *Comptes Rendus Palevol, 16*(1), 103–121.

Martínez-Moreno, J., Mora, R., & de la Torre, I. (2010). Technical variability and changes in the pattern of settlement at Roca dels Bous (Southeastern Prepyrenees, Spain). In N. J. Conard & A. Delagnes (Eds.), *Settlement dynamics of Middle Paleolithic and Middle Stone Age (Vol. III, pp. 485–507)* Tübingen.

Martínez Valle, R. (1996). Fauna del Pleistoceno superior en el País Valenciano: aspectos económicos, huella de manipulación y valoración paleoambiental. PhD dissertation. Universitat de València.

Martínez Valle, R. (2009). Restos óseos de macromamíferos y aves. In V. Villaverde, J. Pérez Ballester, A.C. Ledo (Eds.), *Historia de Xátiva, Prehistoria, Arqueología y Antigüedad, II. Los primeros pobladores de la Costera: los Neandertales de la Cova Negra de Xátiva*. Excm. Ajuntament de Xátiva, vol. I.

Mejdahl, V. (1987). Internal radioactivity in quartz and feldspar grains. *Ancient TL, 5*, 10–17.

Mellars, P. (1996). *The Neandertal legacy.* Princeton: Princeton University Press.

Moncel, M. H. (2003). *L'exploitation de l'espace et la mobilité des groupes humains au travers des assemblages lithiques à la fin du Pléistocène moyen et au début du Pléistocène supérieur. La moyenne vallée du Rhône entre Drôme et Ardèche*. British Archaeological Reports International Series, S1184.

Mora, R., Martínez-Moreno, J., & Casanova, J. (2008). Abordando la noción de "variabilidad musteriense" en Roca dels Bous (Prepirineo suroriental, Lleida). *Trabajos de Prehistoria, 65*, 13–28.

Mora, R., Martínez Moreno, J., Benito, A., Roy, M., Roda, X., Casanova, J., & de la Torre, I. (2011–2012). Roca dels Bous y Cova Gran: historias en torno a dos abrigos musterienses del prepirineo de Lleida. *Mainake, XXXIII*, 101–126.

Newcomer, M. H., & Sieveking, G. G. (1980). Experimental flake scatter-patterns: a new interpretative technique. *Journal of Field Archaeology, 7*, 345–352.

Nicholson, R. A. (1993). A morphological investigation of burnt animal bone and an evaluation of its utility in archaeology. *Journal of Archaeological Science, 20*, 411–428.

Noe-Nygaard, N. (1989). Man-made trace fossils on bones. *Journal of Human Evolution, 4*(6), 461–491.

Murray, A. S., & Wintle, A. G. (2000). Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol. *Radiation Measurements, 32*, 57–73.

Murray, A. S., & Wintle, A. G. (2003). The single aliquot regenerative dose protocol: potential for improvements in reliability. *Radiation Measurements, 37*, 377–381.

O'Connell, J. F. (1987). Alyawara site structure and its archaeological implications. *American Antiquity, 52*, 74–108.

O'Connell, J. F., Hawkes, K., & Blurton Jones, N. G. (1992). Patterns in the distribution, site structure and assemblage composition of Hadza killbutchering sites. *Journal of Archaeological Science, 19*, 319–345.

Pérez, L. J. (2014). La gestión de los recursos animales en los Valles de Alcoy durante el Pleistoceno Superior (MIS 3). Estudio zooarqueológico y tafonómico. Phd (unpublished). Universitat Rovira I Virgili.

Pérez, L. J., Machado, J., Hernández, C. M., Morales J. V., Brugal, J. Ph., Galván, B. (2015). Arqueozoologia y arqueoestratigrafía del yacimiento de El Salt (Alcoi, Alicante): contribución metodológica para el análisis del registro faunístico contenido en palimpsestos arqueológicos del Paleolítico medio. In A. Sanchis and J. L. Pascual-Benito (Eds.), *Preses petites i grups humans en el passat. II Jornades d'Arqueozologia* (pp. 223–244). Museu de Prehistòria de Valencia.

Pérez, L., Sanchis, A., Hernández, C. M., Galván, B. (2017). Paleoecología de macromamíferos aplicada a los conjuntos zooarqueológicos de El Salt y el Abric del Pastor (Alcoy, Alicante). In A. Sanchis, J. L. Pascual (Eds.), Interaccions entre felins i humans (pp. 327–354). III Jornades d'Arqueozologia, Valencia.

Pérez Ripoll, M. (1988). Estudio de la secuencia de desgaste de los molares de la Capra Pyrenaica de yacimientos prehistóricos. *Archivo de Prehistoria Levantina, 17*, 83–127.

Potts, R., & Shipman, P. (1981). Cut-marks made by stone tools on bones from Olduvai Gorge, Tanzania. *Nature, 291*, 577–580.

Prescott, J. R., & Hutton, J. T. (1994). Cosmic ray contributions to dose rates for luminescence and ESR dating: large depths and long-term time variations. *Radiation Measurements, 23*, 497–500.

Prudêncio, M. I., Roldán, C., Dias, M. I., Marques, R., Eixea, A., & Villaverde, V. (2016). A micro-invasive approach using INAA for new insights into Palaeolithic flint archaeological artefacts. *Journal of Radioanalytical and Nuclear Chemistry, 308*, 195–203.

Rillardon, M., & Brugal, J. (2014). What about the broad spectrum revolution? Subsistence strategy of hunter–gatherers in Southeast France between 20 and 8 ka BP. *Quaternary International, 337*(0), 129–153.

Rios, J., Eixea, A., & Villaverde, V. (2014). Ramification of lithic production and the search of small tools in Iberian Peninsula Middle Paleolithic. *Quaternary International, 361*, 188–199.

Rivals, F., & Deniaux, B. (2005). Investigation of human hunting seasonality through dental microwear analysis of two Caprinae in late Pleistocene localities in Southern France. *Journal of Archaeological Science, 32*, 1603–1612.

Roebroeks, W. (1988). *From find scatters to early hominid behaviour. A study of Middle Palaeolithic riverside settlements at Maastricht-Belvedere (The Netherlands)*. Leiden: Leiden University Press.

Roldán, C., Carballo, J., Murcia, S., Eixea, A., Zilhão, J., & Villaverde, V. (2015). Identification of local and allochthonous Flint artefacts from the Middle Palaeolithical site 'Abrigo de la Quebrada' (Chelva, Valencia, Spain) by macroscopic and physicochemical methods. *X-Ray Spectrometry*. https://doi.org/10.1002/xrs.2602.

Rolland, N. (1990). Middle Palaeolithic socio-economic formations in western Eurasia: an explanatory survey. In P. A. Mellars (Ed.), *The emergence of modern humans: an archaeological perspective* (pp. 347–388). Edinburgh: University Press.

Rosell, J., Blasco, R., Rivals, F., Chacon, M. G., Menéndez, L., Morales, J. I., et al. (2010). A stop along the way: the role of Neanderthal groups at level III of Teixoneres Cave (Moià, Barcelona, Spain). *Quaternaire, 21*(2), 139–154.

Rosell, J., Blasco, R., Fernández-Laso, M. C., Vaquero, M., & Carbonell, E. (2012b). Connecting areas: faunal refits as a diagnostic element to identify synchronicity in the Abric Romaní archaeological assemblages. *Quaternary International, 252*, 56–67.

Rosell, J., Cáceres, I., Blasco, R., Bennàsar, M., Bravo, P., Campeny, G., et al. (2012a). A zooarchaeological contribution to establish occupational patterns at level J of Abric Romaní (Barcelona, Spain). *Quaternary International, 247*, 69–84.

Rufà, A., Blasco, R., Rivals, F., & Rosell, J. (2014). Leporids as a potential resource for predators (hominins, mammalian carnivores, raptors): an example of mixed contribution from level III of Teixoneres Cave (MIS 3, Barcelona, Spain). *Comptes Rendus Palevol, 13*, 665–680.

Salazar-García, D. C., Power, R., Sanchis, A., Villaverde, V., Walker, M. J., & Henry, A. (2013). Neanderthal diets in central and southeastern Mediterranean Iberia. *Quaternary International, 318*, 3–18.

Sánchez-Hernández, C., Rivals, F., Blasco, R., & Rosell, J. (2014). Short, but repeated Neanderthal visits to Teixoneres Cave (MIS 3, Barcelona, Spain): a combined analysis of tooth microwear patterns and seasonality. *Journal of Archaeological Science, 49*, 317–325.

Sanchis, A. (2012). Los lagomorfos del Paleolítico medio en la vertiente mediterránea ibérica. Humanos y otros predadores como agentes de aporte y alteración de los restos óseos en yacimientos arqueológicos. *Serie de Trabajos Varios del SIP,* 115. Valencia.

Sanchis, A., Morales, J. V., Real, C., Eixea, A., Zilhão, J., Villaverde, V. (2013). Los conjuntos faunísticos del Paleolítico medio del Abrigo de la Quebrada (Chelva, Valencia): problemática de estudio, metodología aplica da y síntesis de los primeros resultados. In A. Sanchis and J. Ll Pascual (Eds), *Animals i arqueologia hui. I Jornades d'arqueozoologia* (pp. 65–82). Museu de Prehistòria de València.

Sanchis, A., Morales, J. V., Pérez, L., Hernández, C., Galván, B. (2015). La tortuga mediterránea en yacimientos valencianos del Paleolítico medio: distribución, origen de las acumulaciones y nuevos datos procedentes del Abric del Pastor (Alcoi, Alacant). In A. Sanchis and J.L. Pascual (Eds.), *Preses petites i grups humans en el passat. II Jornades d'Arqueozoologia* (pp. 97–120). Museu de Prehistòria de València.

Sanchis, A., & Fernández-Peris, J. (2008). Procesado y consumo antrópico de conejo en la Cova del Bolomor (Tavernes de la Valldigna, Valencia). El nivel XVII c (ca 350 ka). *Complutum, 19*(1), 25–46.

Sañudo, P., & Fernández-Peris, J. (2007). Análisis espacial del nivel IV de la Cova del Bolomor (La Valldigna, Valencia). *Saguntum, 39*, 9–25.

Serrano, E., Gállego, L., & Pérez, J. M. (2004). Ossification of the appendicular skeleton in the Spanish ibex *Capra pyrenaica* Schinz, 1833 (Artiodactyla: Bovidae), with regard to determination of age. *Anatomía, Histología, Embriología, 33*, 33–37.

Shipman, P., & Rose, J. (1983). Early hominid hunting, butchering and carcassprocessing behaviors: approches to the fossil record. *Journal of Anthropological Archaeology, 2*, 57–98.

Silver, I. (1980). La determinación de la edad de los animales domésticos. In D. Brotwell & E. Higgs (Eds.), *Ciencia en Arqueología* (pp. 289–308). Madrid: Fondo de Cultura Económica.

Simek, J. (1987). Spatial order and behavioural change in the French Palaeolithic. *Antiquity, 61*.

Solé, A., Allué, E., & Carbonell, E. (2013). Heart-related wood remains from Abric Romaní layer M (Capellades, Spain). *Journal of Anthropological Research, 69*, 535–559.

Sørensen, B. (2011). Demography and the extinction of European Neanderthals. *Journal of Anthropological Archaeology, 30*, 17–29.
Stiner, M. C., Kuhn, S. L., Weiner, S., & Bar-Yosef, O. (1995). Differential burning, recrystallization, and fragmentation of archaeological bone. *Journal of Archaeological Science, 22*, 223–237.
Stiner, M. C. (2001). Thirty years on the "broad spectrum revolution" and Palaeolithic demography. *Proceedings of the National Academy of Sciences*, (13), 6993–6996.
Stapert, D. (1990). Middle Palaeolithic dwellings: fact or fiction? Some applications of the ring and sector method. *Palaeohistoria, 32*, 1–19.
Talamo, S., Blasco, R., Rivals, F., Picin, A., Chacón, M. G., Iriarte, E., Manuel-García, J., et al. (2016). The radiocarbon approach to Neanderthals in a carnivore den site: a well-defined chronology for Teixoneres cave (Moià, Barcelona, Spain). *Radiocarbon, 58*, 247–265. https://doi.org/10.1017/RDC.2015.19.
Théry-Parisot, I., Brugal, J. P., Costamagno, S., & Guilbert, R. (2004). Conséquences taphonomiques de l'utilisation des ossements comme combustible. *Approche expérimentale, Les nouvelles de l'Archéologie, 95*, 19–22.
Thiébault, S. (1995). Functioning of hearths and ancient vegetation at the Balme de Thuy (Haute-Savoie, France). The charcoal contribution. *Quaternaria Nova, 5*, 129–170.
Thiel, C., Buylaert, J.-P., Murray, A., Terhorst, B., Hofer, I., Tsukamoto, S., & Frechen, M. (2011). Luminescence dating of the Stratzing loess profile (Austria)—testing the potential of an elevated temperature post-IR IRSL protocol. *Quaternary International, 234*, 23–31.
Thomsen, K. J., Murray, A. S., Jain, M., & Bøtter-Jensen, L. (2008). Laboratory fading rates of various luminescence signals from feldspar-rich sediment extracts. *Radiation Measurements, 43*, 1474–1486.
Tixier, J., Inizan, M.-L., & Roche, H. (1980). *Préhistoire de la pierre taillée: terminologie et technologie*. Paris: Cercle de Recherches et d'Études Préhistoriques.
Tormo, C., & Guillem-Calatayud, P. M. (2015). Los micromamíferos del yacimiento del Paleolítico medio del Abrigo de la Quebrada (Chelva, Valencia): niveles I-VIII. In A. Sachis and J. Ll. Pascual (Eds.), *Preses petites i grups humans en el passat. II Jornades d'Arqueozoologia*, (pp. 181–208). Museu de Prehistòria de València.
Turq, A. (2000). Paléolithique inférieur et moyen entre Dordogne et Lot. *Paléo*, suppl no. 2. Les Eyzies.
Turq, A., Faivre, J.-P., Gravina, B., & Bourguignon, L. (2017). Building models of Neandertal territories from raw material transports in the Aquitaine Basin (southwestern France) 2016. *Quaternary International, 433*(Part B), 88–102.
Vallverdú, J., Allué, E., Bischoff, J. L., Cáceres, I., Carbonell, E., Cebrià, A., et al. (2005). Short occupations in the Middle Palaeolithic level I of the Abric Romaní rock-shelter (Capellades, Barcelona, Spain). *Journal of Human Evolution, 48*, 157–174.
Vallverdú, J., Vaquero, M., Cáceres, I., Allué, E., Rosell, J., Saladié, P., et al. (2010). Sleeping activity area within the site structure of archaic human groups. Evidence from Abric Romaní level N combustion activity areas. *Current Anthropology, 51*, 137–145.
Vallverdú-Poch, J., & Courty, M. A. (2012). Microstratigraphic analysis of level J deposits: a dual paleoenvironmental-paleoethnographic contribution to Paleolithic archeology at the Abric Romaní. In E. Carbonell (Ed.), *High resolution archaeology and Neanderthal behavior: time and space in level J of Abric Romaní (Capellades, Spain)* (pp. 77–133). New York: Springer.
Vaquero, M. (1999). Intrasite spatial organisation of lithic production in the Middle Palaeolithic: the evidence of the Abric Romaní (Capellades, Spain). *Antiquity, 73*, 493–504.
Vaquero, M. (2008). The history of stones: behavioural inferences and temporal resolution of an archaeological assemblage from the Middle Palaeolithic. *Journal of Archaeological Science, 35*, 3178–3185.
Vaquero, M., & Pastó, I. (2001). The definition of spatial units in Middle Palaeolithic sites: the hearth-related assemblages. *Journal of Archaeological Science, 28*, 1209–1220.
Vaquero, M., Vallverdu, J., Rosell, J., Pasto, I., & Allué, E. (2001). Neandertal behavior at the middle Palaeolithic site of Abric Romani, Capellades, Spain. *Journal of Field Archaeology, 28*, 93.113.
Vaquero, M., Chacón, M. G., García-Antón, M. D., Gómez de Soler, B., Martínez, K., & Cuartero, F. (2012a). Time and space in the formation of lithic assemblages: the example of Abric Romaní level J. *Quaternary International, 247*, 162–181.
Vaquero, M., Chacón, M. G., Cuartero, F., García-Antón, M. D., Gómez de Soler, B., & Martínez, K. (2012b). In E. Carbonell (Ed.), *High resolution archaeology and Neanderthal behavior: time and space in level J of Abric Romaní (Capellades, Spain)* (pp. 189–311). New York: Springer.
Vaquero, M., Fernández-Laso, M., Chacón, M. G., Romagnoli, F., Rosell, J., & Sañudo, P. (2017). Moving things: comparing lithic and bone refits from a Middle Paleolithic site. *Journal of Anthropological Archaeology, 48*, 262–280.
Vidal-Matutano, P. (2016). Firewood and hearths: Middle Palaeolithic woody taxa distribution from El Salt, stratigraphic unit Xb (eastern Iberia). *Quaternary International*. https://doi.org/10.1016/j.quaint.2016.07.040.

Vidal-Matutano, P., Henry, A., & Théry-Parisot, I. (2017). Dead wood gathering among Neanderthal groups: charcoal evidence from Abric del Pastor and El Salt (eastern Iberia). *Journal of Archaeological Science, 80*, 109–121.
Villa, P. (1982). Conjoinable pieces and site formation processes. *American Antiquity, 42*, 276–290.
Villa, P., & Mahieu, E. (1991). Breakage patterns of human long bones. *Journal of Human Evolution, 21*, 27–48.
Villaverde, V., Eixea, A., Rios, J., Zilhão, J. (2012). Importancia y valoración de la producción microlevallois en los niveles II y III del Abrigo de la Quebrada (Chelva, Valencia). Zephyrus, LXX, 13–32.
Villaverde, V., Eixea, A., & Zilhão, J. (2008). Aproximación a la industria lítica del Abrigo de la Quebrada (Chelva, Valencia). *Treballs d'Arqueologia, 14*, 213–228.
Villaverde, V., Martínez Valle, R., Guillem Calatayud P. M., Fumanal, M. P. (1996). Mobility and the role of small game in the Paleolithic of the central region of the Spanish Mediterranean: a comparison of Cova Negra with other Palaeolithic deposits. In E. Carbonell, M. Vaquero (Eds), *The last Neandertals, the first anatomically modern humans: a tale about human diversity cultural change and human evolution: the crisis at 40 Ka BP* (pp. 267–288). Universitat Rovira I Virgili, Tarragona.
Villaverde, V., Martínez-Valle, R., Blasco, R. (2009). Análisis de la industria lítica y de la economía: aproximación al uso del espacio. In V. Villaverde, J. Pérez, A.C. Ledo (Coords). Xàtiva. Prehistoria, Arquelogía y Antigüedad, Universitat de València, 147–193.
Villaverde, V., Eixea, A., Zilhão, J., Sanchis, A., Real, C., & Bergadà, M. (2017). Diachronic variation in the Middle Paleolithic settlement of Abrigo de la Quebrada (Chelva, Spain). *Quaternary International, 435*, 164–179.
Whallon, R. (1984). Unconstrained clustering for the analysis of spatial distributions in archaeology. In H. J. Hietala (Ed.), *Intrasite spatial analysis in archaeology (pp. 242–277)*. Cambridge.
Yellen, J. E. (1977). Cultural patterning in faunal remains: evidence from the !Kung bushmen. In D. Ingersoll, J. E. Yellen, W. Macdonald (Eds.), Experimental archeology (pp. 271–331). New York (NY): Columbia University Press.
Zilhão, J., Ajas, A., Badal, E., Burrow, C., Kehl, M., López-Sáez, J. A., et al. (2016). Cueva Antón: a multi-proxy MIS 3 to MIS 5a paleoenvironmental record for SE Iberia. *Quaternary Science Reviews, 146*, 251–273.
Zubrow, E. (1989). The demographic modeling of Neanderthal extintion. In P. Mellars & C. Stringer (Eds.), *The human revolution: behavioral and biological perspectives on the origin of modern humans*. Edinburg: Edinburg University Press.

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