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A STOP ALONG THE WAY: THE ROLE OF NEANDERTHAL GROUPS AT LEVEL III OF TEIXONERES CAVE (MOIÀ, BARCELONA, SPAIN)

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ABSTRACT

Level III of Teixoneres Cave (Moià, Barcelona, Spain) has provided a significant record belonging to the first half of the Late Pleistocene. It corresponds to both human and carnivorous activities. This assemblage is analyzed through an interdisciplinary approach with the objective to discriminate the remains left by these actors and to evaluate the degree of interaction existing between them. The data indicate hunting activities by hominids as well as by carnivores and a minimal relationship or temporal contact between them inside the cave. This allows the characterization of the human occupations at level III in relation to the composition of the groups and their high mobility in the territory.

Keys-words: Teixoneres Cave, Late Pleistocene, hominids-carnivores, interaction, occupation patterns.

RÉSUMÉ

UNE HALTE SUR LE PARCOURS : LE RÔLE DES GROUPES NÉANDERTALIENS DU NIVEAU III DE LA GROTTE DES TEIXONERES (MOIA, BARCELONE, ESPAGNE)

Le niveau III de la grotte des Teixoneres (Moià, Barcelone, Espagne) a fournit un important enregistrement de la première moitié du Pléistocène supérieur. Il présente à la fois des évidences d'occupations humaines et de carnivores. Cet assemblage est analysé selon une approche interdisciplinaire dans le but de distinguer les restes laissés par ces deux agents et d'évaluer le degré d'interaction existant entre eux. Les données indiquent des activités cynégétiques réalisées tant par les hominidés que par les carnivores, et une relation ou contact temporel minime entre eux à l'intérieur de la grotte. Ceci permet de caractériser les occupations humaines du niveau III en relation avec la composition des groupes et leur mobilité élevée sur le territoire.

Mots-clés : Grotte des Teixoneres, Pléistocène supérieur, hominidés-carnivores, modèles d'occupation.

1 - INTRODUCTION

One of the principal characteristics of human groups during the Pleistocene is their behavioral variability in relation to the stability in the territory. Their subsistence strategies imply a certain mobility which depends on the availability of resources in the immediate environment (Butzer, 1989). This generates a wide variety of occupational patterns reflected in the archaeological record (Carbonell & Rosell, 2004). Between the short occupations by small groups and the large camps of hominids with a certain temporal stability, there is a continuum of settlements patterns, such as occupations of long duration, seasonal camps, utilization of natural traps, occasional refuges. The nature of these sites is defined by the realized activities, the number of members in the groups, and the duration and time of settlement.

Caves offer interesting records to establish the occupation patterns. Unlike open-air localities, the activities realized in caves are spatially delimited by the wall of the cave and the post-depositional processes are not so diversified (Marean & Kim, 1998). Nevertheless, these places are also habitually frequented by large carnivores. Bears, hyenas, canids, some felids and mustelids use the caves as refuges or dens for their offspring. Several of these carnivores have the habit to accumulate the remains of their preys in these places, especially hyenas. In general, carnivores are following a seasonal pattern of occupation

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limited in time and annually repeated. When their remains are combined with those left by human groups, they can produce important palimpsests in which it becomes difficult to distinguish between the remains produced by each accumulator (Fosse *et al*., 1998; Stiner, 2002). In addition, depending on the time span between an occupant and the next one, it is possible to observe activities of scavenging. This phenomenon was interpreted in some occasions as a constant and a relation of interdependence between hominids and carnivores (see discussion in Villa & Soressi, 2000). The ideas emerging from these studies were interpreted during the last decades of XXth century as the existence of relations of permanent competition between hominids and carnivores during the Pleistocene, not only for the preys, but also for the inhabitable space (Binford, 1989; Enloe *et al*., 2000).

Many researchers have studied the accumulations of carnivores with the purpose of distinguishing them from the anthropic ones, and evaluating the possible interaction between the two actors (Blumenschine, 1988; Cruz-Uribe, 1991; Lam, 1992; Marean & Spencer, 1991; Marean *et al*., 1992; *inter alia*). The criteria given by these authors are fundamentally based on zooarchaeology and taphonomy. In the present work this problematic is analyzed at level III of Teixoneres Cave from an interdisciplinary approach: faunal remains, lithic industry and spatial distribution. Our objective is to characterize this type of assemblage and to establish the degree of relation between hominids and carnivores during the first half of the late Pleistocene in the North-East of the Iberian Peninsula.

2 - TEIXONERES CAVE

Teixoneres cave is one of the cavities belonging to the karstic system called Toll caves. Located in the Moià village (Barcelona, Spain) (fig. 1) it forms a more than 2 km long galleries course that contain several archaeological deposits from different chronologies. Some of them, like the one known as South Gallery, have been



Fig. 1: Location of Teixoneres Cave (Barcelona, Spain).
Fig. 1 : Localisation de la grotte des Teixoneres (Barcelone, Espagne).

partially excavated since the 1950's and 1970's and report an important Holocene sequence and late Pleistocene paleontological record (Serra *et al*., 1957; Crusafont, 1960; Hopf, 1971; de Lumley, 1971; Guilaine *et al.*, 1982). This complex has been formed by the drainage system of Mal torrent, which modeled the Neogene limestone formations and configures the endokarstic landscape observed nowadays. In this way, Teixoneres cave is a fossilized ancient outlet of the Toll caves system.

Teixoneres is a U-shaped cave 30 m long and with three differentiated chambers called X, Y and Z. The cave has two entrances, the main one acceding to chamber X, and the second one acceding to chamber Z, the latter is smaller and probably more opened more recently than the main one.

Archaeological work in the cave started in the 1950's by a local speleological group. They made three deep test drillings in the main chamber (chamber X) merged by a longitudinal trench in which they recovered some lithic remains and, mainly, an important Pleistocene faunal assemblage. Later, in 1973 another small intervention was carried out and focused on the paleontological record, the cave was then closed until the current excavation project started in 2003.

Teixoneres is filled by a 6 m thick sediment package containing at least 15 archaeo-paleontological levels. We have worked in the first part of the sequence (levels I to IV), belonging to the Upper Pleistocene. Levels I and IV probably correspond to warm and wet periods, in which water and carbonate precipitation have sealed the stratigraphy forming two continuous stalagmitic beds. Uranium series dates have situated confidently the stalagmite of level IV in the MIS 5c with an average date of 100.3 ± 6.1 ka (Tissoux *et al.*, 2006). Uncertain are the data for the stalagmite of level I, which probably corresponds to the MIS 2. Method correction applied to the uranium contamination of the sample results, places level I into the late glacial, between *ca.* 14-16 ka BP (Tissoux *et al*., 2006) (fig. 2).

Extensive works carried in the outer part of the cave, today open-air site due to the progressive collapse of the cornice, allowed the excavation of levels II and III in the zone where more intense human activity areas were expected.

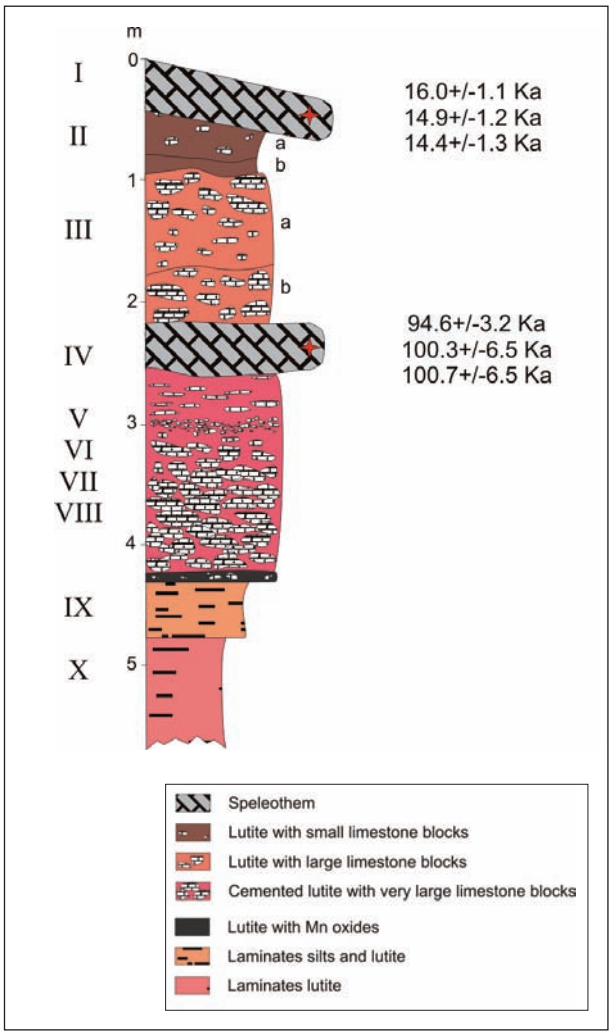


Fig. 2: General stratigraphy and levels dating of Teixoneres Cave.
Fig. 2 : Stratigraphie et datations des niveaux de la grotte des Teixoneres.

3 - METHODOLOGY

All the archaeological remains recovered during the excavation of level III at Teixoneres Cave have been three-dimensionally recovered and mapped. This allows making spatial reconstructions both at horizontal and vertical levels. The analysis of faunal remains has been carried out using the methodological approaches developed in zooarchaeology. All dental and skeletal remains recovered were analyzed for establishing anatomical and taxonomical representation, quantification index and modifications on the bone surface. The unidentified specimens were assigned to weight size categories and type bone (long bone, flat bone, articular bone) wherever possible, to supplement data from the NISP. Weight categories (tab. 1) were established from the size and age of the animals taking into account the taxa present at Teixoneres.

NISP (Number of Identified Specimens), MNE (Minimum Number of Elements), MNI (Minimum Number of Individuals) and skeletal survival rate (Brain, 1981; Lyman, 1994) were calculated. MNE was established taking into account age, portion and weight category. Skeletal survival rate gauges the proportion between the elements recovered and those expected (Brain, 1969).

All the remains were analyzed macroscopically and microscopically, and measured with a digital calliper. For microscopic observations we used a stereomicroscope (Olympus SZ11 magnification up to 1100). Taphonomic modifications observed on the faunal remains included anthropic and carnivore activity principally.

To recognize the agent responsible for the fractures, the Fragmentation Index was calculated (Bunn, 1983) as well as an analysis of outline (transverse, curved/V-shaped, longitudinal), angle (oblique, right, mixed) and fracture edge (smooth, jagged) following Villa & Mahieu (1991).

Body weight	Species and ages
Large size >300 Kg.	Adult and juvenile *Equus ferus* Adult and juvenile *Ursus spelaeus* Adult and juvenile *Bos primigenius*
Medium size 100-300 Kg.	Adult and juvenile *Cervus elaphus* Adult and juvenile *Equus hydruntinus* Adult *Crocuta spelaea*
Small size 20-100 Kg.	Adult *Capreolus capreolus* Infantile *Cervus elaphus* Adult, juvenile and infantile *Sus scrofa* Adult, juvenile and infantile Caprini Infantile *Equus ferus* and *Equus hydruntinus* Infantile *Ursus spelaeus* Infantile *Crocuta spelaea* Adult and juvenile *Meles meles* Adult and juvenile *Hystrix* sp.
Very small size <20Kg.	Infantile *Hystrix* sp. and *Meles meles* Leporidae Passeriforme Testudinae

Tab. 1: Weight size categories by age established for Teixoneres Cave Level III.
Tab. 1 : Catégories de poids établies par âges pour le niveau III de la grotte des Teixoneres.

The surface alterations generated by hominids are cutmarks, bone breakage and burning (Potts & Shipman, 1981; Shipman, 1983; Shipman & Rose, 1983; Shipman & Rose, 1984; Stiner, 1994; Stiner *et al.*, 1995). The analysis of cutmarks took into account the number of striations, their location and distribution across the surface. The butchering activities were related to the action performed when possible (Binford, 1981).

Modifications caused during the bone breakage were also analyzed. The diagnostic elements of anthropic breakage documented are: percussion notches, cortical flakes, medullar flakes, and impact flakes (Sadek-Kooros, 1975; Noe-Nygaard, 1977; Myers *et al.*, 1980; Binford, 1981; Haynes, 1983; Johnson, 1985; Bonnichsen, 1989; Buikstra & Swegle, 1989; Spenneman & Colley, 1989; Giusberti & Peretto, 1991; Pickering & Egeland, 2006; *inter alia*). The peeling has been documented by desquamations at the end of irregular fractures (White, 1992).

Burning was also observed on some bone faunal remains from level III. This modification is related with process of cooking and was identified through macroscopic criteria, mainly the colour of the remains (Stiner *et al*., 1995).

Carnivore modifications like toothmarks and other damages produced during consumption of the carcasses were recorded. Four types of toothmarks were identified: punctures, pits, imprints, and scores. We also observed pitting, furrowing, scooping-out, digested bones, and crenulated edges (Maguire *et al*., 1980; Binford, 1981; Haynes 1980, 1983). With the aim of trying to estimate the size of the carnivore involved, we took measurements of the pits width and length using the criteria described by Andrews & Fernández-Jalvo (1997), Selvaggio & Wilder (2001), and Dominguez-Rodrigo & Piqueras (2003).

The study and analysis of the lithic assemblage from Level III was performed according to the proceedings of the Analytical Logical System methodology (SLA) (Carbonell *et al*., 1983, 1992). It is based on the reconstruction and interpretation of the *chaîne opératoire* as a productive process. Each object is understood as a tool product by the human action on the environment. The tool is basically characterized by an association of morpho-technical attributes that make possible to identify its place in the reduction sequence. Some modifications based on the methodology to study the Middle Palaeolithic assemblages and their spatial distributions at Abric Romani site were considered in this study (Vaquero, 1997).

4 - RESULTS

4.1 - FAUNAL REMAINS

At Level III of Teixoneres Cave a total of 935 faunal remains have been recovered: three antlers, 118 teeth and 814 bones. From these, 171 were identified to the taxonomical level and 764 were attributed to the categories established by weight sizes (tab. 2). The high fragmentation at Level III caused that, in most of the cases, bone remains did not preserve sufficient morphological features to be attributed to an anatomic element or a specific taxonomic group. The MNE is 162, mostly represented by mandibles (26), ribs (17) and vertebrae (16). Scapulae are scarcely represented in this assemblage. The largest number of skeletal elements is assigned to *Cervus elaphus* (24) and to the medium (30) and small (26) size animals. These represent 49.4 % of the elements (tab. 3). The MNI is 28 and was established from the most common skeletal element (principally dental remains) according to species and ages at death. Equids are predominant (8), followed by red deer (3) and ursids (3). These animals represent 50 % of the total MNI in this assemblage. All the other species are nominal. Regarding the animals' age at death, one group is clearly predominant over the others. The adult specimens are the most abundant in all species and weight categories; they represent 57.1 % of the total specimens.

The survival rates show that red deer is the species with the highest skeletal integrity (tab. 4). Animals with weight lower than 20 kg have very low survival rates. Except for red deer, the most represented anatomic segments in the faunal assemblage are the cranial skeleton (mainly from the teeth). At the contrary, metapodials are the elements most represented in red deer. In all taxa a low representation of the axial skeleton and girdles' elements was documented. One of the most relevant data in relation to the skeletal representation of the registered individuals is the scarce presence of basipodial and acropodial bones. According to skeletal survival rate, a biased skeletal representation is observed in all taxa of the assemblage. This selection of elements is essentially characterized by the presence of the proximal appendicular skeleton (stylopodium and zygopodium) and the cranial skeleton (mainly mandibles and maxilla). On the other hand, the low proportions of the axial skeleton are characteristic of most of the species documented at this level (fig. 3).

Level III Taxa	NR	NISP	MNE	MNI	MNI Age			
					Inf.	Juv.	Ad.	Sen.
Ursus spelaeus	20	20	11	3	-	1	1	1
Crocuta spelaea	4	4	2	2	-	1	1	-
Carnivora	1	1	1	-	-	-	-	-
Equus ferus	36	36	11	4	1	1	2	-
Equus hydruntinus	15	15	9	4	-	1	2	1
Sus scrofa	1	1	1	1	-	-	-	1
Cervus elaphus	47	47	24	3	1	1	1	-
Capreolus capreolus	2	2	2	1	-	-	1	-
Bos primigenius	10	10	7	2	-	1	1	-
Caprini	3	3	3	1	-	-	1	-
Hystrix sp.	3	3	1	1	-	-	1	-
Meles meles	2	2	1	1	-	-	1	-
Erinaceridae	1	1	1	1	-	-	1	-
Leporidae	18	18	13	2	1	-	1	-
Passeriforme	5	5	3	1	-	-	1	-
Testudinae	3	3	1	1	-	-	1	-
Large size	91	-	14	-	-	-	-	-
Medium size	364	-	30	-	-	-	-	-
Small size	217	-	26	-	-	-	-	-
Very small size	2	-	1	-	-	-	-	-
Unident.	90	-	-	-	-	-	-	-
Total	935	171	162	28	3	6	16	3
Total Carnivores	27	27	15	6	-	2	3	1
Total Ungulates	114	114	57	16	2	4	8	2

Tab. 2: Number of remains (NR), number of identified specimens (NISP), minimum number of elements (MNE) and minimum number of individuals (MNI) from Level III of Teixoneres Cave.
Tab. 2 : Nombre de restes (NR), nombre de restes déterminés taxonomiquement (NISP), nombre minimum d'éléments (NME), et nombre minimum d'individus (NMI) pour le niveau III de la grotte des Teixoneres.

Level III NR (MNE)	*Ursus spelaeus*	*Crocuta spelaea*	*Carnivora*	*Equus ferus*	*Equus hydruntinus*	*Sus scrofa*	*Cervus elaphus*	*Capreolus capreolus*	*Bos primigenius*	Caprini	*Hystrix* sp.	*Meles meles*	Erinaceridae	Leporidae	Passeriforme	Testudinae	Large size	Medium size	Small size	Very small size	Unident.	Total
Cranium							3(1)										6(1)	7(1)				16(3)
Mandible	(-)4	(-)2		(-)5	(-)5		(-)2		(-)1		(-)1	(-)1	1(1)	1(1)			(-)1		1(1)	(-)1		3(26)
Maxilla	1(2)			(-)1	(-)2	(-)1	(-)2		(-)1	(-)1				(-)1			(-)1	1(1)				2(13)
Teeth	14(-)	4(-)		31(-)	13(-)	1(-)	15(-)		3(-)	1(-)	3(-)	2(-)		1(-)			8(-)	4(-)	5(-)	1(-)	12(-)	118(-)
Vertebrae																		9(8)	10(8)			19(16)
Ribs			1(1)											1(1)			4(1)	14(5)	15(9)			35(17)
Pelvis														1(1)			2(1)					3(2)
Scapulae																		1(1)				1(1)
Humerus							5(3)		1(1)								2(1)	1(1)	1(1)			10(7)
Radius	1(1)																1(1)					2(2)
Ulna							1(1)		2(1)													3(2)
Femur				1(1)			1(1)							1(1)			2(1)					5(4)
Fibula	1(1)																					1(1)
Tibia				1(1)			3(2)	1(1)	2(1)					1(1)			1(1)	2(1)	1(1)			12(9)
Carpal/tarsal							1(1)											3(3)				4(4)
Metacarpals							4(2)										1(1)	1(1)				6(4)
Metapodials				1(1)			3(1)		1(1)								1(1)	7(3)				13(7)
Metatarsals				1(1)	1(1)		7(4)	1(1)		1(1)				1(1)				1(1)				13(10)
Articular bones									1(1)	1(1)				2(2)			1(1)		1(1)			6(6)
Phalange	3(3)			1(1)	1(1)		4(4)								1(1)							10(10)
Long bones														8(3)	3(1)		45(1)	194(2)	137(3)		9(-)	396(10)
Flat bones														1(1)	1(1)		16(1)	111(2)	43(2)			172(7)
Unident.																	1(-)	8(-)	3(-)	1(-)	69(-)	82(-)
Caparace																3(1)						3(1)
Total NR	20	4	1	36	15	1	47	2	10	3	3	2	1	18	5	3	91	364	217	2	90	935
(MNE)	(11)	(2)	(1)	(11)	(9)	(1)	(24)	(2)	(7)	(3)	(1)	(1)	(1)	(13)	(3)	(1)	(14)	(30)	(26)	(1)	(-)	(162)

Tab. 3: NR (MNE) from Level III faunal assemblage.
Tab. 3 : NR (NME) pour l'assemblage du niveau III.

% Surv.															
MNI	3	2	4	4	1	3	1	2	1	1	1	1	2	1	1
Taxa	*Ursus spelaeus*	*Crocuta spelaea*	*Equus ferus*	*Equus hydruntinus*	*Sus scrofa*	*Cervus elaphus*	*Capreolus capreolus*	*Bos primigenius*	Caprini	*Hystrix* sp.	*Meles meles*	Erinaceridae	Leporidae	Passeriforme	Testudinae
Cranial skeleton	6(40)	2(20)	6(30)	7(35)	1(20)	5(33.5)		2(20)	1(20)	1(20)	1(20)	2(20)	2(20)		
Axial skeleton													1(1.8)		
Girdles													1(12.5)		
Stylopodials			1(6.3)			4(33)		1(13)					1(12.5)		
Zygopodials	2(16.7)		1(6.3)			3(25)	1(25)	2(25)					1(12.5)		
Basipodials						1(1.7)		1(2.5)	1(5.1)				2(4.9)		
Metapodials			2(13)	1(6.3)		7(58)	1(25)	1(13)	1(25)				1(2.5)		
Acropodials	3(1.6)		1(2.1)	1(2.1)		4(7.1)								1(4.1)	
Caparace															1(100)

Tab. 4: Skeletal Survival Rate (% Surv.) by anatomic segments of the identified species at Levels III.
Tab. 4 : Taux de survie (% Surv.) des éléments squelettiques pour les espèces identifiées dans le niveau III.

The bone fragments from Level III are generally small. Seventy-one percent measure less than 5 centimetres in length. In general, we observed that the quantity of remains decreases progressively with increasing length (fig. 4). Very few anatomical elements are intact. Besides teeth, there are few articular bones and several phalanges. From these data and the data obtained from the skeletal and specific representation, the assemblage is characterized by a high number of small bone fragments belonging to long bones (mainly stylopodium and zygopodium) and to flat bones of medium size animals. The high degree of bone fragmentation at Level III of Teixoneres Cave corresponds to green bone breakage according to Villa & Mahieu (1991). Analysis of 654 fragments shows that curved/V shaped predominate along with oblique angles and smooth edges (fig. 5).

Hominids and carnivores are the biological agents that affected with major frequency the assemblage at Level III of Teixoneres Cave. The proportion of modifications produced by the two predators is similar, although the number of remains with anthropogenic marks is slightly more abundant (tab. 5). In the whole assemblage, 9.7 % of the remains show evidences of hominids activity, and 7.8 % present modifications realized by carnivores.

Surface damage caused during breakage of the bones was also analyzed. Five diagnostic elements of anthropic breackage were documented. Percussion notches, impact flakes, cortical and medullar flakes, and peeling were reported and summarized in tab. 6. Cutmarks suggest also the association between hominids activity and the faunal record from Level III because 1.2 % of the bone remains analyzed show this type of evidence. These were identified principally on the limb bones of medium and large size animals, with a predominance of incisions on the shaft and sawing marks on the metaphysis. The action performed (skinning, viscera removal, dismembering,

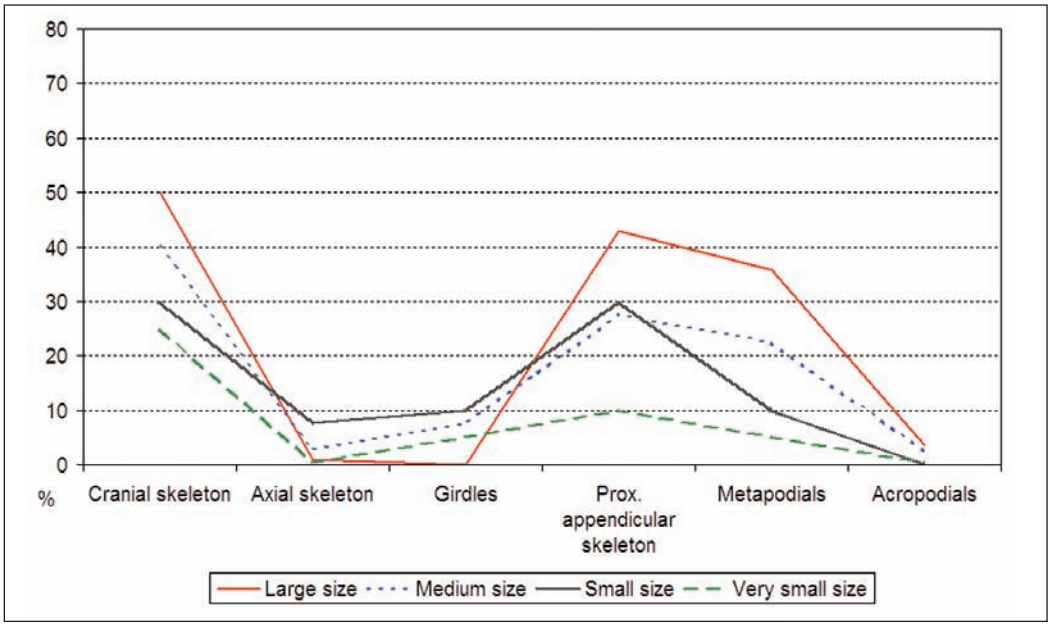


Fig. 3: Representation of % Surv. by anatomic segments from Level III assemblage.
Fig. 3 : Représentation du pourcentage de survie (% Surv.) par segment anatomique dans l'assemblage du niveau III.

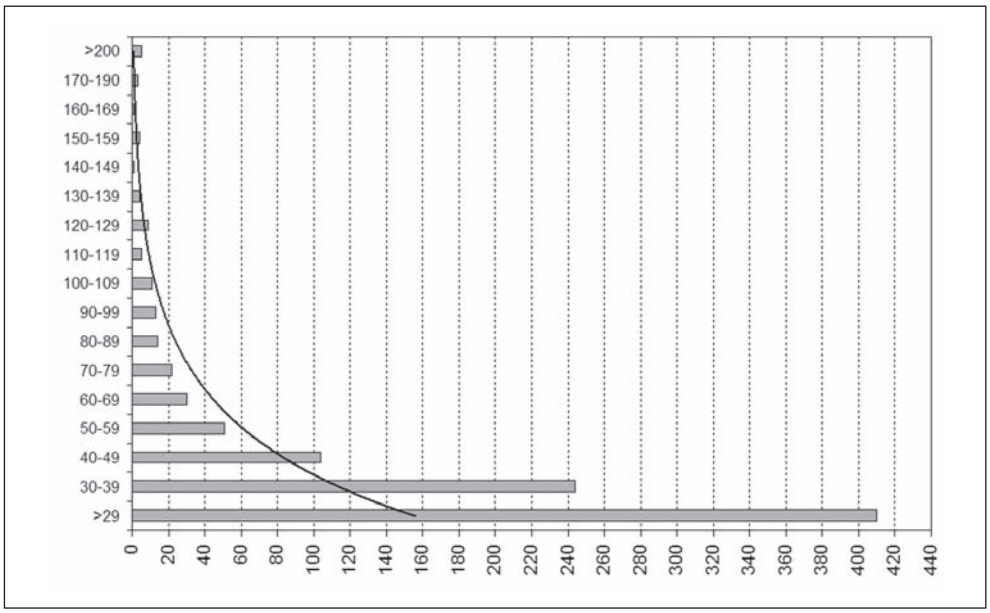


Fig. 4: Histogram with bone lengths and exponential curve from Level III faunal set.
Fig. 4 : Histogramme de la longueur des os et courbe exponentielle pour l'assemblage du niveau III.

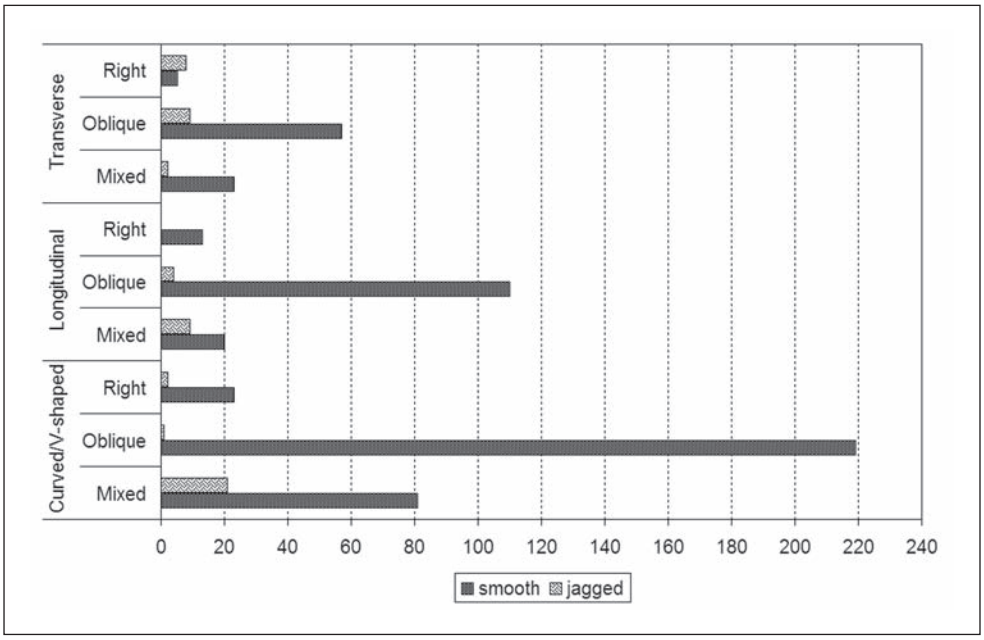


Fig. 5: Graphic of bone breakage according to delineation, angle and surface from Level III faunal remains.
Fig. 5 : Fracturation des os en fonction de la bordure, l'angle et la surface pour les restes fauniques du niveau III.

filleting, disarticulation and periosteum removal) was recorded according to morphology, emplacement and distribution of the striations (tab. 7). Only skinning and defleshing/disarticulation were identified. At Level III of Teixoneres Cave, 44 burned remains were recovered. These remains represent 4.7 % of the total faunal remains. Most of the bones with burned surfaces belong to unidentified faunal remains at the anatomical level and, as a consequence, at the taxonomic level (tab. 8). However, hominids are not the only agents responsible of the faunal accumulation. Carnivore toothmarks and fractures were identified mainly on the long bones of medium and small size animals (tab. 9). Carnivore modifications were documented on 7.8 % of the remains. The dimensions of the predominant toothmarks can be associated to small and medium-sized carnivores. However, toothmarks of large dimensions were observed on some bone fragments. These can be related with the activity produced by hyenids or ursids (fig. 6). The activities of hyenas at Level III are also documented by the presence of coprolites.

Only one bone remain has been modified by both hominids and carnivores, it is a tibia of *Bos primigenius*. This element presents an anthropogenic percussion impact on the middle-shaft and one group of eight scores on the proximal metaphysis. The breadth of these scores (0.6-1.6 mm) is coherent with the toothmarks mean observed in the faunal assemblage.

	Hominids			Carnivores
	Breakage	Cutmarks	Burning	Carnivore damages
Large size	11 (7.75%)	3 (2.11%)	3 (2.11%)	15 (10.56%)
Medium size	23 (5.35%)	7 (1.63%)	21 (4.88%)	36 (8.37%)
Small size	6 (2.45%)	1 (0.41%)	16 (6.53%)	19 (7.76%)
Very small size	-	-	1 (3.57%)	-
Unidentified	5 (5.56%)	-	3 (3.33%)	3 (3.33%)
Total NR (%)	45 (4.81%)	11 (1.18%)	44 (4.71%)	73 (7.80%)

Tab. 5: Number of remains (NR) with anthropic and carnivore modifications from Level III faunal assemblage.
Tab. 5 : Nombre de restes (NR) portant des traces d'activité anthropique et de carnivores dans l'assemblage du niveau III.

	Impact flakes	Cortical flakes	Medular flakes	Percusion notches	Peeling	Total NR (%)
Bos primigenius	-	-	-	2	-	2 (20%)
Caprini	-	-	-	1	-	1 (33.33%)
Cervus elaphus	-	-	-	1	-	1 (2.13%)
Equus ferus	-	1	-	-	-	1 (2.78%)
Large size	6	-	-	2	-	8 (5.63%)
Medium size	19	-	-	2	1	22 (5.12%)
Small size	3	-	-	1	1	5 (2.04%)
Unidentified	1	3	1	-	-	5 (5.56%)
Total NR (%)	29 (3.10%)	4 (0.43%)	1 (0.11%)	9 (0.96%)	2 (0.21%)	45 (4.81%)

Tab. 6: Number of remains (NR) with diagnostical criteria of anthropic breakage from Level III faunal assemblage.
Tab. 6 : Nombre de restes (NR) avec des traces diagnostiques de fractures anthropiques dans l'assemblage du niveau III.

		Groups	No. striae by group	Type of cutmarks	Location	Distribution	Orient.	Lengths (mm)	Action performed
Femur	*Cervus elaphus*	1	3	i (slicing marks)	distal metaphy.	clustered	obl	14,7;5,3	defleshing
Tibia	*Bos primigenius*	1	1	i (slicing marks)	diaphysis	isolated	obl	3,5	defleshing
	Cervus elaphus	1	6	i (slicing marks)	diaphysis	clustered	obl	22,6; 16,8	defleshing
Metatarsals	*Equus hydruntinus*	2	1-5	i (slicing marks)	diaphysis	clustered	obl	8,3; 5,6	skinning
Metapodials	*Equus ferus*	8	1-2	i (slicing marks)	diaphysis	isolated	obl	6,7; 5,4	skinning
Long bones	Large Size	1	2	i (slicing marks)	diaphysis	clustered	obl	9,9; 6,1	defleshing
				i (slicing marks)	diaphysis	clustered	obl	7,4;6,8	
				i (slicing marks)	diaphysis	isolated	obl	11,2; 9,8	
	Medium Size	3	1-8	i (sawing marks)	metaphysis	crossed	tr	12,3; 5,8	defleshing
	Small Size	1	2	i (slicing marks)	diaphysis	clustered	tr	3,0; 2,1	defleshing

Tab. 7: Cutmarks groups according to skeletal element and taxa from Level III faunal remains.
i: incisions (slicing and sawing marks); obl: oblique; long: longitudinal; tr: transverse).
Tab. 7 : Groupes de traces de découpe par élément anatomique et par taxon dans l'assemblage du niveau III. i : incisions (marques de découpe et de sciage) ; obl : oblique ; long : longitudinale ; tr : transversale.

Burned bones	Large size	Medium size	Small size	Leporidae	Unident.	Total NR (%)
Mandible	-	-	-	1	-	1 (0.11%)
Long bones	3	19	12	-	-	34 (3.64%)
Flat bones	-	2	2	-	-	4 (0.43%)
Unidentified	-	-	2	-	3	5 (0.53%)
Total NR (%)	3 (0.32%)	21 (2.25%)	16 (1.71%)	1 (0.11%)	3 (0.32%)	44 (4.71%)

Tab. 8: Number of burned bones according to anatomic elements and weight sizes.
Tab. 8 : Nombre d'os brûlés par élément anatomique et par taille de poids.

		Number of Remains	Types of toothmarks	Location
Bos primigenius	Tibia	1	score	metaphysis
	Ulna	1	puncture-pit	epiphysis
	Sesamoideus	1	imprint	-
Capreolus capreolus	Metatarsal	1	digestion	entire bone fragment
Caprini	Premolar	1	digestion	entire bone fragment
Cervus elaphus	Metacarpal	1	digestion	entire bone fragment
	Phalange	2	digestion	entire bone fragment
	Humerus	1	score	diaphysis
Equus ferus	Phalange	1	scooping	epihysis
Equus hydruntinus	Molar	1	digestion	entire fragment
	Phalange	1	puncture-pit	distal epiphysis
Ursus sp.	Phalange	1	scooping	distal epyphisis
Large size	Rib	1	score-pit	diaphysis
	Femur	2	puncture	prox. epiphysis-diaphysis
	Humerus	1	pit	prox. metaphysis
	Tibia	1	pitting	prox. metaphysis
	Metapodial	1	pitting	diaphysis
	Long bones	4	digestion-pitting	entire bone-diaphysis
			crenulated edge	diaphysis
	Flat bones	1	puncture	-
Medium size	Rib	1	digestion	entire bone fragment
	Metapodial	2	score-digestion	diaphysis-metaphysis
	Skul	1	digestion	temporal bone
	Vertebra	1	scooping	-
	Long bones	14	score-digestion pitting-furrowing	diaphysis
	Flat bones	9	score-puncture-pit	-
			digestion	entire bone fragment
	Unidentified	3	puncture-digestion	-
Small size	Rib	1	scooping	epiphysis
	Vertebrae	1	puncture	spinous apophysis
	Long bones	12	puncture	diaphysis
			pitting-crenulated edges	
	Unidentified	1	digestion	entire bone fragment
Unidentified	Long bones	2	digestion	entire bone fragment
	Molar	1	digestion	entire fragment

Tab. 9: Number of remains (NR) with carnivore toothmarks by taxa and anatomical elements from Level III assemblage.
Tab. 9 : Nombre de restes (NR) avec des traces de morsures de carnivores par taxon et élément anatomique dans l'assemblage du niveau III.

4.2 - RAW MATERIALS AND LITHIC TECHNOLOGY

The lithic assemblage at Level III is formed by 55 pieces and mainly composed by final products of the reduction sequences (knapping products and retouched tools) while cores are scarce (n=2). This pattern confirms a high degree of fragmentation of the reduction sequences.

Raw materials show a great diversity although flint and quartz are the most abundant. The studies about raw materials realized until now (Mangado & Nadal, 2001) show the availability of different sources of flint in primary and secondary position in this geographic area in a maximal perimeter of 30 km. Their outcrops are more distant to the site than the other raw materials used which are local, probably collected from the stream secondary deposits nearby the site.

The knapping methods used are difficult to reconstruct due to the low number of cores and because they are in the final stage of the reduction sequence (fig. 7). It is also important to take into account that the

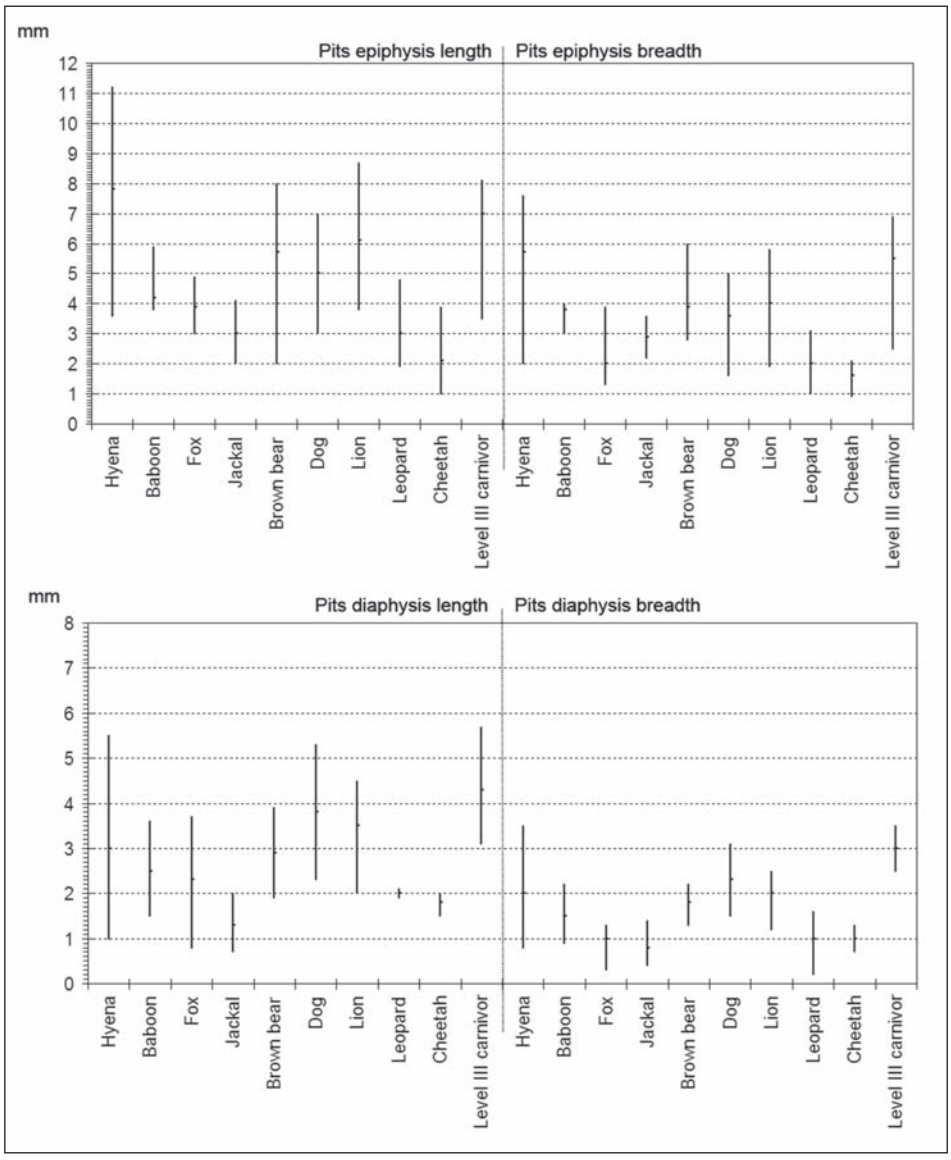


Fig. 6: Mean of tooth pit sizes stratified by bone type according to Andrews & Fernández-Jalvo (1997), Dominguez-Rodrigo & Piqueras (2003), Selvaggio & Wilder (2001).
Fig. 6 : Moyenne de la taille des traces de morsure classées par type d'os d'après Andrews & Fernández-Jalvo (1997), Dominguez-Rodrigo & Piqueras (2003), Selvaggio & Wilder (2001).

maximal utilization of a material would cause that certain cores which first presented typical characteristics of a knapping method finally present varied and different morphologies. This is due to the intensive use of all potential surfaces. Anyway, it looks like that both cores belong to the Levallois method according to Boëda (1993, 1994) criteria because of the surface hierarchy and also for the characteristics of some knapping products. However we also have to bear in mind that other knapping methods would produce similar knapping products (Terradas, 2003; Van Peer, 1992, 1995). It is possible that other methods such as discoidal or even more expeditive (i.e., orthogonal) were also used because of the type and morphology of some flakes and flakes fragments.

The retouched tools (fig. 8) are mainly composed by denticulates, followed by scrapers, and it seems that most of them were introduced to the site as endproducts. The knapping products, especially small size flakes and flakes fragments could be related to some of the final products (flakes and retouched artefacts) recovered. These small pieces seem to be in relation to the knapping process and/or to the retouch or resharpening actions. The pieces were introduced as endproducts and after they were reshapened producing the small knapping products. This pattern is recognizable for some flint pieces but mainly for the quartz assemblage. The refitting studies will allow us to obtain more information about the reconstruction of the reduction sequence. Other knapping products could result from cores that were introduced into the site during the cave occupation, and then some blanks were obtained. When the group left the cave, these cores were transported as toolkit to other sites ("provisioning of individuals" Kuhn, 1995). This pattern (a very low number of cores normally exhausted and some knapping products without clear raw material identification into the site) is very similar in other Middle Palaeolithic sites, such as Abric Romaní (Vaquero, 1999a, b).

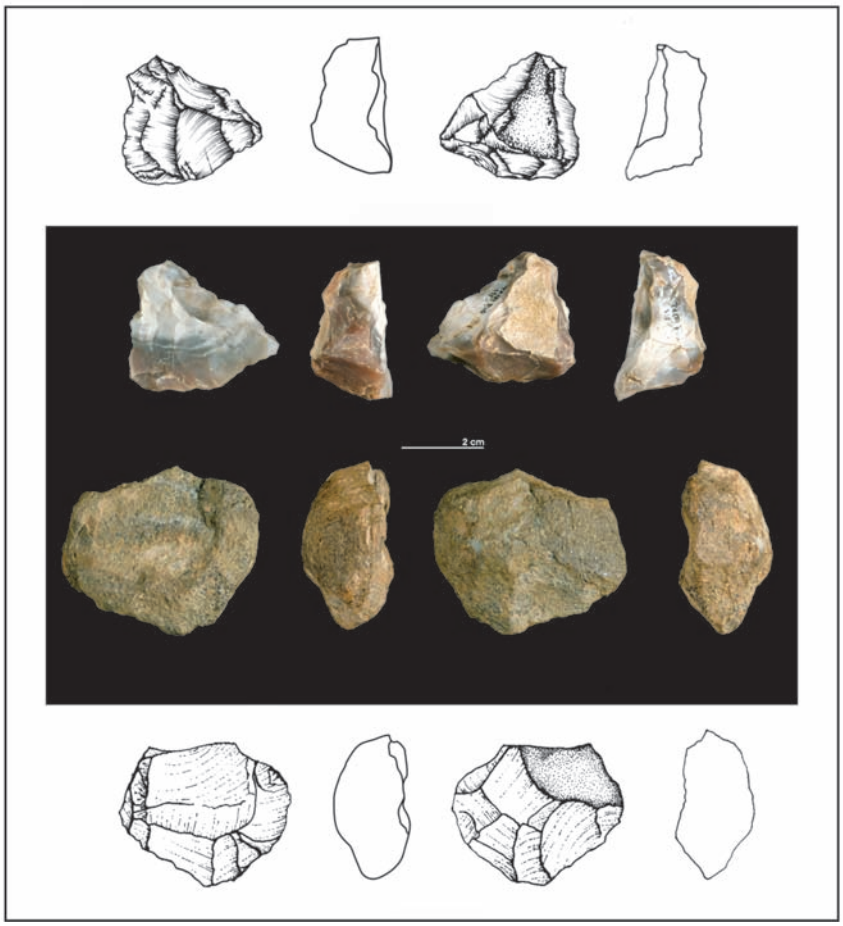


Fig. 7: Draws and photos of level III cores.
Fig. 7 : Dessins et photographies des nucléus du niveau III.

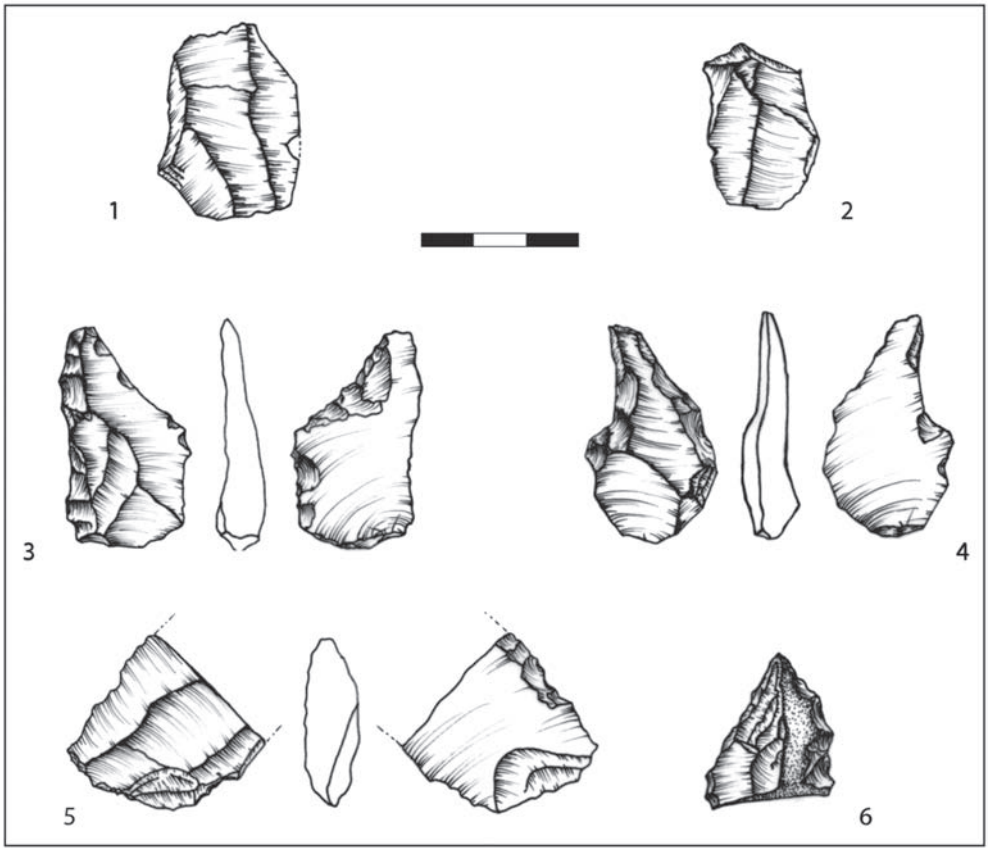


Fig. 8: Level III endproducts (flakes and retouched artefacts).
Fig. 8 : Produits finaux du niveau III (éclats et outils retouchés).

Even if the number of pieces is low at the moment, the two main characteristics of Level's III lithic assemblage are the fragmentation of the reduction sequences with the predominance of endproducts and the high diversity of the raw material used (tab. 10).

4.3 - SPATIAL DISTRIBUTION OF REMAINS

Vertical and horizontal projections of the remains recovered were realized using their Cartesian coordinates (three-dimensional). On these projections special importance is given to the elements resulting from human activities.

On the vertical projection (fig. 9) two different levels of concentration of anthropic elements are observed (upper and lower sub-levels), separated by a level of limestone blocks of large dimensions. The lower sublevel presents a major density of remains than the upper one. Besides lithic artefacts and fauna, it is important to note the presence of some charcoals grouped together. It is necessary to bear in mind that the works for conditioning and protecting of the cave, carried out during the 90's, slanted part of the upper level. From a taphonomical perspective, modifications related to vertical and/or horizontal movements of postdepositional origin are not observed on the material: there is (1) no evidence of preferential orientations of the bones, (2) no striation or erosion provoked by the bones movements against the sediment, and (3) no sorting of the remains by size. Therefore, the data support the identification of two clear events of human occupation in the cave.

On the horizontal projection (fig. 10), a cluster of anthropic remains is observed at the entrance of the cave. From this perspective, it is possible to think that the two human impacts previously identified follow the same spatial distribution pattern. Faunal remains with anthropogenic evidences, lithic artifacts and charcoals are highly clustered. Hominids occupied a small and limited surface, located in the outside area and show a clear preference towards the eastern wall of the cave.

	Cores	Flake fragments	Flakes	Fragments	Hammer-stones	Retouched artefacts	Total
Flint	1(1.82)	5(9.09)	9(16.36)	-	-	6(10.91)	21(38.18)
Quartz	-	10(18.18)	8(14.55)	3(5.45)	-	4(7.27)	25(45.45)
Quartzite	-	1(1.82)	2(3.64)	2(3.64)	-	-	5(9.09)
Holfern	1(1.82)	-	1(1.82)	-	-	-	2(3.64)
Limestone	-	-	-	-	1(1.82)	-	1(1.82)
Sandstone	-	-	-	-	1(1.82)	-	1(1.82)
Total	2(3.64)	16(29.09)	20(36.36)	5(9.09)	2(3.64)	10(18.18)	55

Tab. 10: Lithic assemblage of Teixoneres Level III (values in parentheses are percentages calculated to the total of the Level III assemblage).
Tab. 10 : Assemblage lithique du niveau III des Teixoneres (les valeurs entre parenthèses sont des pourcentages par rapport au total de l'assemblage du niveau III).

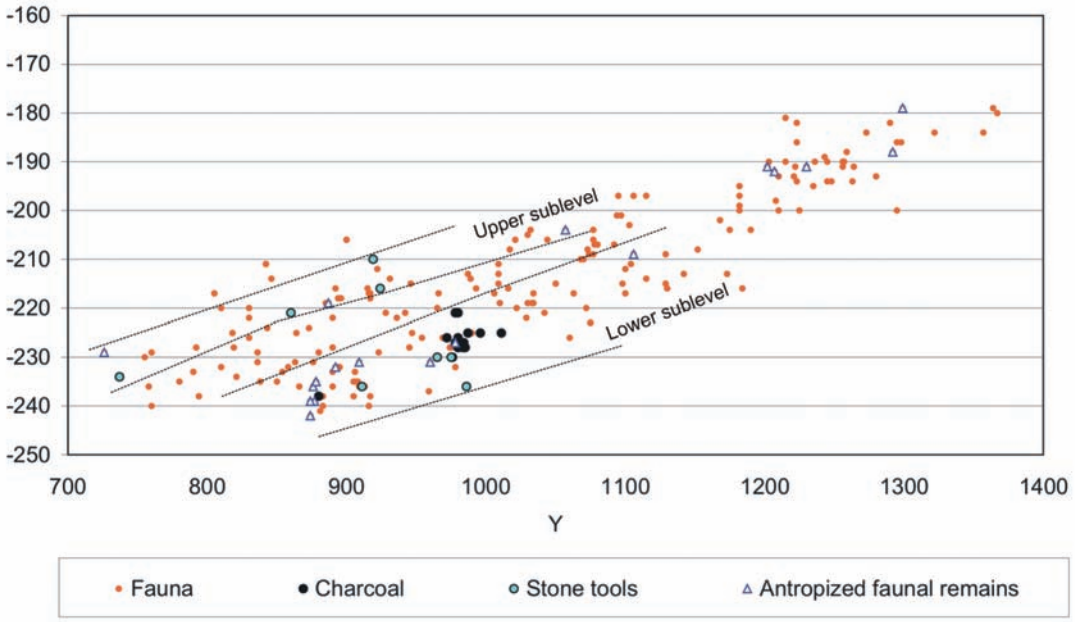


Fig. 9: Vertical (Z in cm) and longitudinal (Y in cm) distribution of anthropogenic evidences from Teixoneres Cave Level III (x = 1450-1500).
Fig. 9 : Distribution verticale (Z en cm) et longitudinale (Y en cm) des évidences anthropiques du Niveau III de la Grotte des Teixoneres (x = 1450-1500).

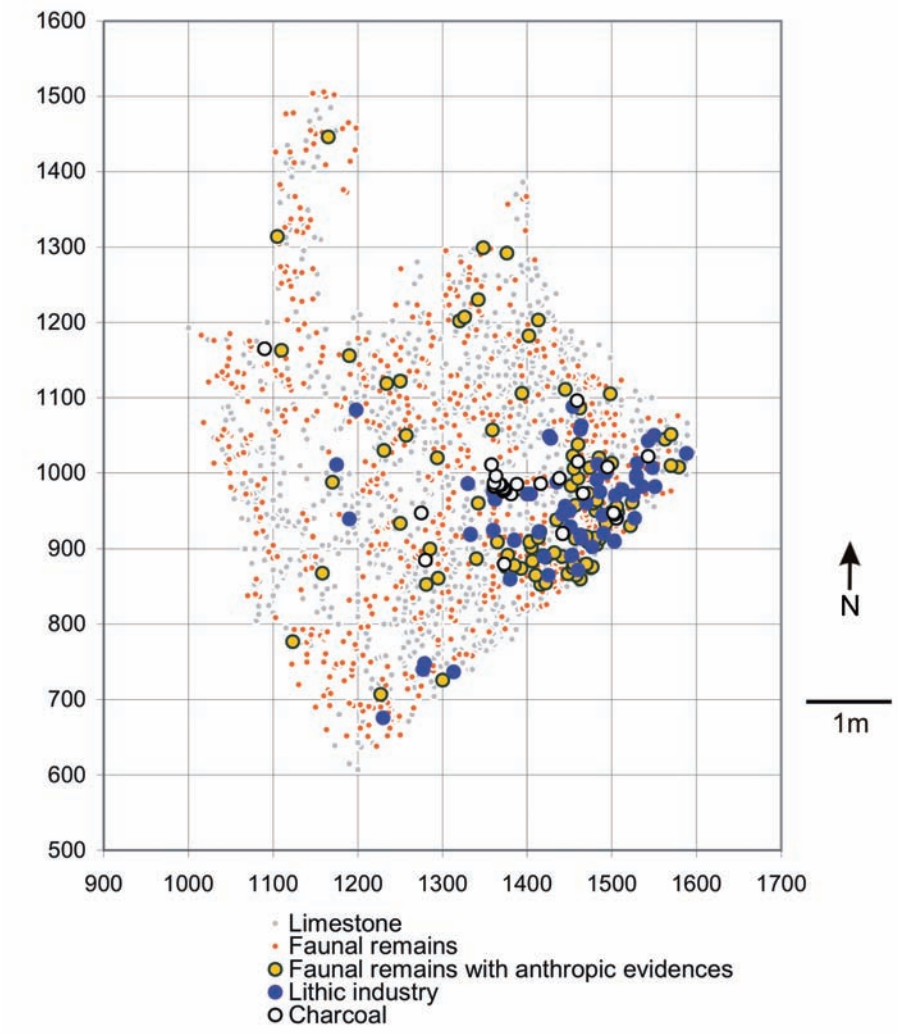


Fig. 10: Horizontal distribution of anthropogenic evidences from Teixoneres Cave Level III.
Fig. 10 : Distribution horizontale des évidences anthropiques du Niveau III de la Grotte des Teixoneres.

5 - DISCUSSION

The distribution of the remains with evidences of anthropic activity at level III of Teixoneres (lithic industry, faunal remains, and charcoals) shows two clear clusters which are temporally and spatially limited. At Teixoneres Cave, we do not recognize any taphonomical modifications related to post-depositional movements and/or reworking of remains, such as erosion, scratch marks, polished or rounded bones. Therefore, the different archaeological elements have scarce movements and support the idea that these concentrations correspond to two different occupational events. Both occupations are located in the south-east sector of the principal entrance of the cavity, in between the wall of the cave and the bank formed by the sediments falling towards the river. All the human activities identified are located in that area of the cave and no exceed 15 m^2. Therefore, they correspond to multifunctional areas occupied by small groups. A major permanence of the groups in the cave would imply the presence of specialized areas of activity. In the same way, by definition, a large group would have major spatial requirements.

In the caves of Sclayn (Belgium), short-term occupations with unspecific areas of activity were identified (Patou-Mathis, 1998; Patou-Mathis & Lopez-Baylon, 1998). Several short-term occupations by small human groups in different archaeological levels are suggested also at Wallertheim (Germany) on the basis of bones and stone tools refitting (Conard *et al.*, 1998). This occupation model contrasts with a larger surface used in a more complex way as at Abric Romaní (Barcelona, Spain), for example, where a succession of long and short occupations are documented (Vaquero *et al*., 2001; Vallverdú *et al.*, 2005). With a smaller used area than at Abric Romaní, a similar phenomenon can be observed at Tor Faraj, in southern Jordan. In this site, two levels with the same spatial patterns are interpreted as the recurrence of human groups with redundant occupational behaviour (Henry *et al*., 1996, 2004).

One of the principal characteristics of short-term events is the low number of archaeological elements produced. Among lithic artefacts, flakes, retouched artefacts, and end cores are frequent, which indicates that most of these materials come into the cave as end products from other places. The importance of the so

called curated tools (Kuhn, 1992; Dibble, 1984) is evident in this sense. This kind of artefacts reveals a high capacity of prevision and anticipation of these hominids who move along the territory with a fundamental toolkit already prepared to assume predictable and variable necessities. The idea of a territorial mobility of these groups is supported also by the diversity of raw materials selected, in which bimodality could be observed between the local and the exogenous elements, which are distributed in similar proportions.

The faunal remains modified by hominids are more abundant as the lithic industry (Ratio lithic industry/ faunal remains = 1/17). Among the assemblage, 9.7 % of the faunal remains present indications of modifications by the human groups. Cutmarks and intentional breakage are identified principally on remains of animals of large, medium and small sizes. Only one bone of a very small size animal presented an anthropic modification (a rabbit mandible burned). This element is similar to other burned bones at Level III, which are related to the anthropic events. Therefore, it is possible to suggest an anthropogenic origin for this specimen.

Cutmarks are located exclusively on long bones and indicate two preferential activities: skinning and defleshing/disarticulation. Both activities suggest that hominids got access to recently dead animals. The breakage of the long bones to access to the marrow also indicates an early access to the animals. Nevertheless, the integrity of the skeletons processed by hominids is biased in all weight categories in favour of the proximal part of the extremities (stylopods and zygopods) and the crania. According to the data of Binford (1978, 1981) and Emerson (1993) related to nutritional values of bones, the skeletal elements transported are characterized by a high nutritional content, both in meat, and fat and marrow. This pattern of skeletal representation coincides with other anthropic assemblages of that period in Europe, where a systematic transport of extremities and crania to the habitat is frequently observed in sites interpreted as camp-sites (Cáceres *et al*., 1998; Valensi & Psathi, 2004; de Lumley, 2004). The systematic transport to the site suggests a modality of primary and immediate access of the human groups to the herbivores (hunting activity). The processing and consumption of the transported parts is realized inside the cavity, as indicated by the cutmarks, the presence of elements resulting of bone breakage, and burned bones.

On the other hand, remains with evidences of carnivore activity present a more dispersed distribution than the anthropized ones. Those remains are found on the whole surface of the site, with clear preferences for places more protected in the interior of the cave. As observed for the hominids, the toothmarks are identified on the remains of animals of all sizes. At a skeletal level, a preference for the long bones is observed, though also exists a certain access to the elements of the axial skeleton. The toothmarks are indistinctly located on all the portions of the bones (epiphysis, metaphysis and diaphysis). The morphologic and morphometric analyses of these marks point out the hyenids as the most active carnivore acting on the assemblage. As demonstrated for the hominid activities, the transport of anatomical elements with a high nutritional value aims to primary and immediate accesses to the prey. From an ecological point of view, this suggests that the predation-pressure is not high in this landscape and that they are no confrontation or competition relationships between human and non-human predators.

Therefore, the apparent relationship between carnivores and hominids at Teixoneres Cave must be understood in the context of palimpsests determined by the low rate of sedimentation existing in the cave. According to the radiometric dates obtained (Tissoux *et al*., 2006), most of the Late Pleistocene is contained in three sedimentary levels which maximum thickness is only 1.5 m. This is supported by the very low representation of remains simultaneously modified by hominids and carnivores (only one specimen). Something similar occurs at Yarimburgaz Cave (Turkey), where the close spatial relations between hominids and carnivores are explained by important palimpsests related to a very low rate of sedimentation (Stiner, 2002).

The presence of very small animals remains (such as rabbits, birds, rodents) unmodified by hominids or carnivores suggests a natural intrusion of these animals in the cavity when it is unoccupied. However, we cannot discard their presence occasionally related to small carnivore activities, such as lynx or fox, or inclusive hominids (burned mandible of rabbit).

To summarize, Teixoneres Cave shows a clear dichotomy between human and carnivore occupations. For the Neanderthal groups, Teixoneres is a space occasionally suitable for small groups of hunters along their territorial movements. Nevertheless, for the large carnivores it represents an ideal place to establish their den (hyena), places for hibernation (bear) and, probably, sporadic refuges (lynx and fox). The natural intrusions of small animals indicate the existence of moments when the cave was unoccupied by hominids or non-human predators. In general, interaction or competition between hominids and carnivores are not observed at Teixoneres Cave.

6 - CONCLUSION

The interdisciplinary studies realized up to date at Level III of Teixoneres Cave indicate the absence of relation between hominids and carnivores in this site. A clear spatial separation is observed between the areas of activity of the two biological agents. Carnivores tend to use the interior areas of the cave, whereas hominids show a predilection for the most luminous and less humid areas of the entrance. The occupations by large carnivores have probably a marked seasonal character (hibernation for the bears, hyena den). Nevertheless, the human activities are the result of sporadic visits, very spread chronologically, of small groups of hunter-gatherers. These stops at Teixoneres are a consequence of a high mobility of the human communities in their territory, as attested by the high diversity of raw lithic materials.

According to these criteria, the human occupations of short duration at Teixoneres are characterized by:

1) the expeditive character of the lithic industry, with the introduction and abandon in the cave of the endproducts and cores in the final of the reduction sequence nearly exhausted,

2) the combination of local and non local raw materials, as result of the high mobility of the groups in their territory,

3) the selective transport of the most nutritive parts of the extremities and the crania indicating primary and immediate access to the herbivores and the anthropogenic modifications on bones remains suggesting a process and final consumption in the cave,

4) the presence of charcoal concentrations and burnt bones that coincide with the area of major anthropization in terms of density,

5) the remains are not so scattered, with the formation of a unique area of activity where all the householding activities are realized: knapping process, processing and consumption of the animals,

6) the absence of confrontation and/or interaction with the large carnivores living in the surroundings of the cave.

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REFERENCES

ANDREWS P., & FERNÁNDEZ JALVO Y., 1997 - Surface modifications of the Sima de los Huesos fossil humans. *Journal of Human Evolution*, **33**, 191-217.

BINFORD L.R., 1978 - *Nunamiut Ethnoarchaeology*. Academic Press, New York, 521 p.

BINFORD L.R., 1981 - *Bones: Ancient Men and Modern Myths*. Academic Press, New York, 320 p.

BINFORD L.R., 1989 - Etude taphonomique des restes fauniques de la Grotte Vaufrey, Couche VIII. *In* J.P. Rigaud (ed.), *La Grotte Vaufrey: Paléoenvironnement, chronologie, activités humaines*. Mémoires de la Société Préhistorique Française, **19**, 535-564.

BLUMENSCHINE R.J., 1988 - An experimental model of the timing of hominid and carnivore influence on archaeological bone assemblages. *Journal of Archaeological Science*, **15**, 483-502.

BOËDA É., 1993 - Le débitage Discoïde et le débitage Levallois récurrent centripète. *Bulletin de la Société Préhistorique Française*, **90** (6), 392-404.

BOËDA É., 1994 - *Le concept Levallois : variabilité des méthodes.* Paris, Éditions CNRS, Monographie du CRA, **9**, 280 p.

BONNICHSEN R., 1989 - Construction of Taphonomic Models: Theory, Assumptions, and Procedures. *In* R. Bonnichsen & M.H. Sorg (eds.), *Bone Modification*. Orono, University of Maine, 515-526.

BRAIN C.K., 1969 - The contribution of Namib Desert Hottentots to an Understanding of Australopithecine Bone Accumulations. *Scientific Papers Namib Desert Research*, **39**, 13-22.

BRAIN C.K., 1981 - *The hunters of the hunted? An introduction to African cave taphonomy*. Chicago and London, University of Chicago Press, 365 p.

BUIKSTRA J., & SWEGLE M., 1989 - Bone modification due to burning: experimental evidence. *In* R. Bonnichsen & E. Sorg (eds.), *Bone Modification*. University of Maine, Orono, 247-258.

BUNN H.T., 1983 - Comparative analysis of modern bone assemblages from a San hunter-gatherer camp in the Kalahari desert, Botswana, and from spotted hyena den near Nairobi, Kenya. *In* J. Clutton-Brock & C. Grigson (eds.), *Animals and Archaeology*, *Vol. 1. Hunters and their prey*. British Archaeological Reports International Series, **163**, Oxford, 143-148.

BUTZER K.W., 1989 - *Arqueología: una Ecología del Hombre*. Bellaterra, Barcelona, 424 p.

CACERES I., ROSELL J., & HUGUET R., 1998 - Séquence d'utilisation de la biomasse animale dans le gisement de l'Abric Romaní (Barcelone, Espagne). *Quaternaire*, **9**, 379-383.

CARBONELL E., & ROSELL J., 2004 - Ocupaciones de homínidos en el Pleistoceno de la Sierra de Atapuerca. *In* E. Baquedano & S. Rubio (eds.), *Zona Arqueológica. Miscelania en Homenaje a Emiliano Aguirre*. Alcalá de Henares, Museo Regional, **4**, 102-115.

CARBONELL E., GUILBAUD M., & MORA R., 1983 - Utilización de la Lógica Analítica para el estudio de los Tecno-complejos de los cantos tallados. *Cahier Noir*, **1**, 3-79.

CARBONELL E., MOSQUERA M., OLLÉ A., RODRÍGUEZ X.P., SALA R., VAQUERO, M., & VERGÉS, J.M., 1992 - New elements of the Logical Analytic System. *In* E. Carbonell, X.P. Rodríguez, R. Sala, & M. Vaquero (eds.), *First International Meeting on technical systems to configure lithic objects of scarce elaboration*. Universitat Rovira i Virgili, Reial Societat Tarraconenses, Cahier Noir, **6**, 5-61.

CONARD N.J., PRINDIVILLE T.J., & ADLER D.S. 1998 - Refitting bones and stones as a means of reconstructing Middle Paleolithic subsistence in the Rhineland. *In* J.-P. Brugal, L. Meignen & M. Patou-Mathis (eds.), *Economie préhistorique : les comportements de subsistance au Paléolithique*. Editions APDCA, Sophia-Antipolis, 274-290.

CRUSAFONT M., 1960 - Le Quaternaire espagnol et sa faune de Mammifères. Essai de synthèse. *Anthropos*, **1**, 55-64.

CRUZ-URIBE K., 1991 - Distinguishing hyena from hominid bone accumulations. *Journal of Field Archaeology*, **18**, 467-486.

DIBBLE H., 1984 - Interpreting Typological Variation of Middle Paleolithic Scrapers: function, style, or sequence of reduction? *Journal of Field Archaeology*, **11**, 431-436.

DOMÍNGUEZ-RODRIGO M., & PIQUERAS A., 2003 - The use of tooth pits to identify carnivore taxa in tooth-marked archaeofaunas and their relevance to reconstruct hominid carcass processing behaviours. *Journal of Archaeological Science*, **30**, 1385-1391.

EMERSON A.M., 1993 - The role of body part utility in small-scale hunting under two strategies of carcass recovery. *In* J. Hudson (ed.), *From Bones to Behavior: Ethnoarchaeological and Experimental Contributions to the Interpretation of Faunal Remains*. Southern Illinois University at Carbondale, Center for Archaeological Investigation, Occasional Paper, **21,** 138-155.

ENLOE J.G., DAVID F., & BARYSHNIKOV G., 2000, - Hyenas and hunters: zooarchaeological investigations at Prolom II Cave, Crimea. *International Journal of Osteoarchaeology*, **10**, 310-324.

FOSSE P., BRUGAL J.-P., GUADELLI J.-L., MICHEL P., & TOURNEPICHE J. F., 1998 - Les repaires d'hyènes des cavernes en Europe occidentale: présentation et comparaisons de quelques assemblages osseux. In *Économie Préhistorique, les comportements de subsistance au Paléolithique. XVIIIe. Rencontres Internationales d'Archéologie et d'Histoire d'Antibes.* Sophia Antipolis, Éditions APDCA, 43-61.

GIUSBERTI G., & PERETTO C., 1991 - Évidences de la fracturation intentionnelle d'ossements animaux avec moelle dans le gisement de "La Pineta" de Isernia (Molise), Italie. *L'Anthropologie*, **95**, 765-778.

GUILAINE J., BARBAZA M., GEDDES D., & VERNET J.-L., 1982 - Prehistoric human adaptations in Catalonia (Spain). *Journal of Field Archaeology*, **9**, 407-416.

HAYNES G., 1980 - Evidence of carnivore gnawing on Pleistocene and Recent mammalian bones. *Paleobiology*, **6**, 341-351.

HAYNES G., 1983 - Frequencies of spiral and green-bone fractures on ungulate limb bones in modern surface assemblages. *American Antiquity*, **48**, 102-114.

HENRY D.O., HALL S.A., HIETALA H.J., DEMIDENKO Y.E., USIK V.I., ROSEN A.M., & THOMAS P.A., 1996 - Middle Paleolithic behavioral organization: 1993 excavation of Tor Faraj, Southern Jordan. *Journal of Field Archaeology*, **23** (1), 31-53.

HENRY D.O., HIETALA H.J., ROSEN A., DEMIDENKO Y.E., USIK V.I., & ARMAGAN T.L., 2004 - Human behavioral organization in the Middle Paleolithic: Were Neanderthals different? *American Anthropologist*, **106**, 17-31.

HOPF M., 1971 - Vorgeschichtliche pflanzenreste aus ostspanien. *Madrider Mitteilungen*, **12**, 20-28.

JOHNSON E., 1985 - *Current developments in bone technology. Advances in archaeological method and theory*, **8**, Academic Press, 157-235.

KUHN S., 1992 - On planning and curated technologies in the Middle Paleolithic. *Journal of Anthropological Research*, **43** (3), 185-214.

KUHN S., 1995 - *Mousterian Lithic Technology. An Ecological Perspective.* Princeton, Princeton University Press, 209 p.

LAM Y. M., 1992 - Variability in the behaviour of spotted hyaenas as taphonomic agents. *Journal of Archaeological Science*, **19**, 389-406.

LUMLEY H. de, 1971 - *Le Paléolithique inférieur et moyen du Midi méditerranéen dans son cadre géologique*, *II, Bas-Languedoc, Roussillon, Catalogne*. V supplément à "Gallia Préhistoire", CNRS, 2 tomes, 443 p. et 445 p.

LUMLEY H. de, 2004 - *Le Sol d'Occupation Acheuléen de l'Unité archéostratigraphique UA 25 de La Grotte du Lazaret*. EDISUD, Aix-en-Provence, 493 p.

LYMAN R.L., 1994 - *Vertebrate Taphonomy*. Cambridge Manuals in Archaeology, Cambridge, Cambridge University Press, 524 p.

MAGUIRE J.M., PEMBERTON D., & COLLETT M.H., 1980 - The Makapansgat limeworks grey breccia: hominids, hyaenas, hystricids or hillwash. *Paleontologia Africana*, **23,** 75-98.

MANGADO J., & NADAL J., 2001 - Àrees de captació de primeres matèries lítiques durant la prehistòria del moianès: com utilitzaven els nostres avantpassats el territori. *Modilianum*, **24**, 43-53.

MAREAN C.W., & SPENCER L., 1991 - Impact of carnivore ravaging on zooarchaeological measures of element abundance. *American Antiquity*, **56**, 645-658.

MAREAN C.W., SPENCER L.M., BLUMENSCHINE R.J., & CAPALDO S.D., 1992 - Captive hyena bone choice and destruction, the schlepp effect, and Olduvai Gorge archaeofaunas. *Journal of Archaeological Science*, **18**, 101-121.

MAREAN C.W., & KIM S.Y., 1998 - Mousterian large-mammal remains from Kobeh Cave. Behavioral implications for Neanderthals and Early Modern Humans. *Current Anthropology*, **39** (Supplément), 79-113.

MYERS T.P., VOORHIES M.R., & CORNER R.G., 1980 - Spiral fractures and bone pseudotools at paleontological sites. *American Antiquity*, **45** (3), 483-490.

NOE-NYGAARD N., 1977 - Butchering and marrow fracturing as a taphonomic factor in archaeological deposits. *Paleobiology*, **3**, 218-237.

PATOU-MATHIS M., 1998 - Origine et histoire de l'assemblage osseux de la couche 5. Comparaison avec la couche 4 sus-jascente, non anthropique. *In* M. Otte, M. Patou-Mathis & D. Bonjean (eds.), *Recherches aux grottes de Sclayn*, vol. 2. L'Archéologie **79**, Liège, E.R.A.U.L., 281-295.

PATOU-MATHIS M., & LOPEZ-BAYLON I., 1998 - Analyse spatiale des ossements de la couche 5. *In* M. Otte, M. Patou-Mathis & D. Bonjean (eds.), *Recherches aux grottes de Sclayn*, vol. 2. L'Archéologie, **79**, Liège, E.R.A.U.L., 377-395.

PICKERING T.R., & EGELAND C.P., 2006 - Experimental patterns of hammerstone percussion damage on bones: implications for inferences of carcass processing by humans. *Journal of Human Evolution*, **33**, 459-469.

POTTS R.B., & SHIPMAN P., 1981 - Cutmarks Made by Stone Tools on Bones from Olduvai Gorge, Tanzania. *Nature*, **291**, 577-580.

SADEK-KOOROS H., 1975 - Intentional fracturing of bone: description of criteria. *In* A.T. Classon (ed.), *Archaeozoological studies*. North Holland Publishing Co, Amsterdam, 130-150.

SELVAGGIO M.M., & WILDER J., 2001 - Identifying the involvement of multiple carnivore taxa with archaeological bone assemblages. *Journal of Archaeological Science*, **28,** 465-470.

SERRA J.D.C., VILLALTA J.F., THOMAS J., & FUSTE M., 1957 - Livret Guide des excursions B2-B3. *Alentours de Barcelona et Moià*, V Congrés International del INQUA, Madrid-Barcelona, **3**, 5-25.

SHIPMAN P., 1983 - Early hominid livestyle: hunting and gathering or foraging and scavenging? *In* J. Clutton-Brock & C. Grigson (eds.), *Animals and Archaeology. Vol 1. Hunters and their prey*. British Archaeological Reports International Series, **163**, Oxford, 31-49.

SHIPMAN P., & ROSE J., 1983 - Early Hominid Hunting, Butchering, and Carcass-Processing Behaviors: Approaches to the Fossil Record. *Journal of Anthropological Archaeology*, **2**, 57-98.

SHIPMAN P., & ROSE J., 1984 - Cutmark Mimics on Modern and Fossil Bovid Bones. *Current Anthropology*, **25**, 116-117.

SPENNEMAN D., & COLLEY S., 1989 - Fire in a pit: the effects of burning on faunal remains. *Archaeozoologia*, **3**, 51-64.

STINER M. C., 1994 - *Honor among thieves: A zooarchaeological study of Neandertal ecology*. Princeton University Press, Princeton, 447 p.

STINER M.C., 2002 - Pourquoi ossements d'ours et outillages coexistent-ils dans les sites en grotte paléolithiques ? Observations provenant du pourtour méditerranéen. *In* T. Tillet & L.R. Binford (eds.), *L'ours et l'Homme*. Liège, E.R.A.U.L., **100**, 157-165.

STINER M.C., KUHN S.L., WEINER S., & BAR-YOSEF O., 1995 - Differential burning, recrystallization, and fragmentation of archaeological bones. *Journal of Archaeological Science*, **22**, 223-237.

TERRADAS X., 2003 - Discoid flaking method: conception and technological variability. *In* M. Peresani (ed.), *Discoid lithic technology. Advances and implications*. British Archeological Reports International Series S1120, Oxford, 19-32.

TISSOUX H., FALGUÈRES C., BAHAIN J-J., ROSELL J., CEBRIA A., CARBONELL E., & SERRAT D., 2006 - Datation par les séries de l'Uranium des occupations moustériennes de la grotte de Teixoneres (Moia, Province de Barcelone, Espagne). *Quaternaire*, **17** (1), 27-33.

VALENSI P., & PSATHI E., 2004 - Faunal exploitation during the Middle Palaeolithic in South-eastern France and North-western Italy. *International Journal of Osteoarchaeology*, **14**, 256-272.

VALLVERDÚ J., ALLUÉ E., BISCHOFF J. L., CÁCERES I., CARBONELL E., CEBRIÀ A., GARCIÁ-ANTÓN, M. D., HUGUET R., IBÁÑEZ N., MARTÍNEZ K., PASTÓ I., ROSELL J., SALADIÉ, P., & VAQUERO M., 2005 - Short human occupations in the Middle Palaeolithic level I of the Abric Romaní rockshelter (Capellades, Barcelona, Spain). *Journal of Human Evolution*, **48**, 157-174.

VAN PEER P., 1992 - *The Levallois Reduction Strategy.* Monographs in World Archaeology, **13**, Prehistory Press, Madison, Wisconsin, 137 p.

VAN PEER P., 1995 - Current issues in the Levallois problem. *In* H.L. Dibble & O. Bar-Yosef (eds.), *The Definition and interpretation of Levallois technology*. Monographs in World Archaeology, **23**, Prehistory Press, Madison, Wisconsin**,** 1-10.

VAQUERO M., 1997 - *Tecnología Lítica y Comportamiento Humano: Organización de las actividades Técnicas y Cambio diacrónico en el Paleolítico Medio del Abric Romaní (Capellades, Barcelona)*. Àrea de Prehistòria. Departament d'Història i Geografia, Tarragona, Universitat Rovira i Virgili, PhD, 872 p. (unpublished).

VAQUERO M., 1999a - Intrasite spatial organization of lithic production in the Middle Palaeolithic: the evidence of the Abric Romaní (Capellades, Spain). *Antiquity*, **73**, 493-504.

VAQUERO M., 1999b - Variabilidad de las estrategias de talla y cambio tecnológico en el Paleolítico medio del Abric Romaní (Capellades, Barcelona). *Trabajos de Prehistoria*, **56**, 37-58.

VAQUERO M., VALLVERDÚ J., ROSELL J., PASTÓ I., & ALLUÉ E., 2001 - Neandertal behavior at the Middle Palaeolithic site of Abric Romaní, Capellades, Spain. *Journal of Field Archaeology*, **28**, 93-114.

VILLA P., & MAHIEU E., 1991 - Breakage patterns of human long bones. *Journal of Human Evolution*, **21**, 27-48.

VILLA P., & SORESSI M., 2000 - Stone tools in carnivore sites: the case of Bois Roche. *Journal of Anthropological Research*, **56**, 187-215.

WHITE T.D., 1992 - *Prehistoric Cannibalism at Mancos 5MTUMR-2346*. Princeton NJ, Princeton University Press, 492 p.