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ORIGINAL PAPER

An autumn at Pincevent (Seine-et-Marne, France): refitting for an ethnographic approach of a Magdalenian settlement

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Abstract

To provide an image of the Magdalenians who came to hunt reindeers on the banks of the Seine River 13,000 years ago, we largely, but not only, relied on flint refitting that is just one of the many analytical tools. This reconstruction of a Paleolithic camp shows habitations and workshops extending over an area of nearly 5.000 m^2. The refitted debitage sequences enabled us to identify individuals from their performances. There are young apprentices knapping for un-useful production, only to acquire a skill. Productive knappers can be experienced or only competent. By applying a frame of reference to the refitting done in each habitation, we have identified knappers whose skills we have assessed and that we can count. Their numbers vary according to the different habitations, and we can propose an evaluation of the size of the group and show that the organization of the camp and of each of the habitations obeyed rules. The connections highlighted for each category of remains do not always have the same intensity nor the same meanings. By analyzing the relationships between the units indicated by the flint, but also stones and fauna refittings, we have outlined, probably in a very fragmentary way, some aspects of the social organization of those Magdalenian families, suggesting that certain relationships of dependency existed between them: three families accept a particular status of the master of the fourth residence whose social unit appears different from the others, and with whom the community of the camp maintained relationships of allegiance.

Keywords Refitting · Flint knapping · Performance · Magdalenian · Nomadic camp · Reindeer hunting

Introduction

Thirty years ago, in 1987, during the "Big Puzzle" symposium of Monrepos (Germany), we presented, with the late Sylvie Ploux and Pierre Bodu, a state of our research drawn on lithic refitting studies. Refitting allowed us a first approach to recognizing individual knappers at Pincevent, particularly in a habitation unit of the Magdalenian level IV20, as well as highlighting relationships between various units (Karlin et al. 1990). Thirty years later, a new "Big Puzzle" meeting in Tarragona (Spain) revisited the issue of refitting. This international workshop has shown that, while research is being conducted today on the use of new technologies to facilitate refitting, the primary objective remains their contribution to the understanding of prehistoric occupations and, thereby, to that of human behavior.

Thus, we would like to present the results of a research published in a monograph in which refitting, whether of flint, stone, or animal matter, plays an important role (Julien and Karlin 2014).[1] We have tried to bring back to life an entire camp set up on the level IV20 at Pincevent.

What does the very principle of refitting bring? In his inaugural lecture at the "Collège de France," André Leroi-Gourhan considered that to implement an ethnology of prehistory, it was necessary to characterize cultural entities that cover as completely as possible the different fields of activity of Men of the past, including that which does not materialize directly in the unearthed objects, but in the relationships that these objects maintain between them (Leroi-Gouran 1970). Refitting is an essential way to give meaning to these relationships (Cahen 1987). But as a simple tool of analysis, it must be associated with other tools to allow the interpretation of a prehistoric occupation. Our results, at the end of a collective

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[1] This is why numerous bibliographical references refer back to the chapters of this monograph, which results from a collective research.

research, depend on a confrontation of approaches that interact with each other to give meaning to our data. Also, if refitting takes an important place in this presentation, it will not always be the only common thread, but we will see how, during our demonstration, it regularly helps us to better understand social organization.

After 14 years excavating in the caves of Arcy-sur-Cure (Yonne, France), with long stratigraphy, the discovery of the open-air site of Pincevent in 1964 allowed A. Leroi-Gourhan to develop resolutely palethnological research, insofar as, on the banks of the Seine River, the levels of occupation were clearly separated from each other by flood silt deposits and the human occupations extended over vast areas. It became possible for him to highlight the various prehistoric activities and the way they were organized in space, being certain that this organization should reflect part of the social organization (Leroi-Gouran and Brézillon 1966, 1972). With this in mind, for the first time, flint refitting became a systematic tool of analysis (Julien et al. 1992). What first interested A. Leroi-Gourhan was the time restored by the succession of the refitted removals that he could inscribe in space. It took several years and numerous refitting sessions of debitage sequences, a particularly time-consuming operation, before his team, from an interpretation of the refitting, could inscribe flint knapping technology in his preoccupations (Bodu 1983).

Pincevent is located on a lower terrace of the Seine River, between a broad valley at the Yonne/Seine confluence upstream and a narrow between two plateaus downstream. The Magdalenians came to settle in this strategic point more than twenty times, around — 14.000 (Orliac 1989). Most of the time, they came to hunt wild reindeer during the autumn migration (David and Enloe 1992). The river was still high at this season; the herds had to swim across it, a time when animals are the easiest to kill.

The level considered here is situated at the top of the site's settlement sequence. It was recognized on more than 4500 m^2 and shows numerous concentrations of more or less dense remains (Fig. 1).

Equipment and products of the hunt

Coming from the center of the Paris Basin with a small batch of tools and blades of tertiary flint, the Magdalenians were soon picking up numerous flint blocks on the banks of the Seine River, fallen from Cretaceous cliffs and carried by the river. The total weight of flint brought back to the site is about 300 kg and the number of knapping wastes about 30,000, which is not huge. This means that the knapping activity did not represent a significant investment during the stay. As shown by the refitting, most of the debitages are relatively simple, due to the volume and average quality of the available blocks (Ploux et al. 2014a). The objective of the production was twofold: narrow bladelets about 5 cm in length, most of which intended to arm the points of the reindeer antler spears, as evidenced by the exceptional discovery of a reindeer point fragment with flint barbs still fixed on it; and wider and longer blades, up to 15 cm, that could be used untreated as a knife or processed by retouching into endscrapers to work hides, borers with beaks of varying thicknesses to perforate different types of materials, and burins to cut reindeer antler or bone into segments (Fig. 2) (Julien 2014). The number of backed bladelets is significantly higher (59%) than that of domestic tools, which confirms the importance of the hunting activity, even if it takes several bladelets to make a single hunting weapon. Moreover, the relative representation of the types of domestic tools shows, in a classical way for the Magdalenian, the preponderance of burins, but also, more surprisingly, of borers compared with endscrapers. Those tools showed an important surface alteration, but in some rare cases, E. Moss could recognize meat cutting, skin processing, and antler graving (Moss 1983, 1986; Moss and Newcomer 1982).

On level IV20, the Magdalenians also brought more than 800 kg of stones collected on the banks of the nearby river. Many have been used to organize the hearths. Large slabs or large blocks were selected as furniture items, tables, anvils or seat-blocks. Two hundred eighty rounded and easily manipulable pebbles, of various weights and texture, with traces of use, can be added to these elements: hammers for flint knapping, spearhead or needle polishers, grinders and pestles for coloring materials, smoothers that were rubbed on soft materials such as hide probably in order to soak it with fat or coloring materials (Julien and Beyries 2014). All these elements have been subjected to refitting, which restores the initial chosen volume but also accounts for the circulation of the fragments (Fig. 3).

The traces of vegetal wood working can be noted, also a likely occupation of the craftspeople of Pincevent. This reminds us that the place of this material, now destroyed, must have been much more significant than the one we are granting it today for lack of evidence (Julien et al. 2014d).

Having come there to hunt, the Magdalenians slaughtered at least 71 reindeers (adults, juveniles et fawns under a year old); this corresponds to a total of 3518 determinate bone remains, spread over the entire level IV20 (David et al. 2014). Beyond the edible materials, this game was also a source of raw material: hides for clothing, bedding, and housing; antlers for making tools and weapons. Reindeer antler working was significant during the stay and the Magdalenians took advantage of the mass supplying of this raw material (Averbouh 2014). Twenty reindeer antler spearheads were found, some much damaged, others complete, left, or forgotten by a hearth (Pétillon 2014) (Fig. 4).

Refitting to demonstrate the existence of a camp

Level IV20 has, as we have said, numerous more or less dense concentrations of remains centered on hearths: each of them

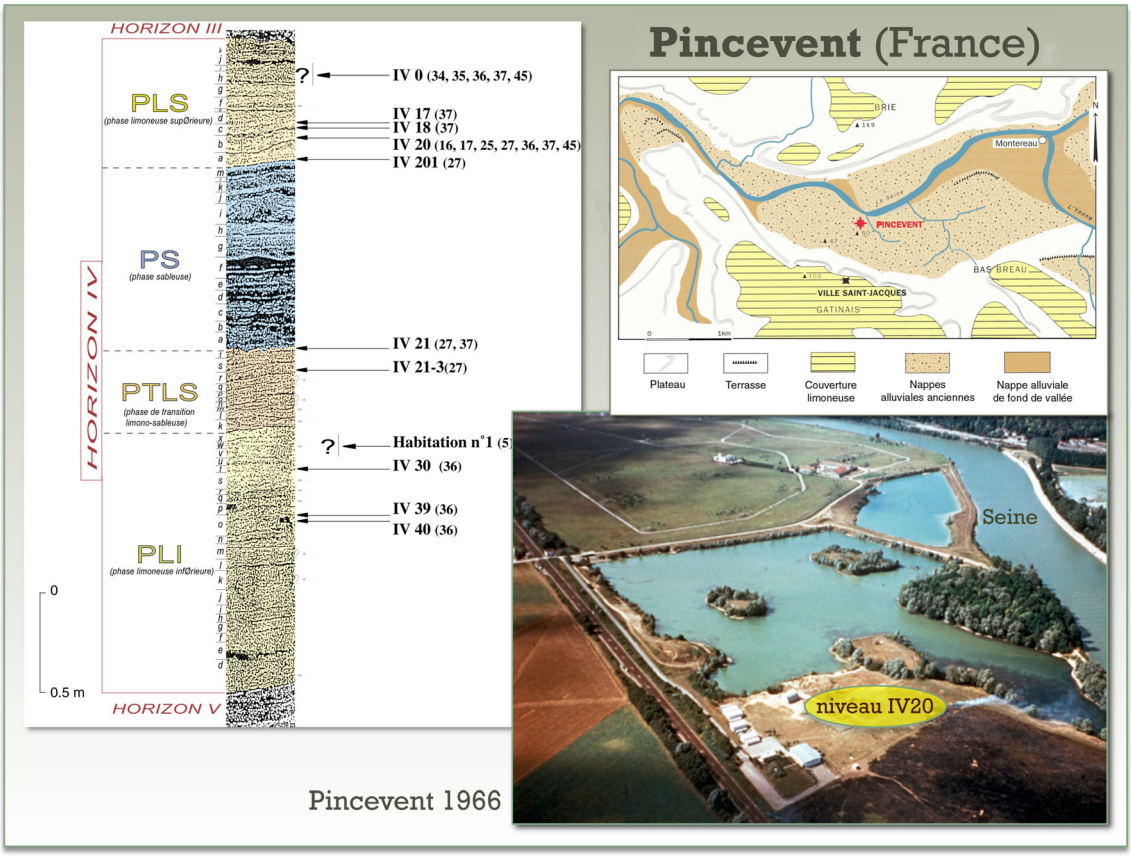

Fig. 1 Pincevent (Seine-et-Marne, France). **a** Location of the site; b) a view of the site; c) Stratigraphy of the Magdalenian levels: level IV20 is located at the top of the occupation sequence

was considered as an "occupation unit." These concentrations appeared to be based on the same level of silt, but were they really contemporary?

At first, links between fragments of heated stones found in various units made it possible to show that stone transportations had taken place. The slabs and blocks used in the hearths were fractured by heat. Some of these fragments were taken and transported for use in another hearth, to be used as portable element in an external activity area or again to be immersed in liquids for cooking food. But there was nothing that allowed saying whether these stone transportations from one place to another corresponded to activities carried out during the same stay, or if the Magdalenians, during a following visit, had been able to recover them in abandoned facilities (Julien and Karlin 2002).

On the other hand, the flint connections made it possible to validate the hypothesis of a single stay. Numerous refittings of debitage sequences and refits of laminar blanks showed a network of connections between most of the occupation units (Bodu 1993). These transportations of flint products, especially when they are bidirectional, clearly illustrate a movement of occupiers between the various settlements and confirm the contemporaneity of the groups settled on level IV20 (Orliac et al. 2014).

Evidence of game sharing between several of the various units was even more decisive (Enloe 1991; 1992). Precise measurements of articular surfaces have made it possible to refit some long bones of anterior or posterior reindeer limbs or to highlight pairs of long bones or mandibles. It became possible to assign remains scattered in various parts of the camp to the same animal. In Pincevent, the distribution of carcass component refits provides a consistent model of shared food between the units of occupation, with the exception of very young animals found complete in the units (Enloe and David 1989, 1992, 2014). Since the distribution of edible material can only be done over a very short period of time, the simultaneity of the occupations became absolutely certain (Fig. 5).

It is therefore a camp, corresponding to a single time of stay that we estimate at several weeks. Because of its extent and the mass of data provided, this camp is undoubtedly quite exceptional for the Upper Paleolithic. Groups of Magdalenians gathered at the same time on the banks of the Seine River to participate in a collective hunt. This mass slaughter of reindeers probably involved all members of the camp, hunters and beaters, which explains why there may have been a division of carcasses between groups of occupiers.

In addition, the detection of male and female reindeer, of 16-month-old juveniles and 4-month-old fawns in the bone remains

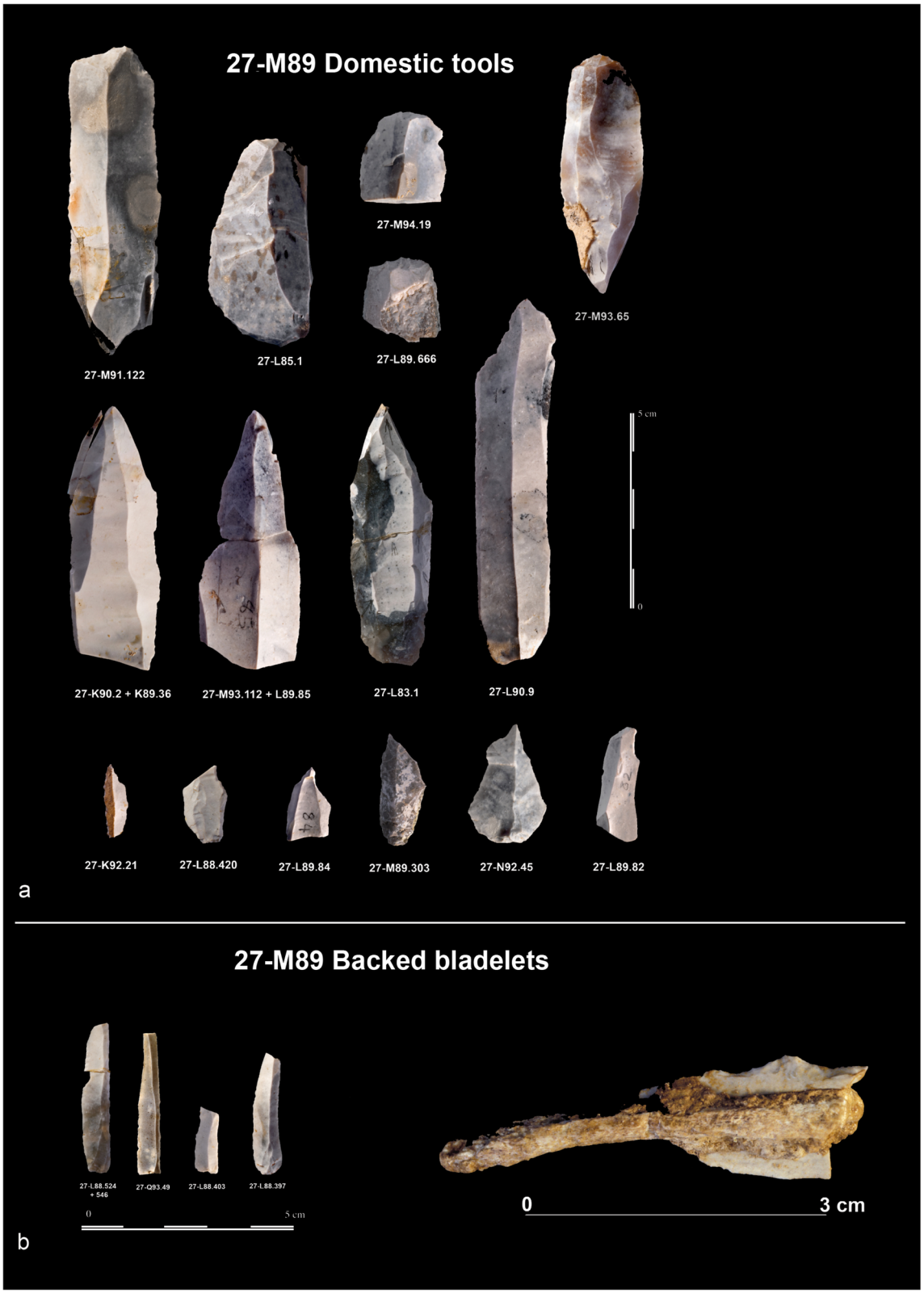

Fig. 2 Examples of flint equipment of the camp (unit 27-M89). **a** Domestic tools. **b** Backed bladelets. **c** Fragment of a reindeer antler spear, with two backed bladelets still attached

suggests that the slaughter involved a herd moving towards winter pastures around September and October, a hypothesis confirmed by the study of the teeth (Enloe and David 1997). This is the time when the animals are at their best after the

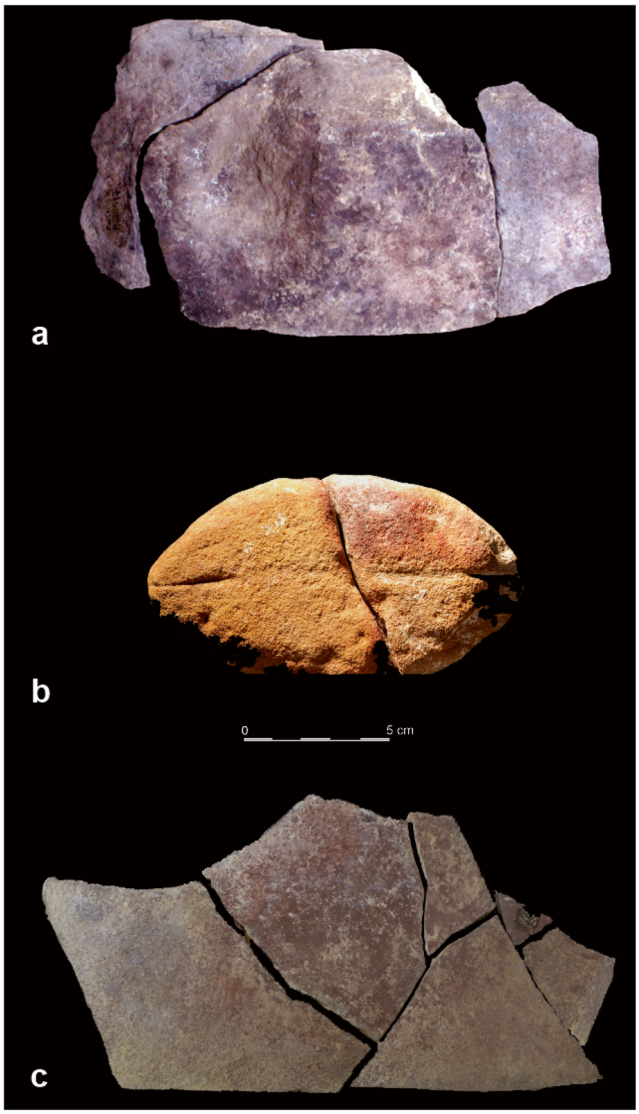

Fig. 3 Examples of refitting (unit 27-M89). **a** Heated stones. **b** Pebble-tool (polisher). **c** Plaque with ochre (c)

summer. Even without counting the meat intake of some 13 fawns, this represents about 4200 kg of meat and fat, which suggests not only immediate consumption, particularly of what is difficult to keep or carry, but also a preparation for winter stores.

Can we identify the habitations of these hunters?

Four groups

A quantitative spatial approach allowed to first consider and discriminate the various structural entities of the camp. The estimates of the numbers of stones, osseous remains, or lithic productions vary greatly according to the concentrations. Although the same types of remains are represented everywhere, the variations that exist in their relative compositions refer to different spectra of activity (Julien et al. 2014a). Various calculation methods have led us to separate these concentrations into four groups (Fig. 6).

Two criteria are distinguishing between the central group and the three others. It alone contains 66% of the material with a predominance of osseous remains that reflect a consumption of food as well as backed bladelets (known to be associated with reindeer antler points). The presence of these remainders of hunting weapons indicates a significant activity of manufacturing and repairing of barbed spears. In the peripheral groups, the number of osseous remains is proportionately lower and that of the backed bladelets is always lower than that of the domestic tools (Table 1).

Besides, the units of the central group have an asymmetrical distribution of the remains. A ring-shaped area of activity associated with a concentration of tools and an ocher-colored soil extends around a large built domestic hearth. The nature, number, and variety of evidence confirm that this is the place where the best part of daily activities, food preparation and consumption, manufacture and maintenance of tools and other equipment, were carried out; hunting weapons were also prepared near this hearth. This area continues on one side with a relatively empty area, interpreted as the location of a covered shelter and, on the opposite, with an area cluttered with waste. This is in fact a garbage dump area where residues from manufacturing and consumption activities have been rejected. The existence of these garbage dumps indicates that the central area of activity must have been cleared regularly (Leroi-Gouran and Brézillon 1972; Julien 1984) (Fig. 7a).

In the other three groups, the remains are organized in a concentric distribution around the hearths that remain attraction poles, with densities of remains decreasing in a halo. This organization suggests completely open spaces, with no marked dumping areas and no trace of a possible shelter (Fig. 7b). The variations in the number of osseous remains, in the relative proportions of the domestic tools and in those of animal hard matter objects testify to, for each unit, different specific functions.

The three peripheral groups

– The Southern Group is a multipurpose area where multiple hearths were set up. Some have only functioned once, and others have been re-lit several times; they could even have functioned simultaneously. These hearths are highly varied in morphology, simple or stone-filled basins, flat hearth ignited directly on the ground without preparation but whose irregular shape with extensions of heated earth suggests a diversified regulation of the heat by spreading embers. The densest area gathers five hearths, plus two hearths located at a distance on each side. Flint knapping, actively carried out,

Fig. 4 Reindeer antler objects. **a** Shed antler abandoned on the floor (Northern Group). **b** Grooved spear point (unit 36-V105—Central Group). **c** Pierced baton tip (Northern Group)

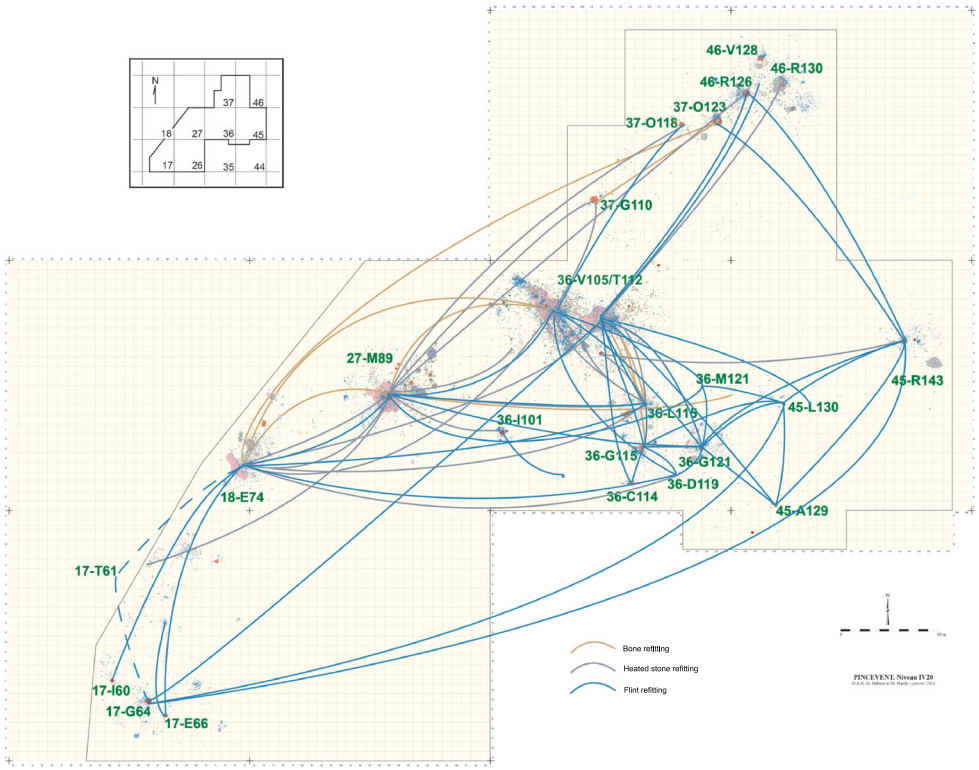

Fig. 5 Cumulative mapping of heated stone, flint, and bone connections confirming the simultaneity of occupation in all the units of the camp

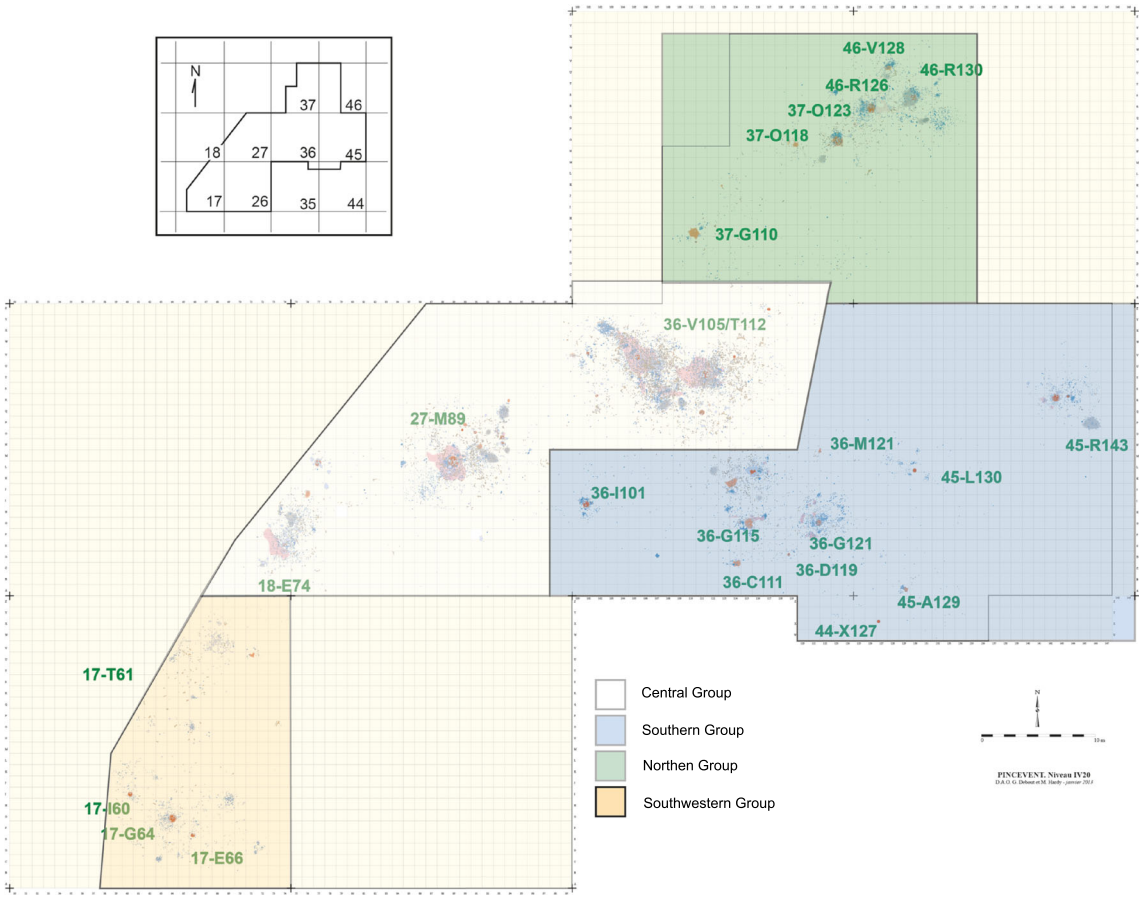

Fig. 6 Topographical division of the camp in four large groups of occupation

provided tools used on site or carried to the habitations. The tools on pebble and a large number of untreated blades extracted from the knapping clusters are demonstrating the extent of manufacturing and processing activities, including hide working, especially around the most eastern hearth. It is clear that activities that required both space and the use of heat could not take place near the domestic hearths inside the habitations. Outside of this "constellation," three small hearths to the south were the location of clumsy knapping exercises (Fig. 8). The refitting suggests that if all the inhabitants of the camp found themselves at one time or another in this communal area of workshops, the links are more

Table 1 Quantitative comparison of the groups defined according to the numbers of each of the categories of remains (light blue, numbers expected in a normal representation; dark blue, numbers superior to the expected values in a normal representation; gray, numbers inferior to the expected value). The values in bold are higher than the expected values and the italics one are lower

Spatial Groups	Stones	Bones	Lithic	Backed bladelet	Domest. Tools	Pebble tools	Tools HAM	TOTAL	%
Central Group	2964	**3518**	**19391**	**1018**	**560**	150	**44**	**27645**	*65.8*
Expected values	*3355*	*2815*	*19889*	*797*	*556*	*194*	*38*	*27644*	
Southern Group 36-45	**1178**	197	**4023**	113	**161**	**58**	3	**5733**	*13.7*
Expected values	*696*	*584*	*4125*	*165*	*115*	*40*	***8***	*5733*	
North Group 37-46	**677**	444	**3370**	73	**98**	**70**	**12**	**4744**	*11.3*
Expected values	*576*	*483*	*3413*	*137*	*95*	*33*	*7*	*4744*	
South-West Group 17	278	117	**3430**	6	26	17	0	**3874**	*9.2*
Expected values	*470*	*395*	*2787*	*112*	*78*	*27*	*5*	*3874*	
TOTAL	**5097**	**4276**	**30214**	**1210**	**845**	**295**	**59**	**41996**	*100*

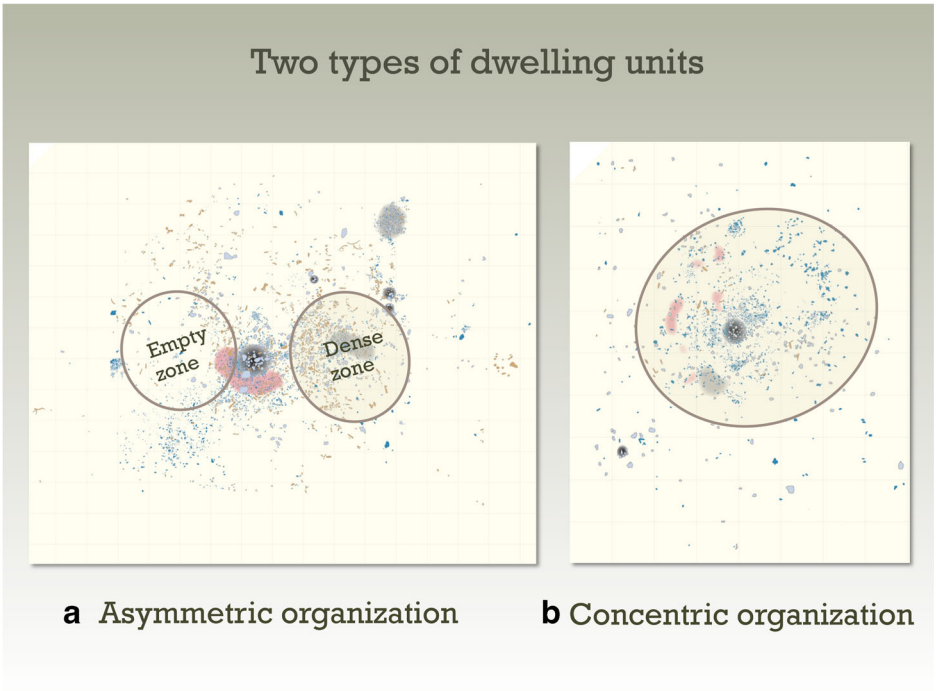

Fig. 7 Difference of distribution of the remains around a hearth between a habitation (**a**) and an outdoors workshop (**b**)

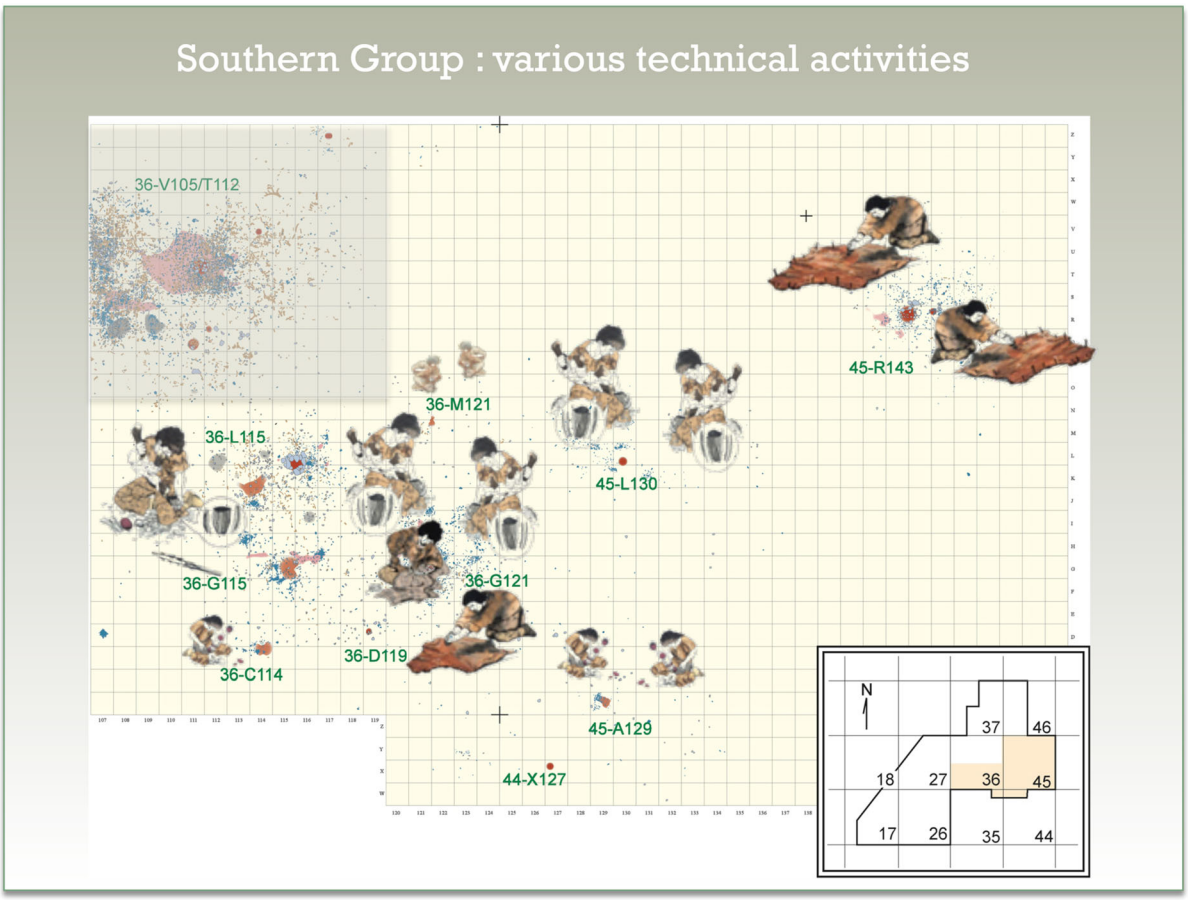

Fig. 8 Location of the areas of activities and evocation of their functions in the Southern Group (drawings from G. Tosello)

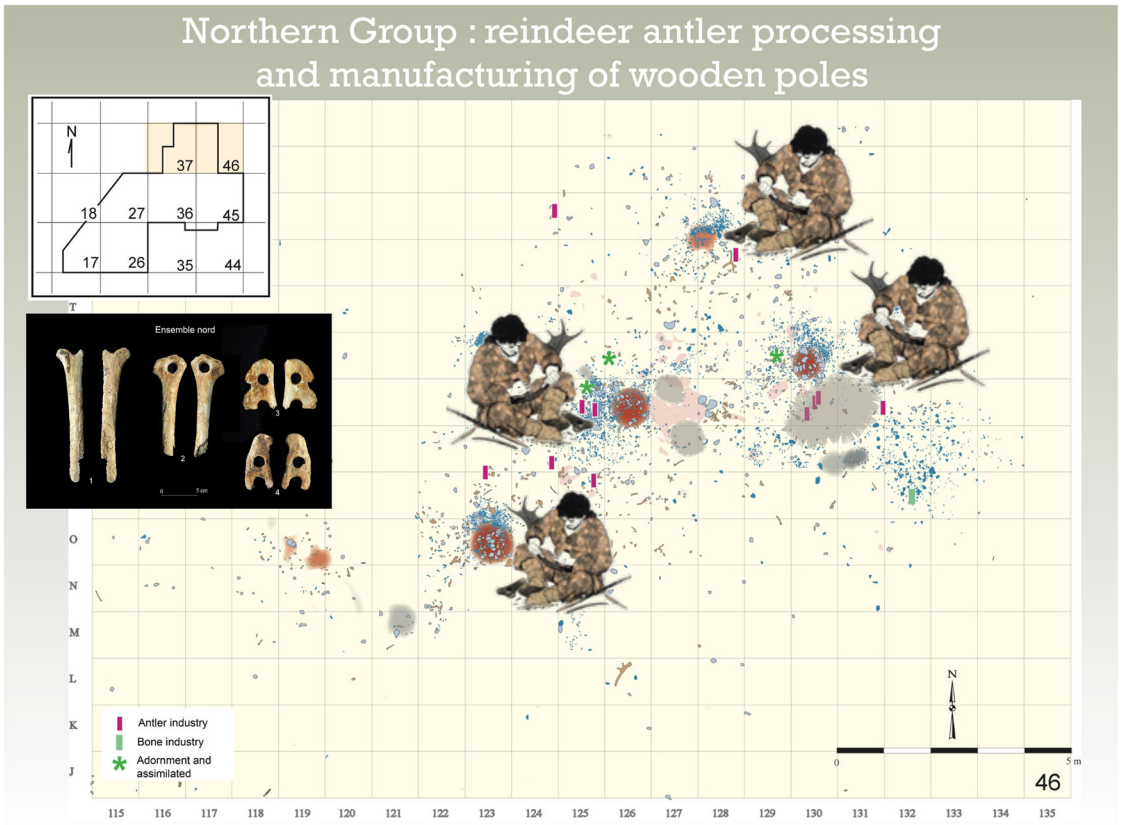

Fig. 9 Location of the areas of activities and evocation of their functions in the Northern Group (drawings from G. Tosello)

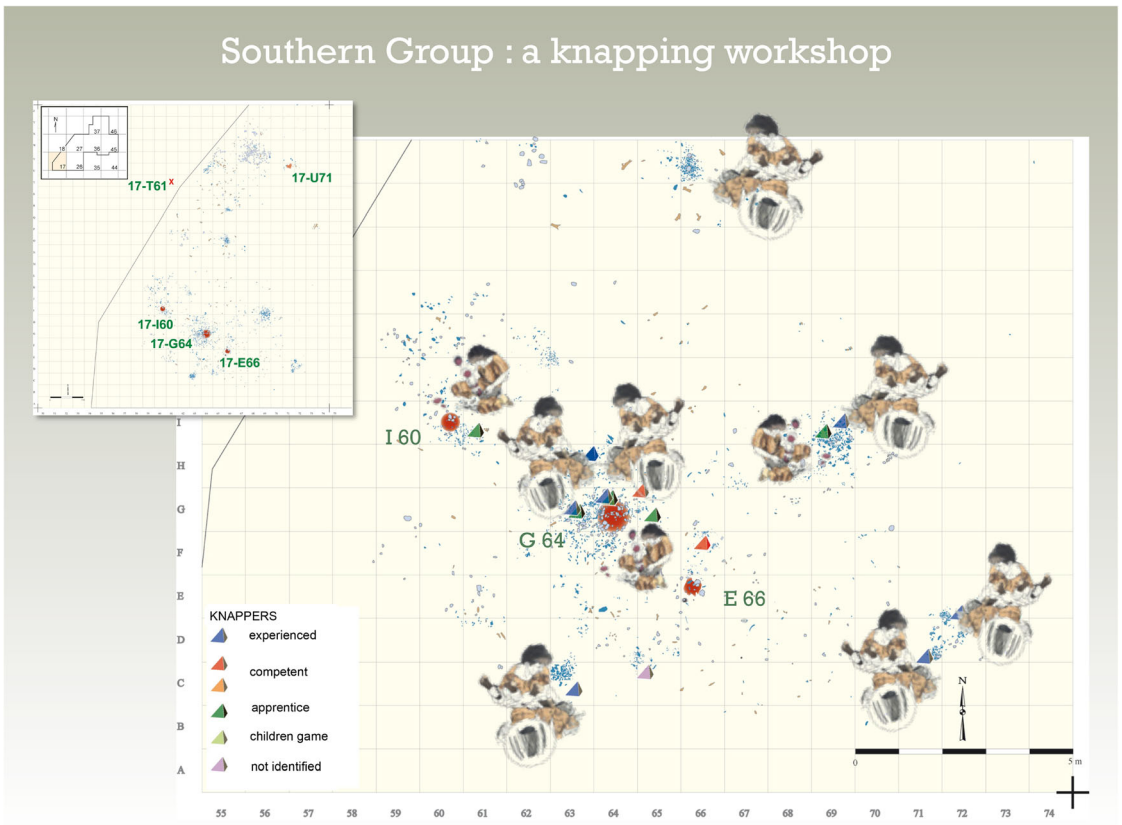

Fig. 10 Location of the areas of activities and evocation of their functions in the Southwestern Group (drawings from G. Tosello)

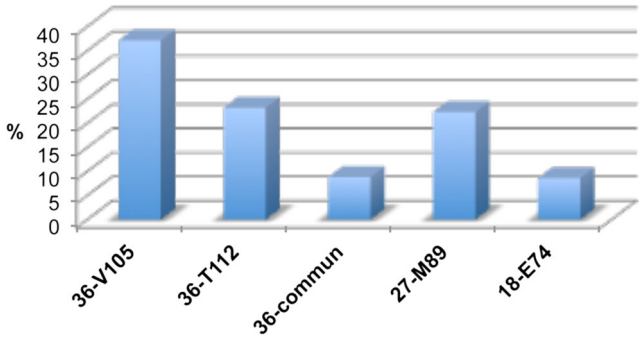

Fig. 11 Relative representation of the total number of occupation remains in the four residential units. A common space to units V105 and T112, not attributable to one or the other, is singled out

numerous with the two neighboring residences 36-V105 and T112 (Bodu et al. 2014).

– In the Northern Group, close to water, three hearths, varying in their configuration as previously, and placed in a triangle, seem to have functioned in complementarity and probably at certain times simultaneously. Indeed, the workstations are set up on their edges so as to be opposite to each other. Two other hearths, more on the outside, are completing this pole (Fig. 9). The chain of production is dedicated to the extraction of reindeer antler rods and their processing into spearheads. The presence of coarse flint push planes suggests the smoothing down of vegetal wood stalks that could have been hardened by fire judging by an extension of the embers in one of the hearths. Several vertebrae of small fish associated with grinders and concentrated near one of the hearths could be the residues of possible glue manufacturing; it would have been used for the fitting of various elements constituting these hunting weapons. The links show that in this area, various members of the camp had to work in cooperation (Julien et al. 2014b).

– The Southwestern Group was partially destroyed by the works of the sand quarry that enabled the discovery of the site. Refitting do connect this area to the rest of the camp we know, but it also appears that it is linked to at least one residence located further west, but destroyed before our arrival, as reported by the amateur archeologists who surveyed the exploitation of the sand quarry (Julien et al. 2014c). At the center of the preserved group, a large hearth and a little further two other small ones are found. There, flint knapping was almost exclusively carried out and, beyond the central knapping station near the hearth, six other debitage stations were highlighted, two of which were of a clumsy type (Fig. 10).

Fig. 12 Different production modes of blades and bladelets. **a** Production of long blades, 45-N128.1: after a simplified shaping out, the debitage, proving a good technical level, proceeds in a semi-rotating way, from one single platform, thus focusing on the length of the block for the production of blades (© Bodu). **b** Production of small blades and bladelets by intercalated debitage, 36-I121.57: the strategic use of a natural volume allowed, without vain shaping out, a bladelet production through intercalated debitage, while a debitage rational chain allowed high production (© Bodu). **c** Cumulated production of blades and bladelets, 36-W103.7: on a simple scheme, after a careful shaping out, a steady and progressive reduction of the core moves from a production of blades to a production of small blades/bladelets (© Bodu). **d** Production of bladelets, 27-D77.4: scanty production on a small block by an experienced knapper working on a flaking angle inferior to 70°.

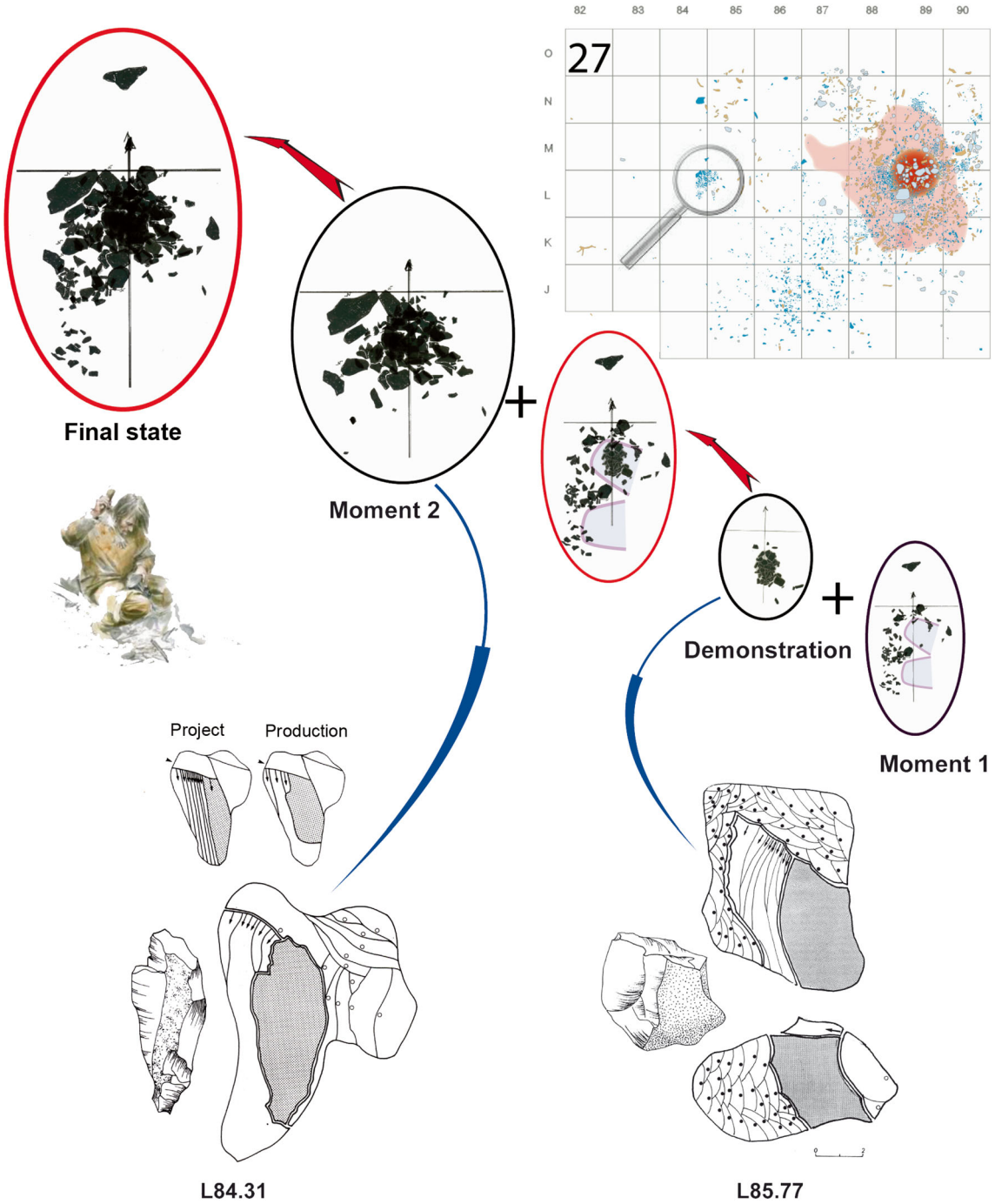

Fig. 13 Progress of the knapping lesson, from the microstratigraphical analysis of the flint deposits (unit 27-M89)

The Central Group

The four units of the Central Group are indeed habitations. They have been named after their metric coordinates, 18-E74, 27-M89, 36-V105, and 36-T112.[2] The occupiers of these four habitations moved away when their tasks required space to spread out and, no doubt, also diversified uses. This explains why the workshops that make up the Southern, Northern, and Southwestern Groups are, in fact, the annexes of the residential units constituting the Central Group.

We observed that the four units of residence show strong quantitative differences between them (Fig. 11). Habitations V105 and T112, adjacent to each other, account for 69% of all the evidence in this Central Group. If we separate them,

[2] We will simplify here by indicating only the letter and the number that indicate the square meter of the main hearth around which the residence developed

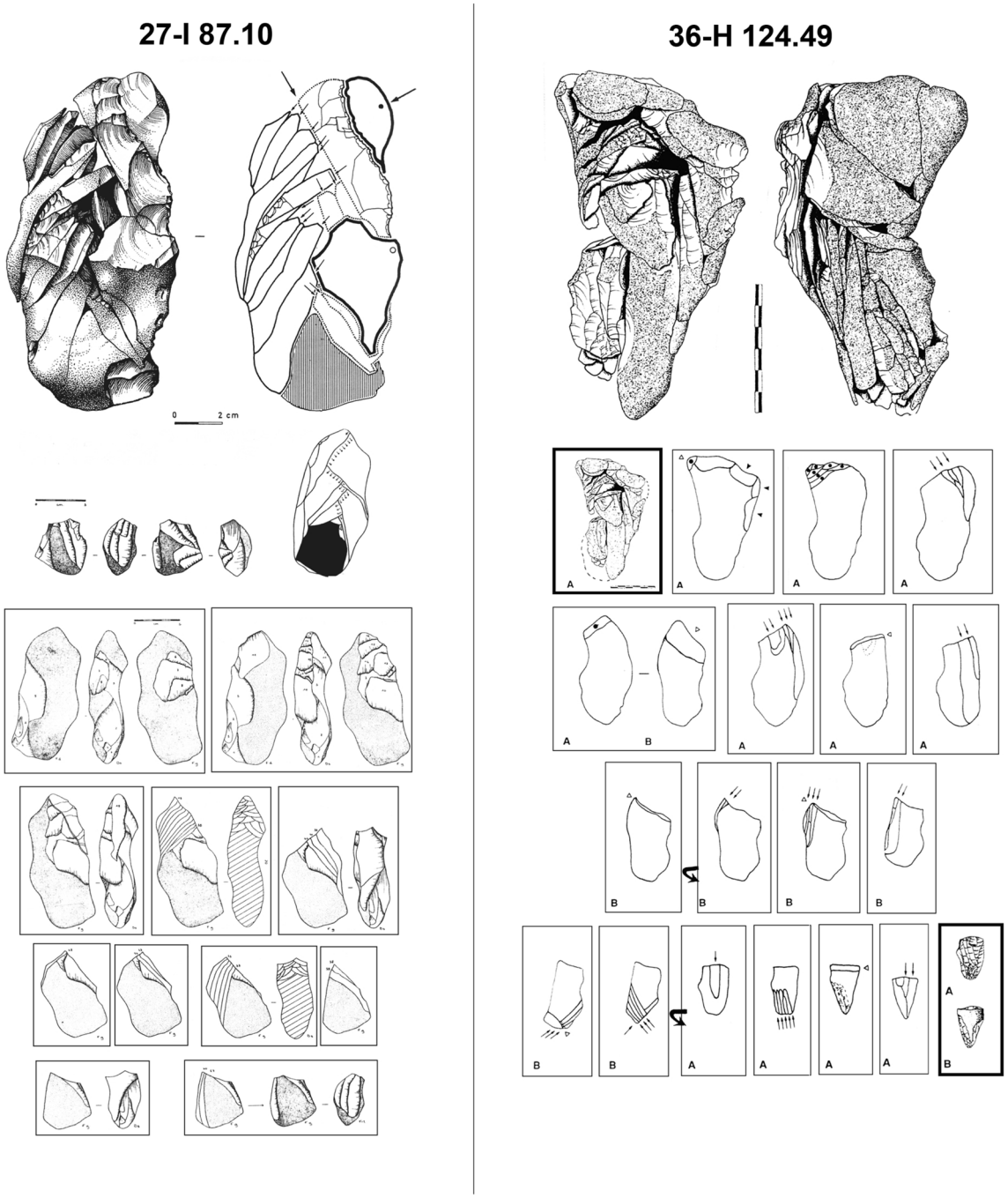

Fig. 14 The productive knappers. **a** Example of a sequence, 27-I87.10, carried out by an experienced knapper for a production of short blades: the herring bone pattern reveals an adaptation to the nodule's volume and a mastery of concepts for a project where the variability of the products is part of the processing scheme (refitting drawing R. Humbert, core and proceeding of the sequence drawing S. Ploux). **b** Example of a sequence, 36-H124.49, carried out by a merely competent knapper for a cumulative production of blades/bladelets; on the same surface, a semi turning debitage is successively unipolar and bipolar; the knapper, through a reduced shaping out, took advantage of this medium size nodule (drawing D. Molez)

setting aside a common garbage dump (Leroi-Gourhan and Brezillon 1972), V105 remains the majority and T112 becomes comparable with M89 while E74 is by far the least dense. Rather than explaining these differences by varying staying durations, we suggest that the reason for this is the respective number of occupiers in each of them. Our initial hypothesis is that for such an important hunting meeting during autumn reindeer migration, all the actors must be there, on the spot, at the same time. Hunting a mass of reindeers at this moment needed the gathering of all the active forces because of the work to do (hunting, beating, game handling). The total of these occupiers makes the

group that settled on these banks of the river, knowing that at least one habitation is missing in the west.

Refitting to identify the occupiers through their performances

Each refitting of a flint knapping sequence is a piece of data that we translate into a *chaîne opératoire*. For each refitted block, the *chaîne opératoire* highlights the internal logic of the knapping operation and each one fits in a duration that it is possible to approach (Pelegrin et al. 1988).

From the similarities between the various reconstituted *chaînes opératoires*, we have constructed a scheme, an image of an ideal *chaîne opératoire* that the Magdalenians of the Paris Basin had in mind. This scheme was part of their heritage: everyone knew how it was done, which does not mean that everyone did it (Chamoux 1978). It is based on a single principle that makes it possible to obtain a series of similar blanks from a block. This principle is based on a three-dimensional perception of the block whose potential is conceived as a volume (Ploux et al. 2014a). In Pincevent, the objectives of the debitage were, on the one hand, the manufacturing of bladelets for hunting purposes, making 59% of the retouched elements and, on the other hand, that of blades for domestic use, used untreated or processed. The refitting show that these two objectives can be achieved independently on blocks of varying volumes or be juxtaposed in

Fig. 15 On some refittings, the demonstration of strong variations in the expertise levels applied during the same sequence allows identifying the recovery by an apprentice of cores abandoned by productive knappers. Here, an abandoned long blade core, 36-0112.4, was recovered by an apprentice who disfigured the flaked surface by knapping accidents (© Bodu)

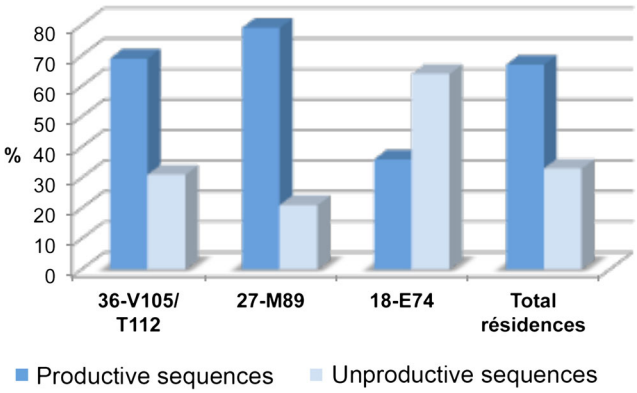

Fig. 16 Relative representation of the number of productive and non-productive sequences in each residential unit

the same sequence, either succeeding one another during the processing, as the core reduces in size, or by interlocking, which corresponds to intercalated debitage in which the ridges of laminar scars are guiding bladelet extractions (Fig. 12).

If the scheme depends on knowledge, that is knowledge disseminated at a collective scale, it is interpreted in terms of expertise, namely the "ability to do" that develops at an individual scale. Any reconstituted *chaîne opératoire* reflects a performance by one individual. But each individual implements at a given time a know-how of his own (Ploux 1989). At the end of the reconstruction of a sequence, we have a corpus of data in which each of the gestures made is characterized in terms of effectiveness with respect to a set of variously constraining situations. A comparison can therefore be made by considering the different complexities of the devised schemes, the range of gestures made, the degree of appropriateness of the gestures to the situations to which they were supposed to respond, and the degree of stability or variability in the control of gestures during the sequence. The more complex the division of each *chaîne opératoire* is, the more numerous the combinations of variables will be, whether they are strategic moments normally unavoidable, tactical moments that can be the subject of choice, or simple variations of the knapper's habits (Pigeot 2004). These combinations of variables express different know-how that refer to different individuals.

Two types of *chaînes opératoires* have been identified: productive chains that will result in tools and non-productive

Table 2 Estimation of the minimal number of the camp occupiers

Number of Knappers	36-V105	36-T112	27-M89	18-E74	Total
Experienced Knappers	2	1	1	1	**5**
Competent Knappers	3	2	2	1	**8**
«Young Knappers»	2/3	1/2	2	1/2	**6/9**
Total Knappers	7/8	4/5	5	4	**19/22**
Other occupants	3	1/2	2/3	0	6/8
Estimated total	10/11	5/7	7/8	3/4	**25/30**

Fig. 17 Examples of lithic production from unit E74. **a** On 27-K87.32, the knapper, using only one striking platform, promoted the length of the production of blades After blades production the core was taken to 27-M89 unit. **b** On 27-I76.6, a small nodule provided a production of small blades/bladelets from one unique striking platform. **c** On 27-M77.1, the processing of this ill-chosen nodule indicates the work of an unskillful knapper

chains that never provide tools. What is the purpose of the latter?

We can see that these non-productive chains are connected to individuals with more or less limited skills, or sometimes even non-existent. This was studied through the motor know-how (the gesture) and the ideational know-how (i.e., the sequence of actions associated with an operation and then the sequences of operations). Variability can be observed in the degree of preconception of the « *chaîne opératoire* », the originality and complexity of the operating scheme, the gap between project and realization, the productivity, and the state of abandonment of the core.

We propose that their goal is apprenticeship, adolescent exercises showing the knowledge of some principles and beginner motor skills or games of very young children (Pigeot 1988; Ploux 1989; Audouze and Janny 2009; Janny 2010; Ploux and Karlin 2014). Apprenticeship of the knapping techniques that are essential to nomad lifestyles is based on observation of what is happening in full view of all: imitation applied from very young, games that prepare for the activities of adults and, very early, involvement in helping adults. Thus, on the 27-L84.31-refitted debitage sequence, certain principles are mastered such as the search for an oblong volume or the implementation of the striking platform, but others are not as the commitment of full debitage on a necessarily convex surface, or a measured gesture that does not fracture the removals at the point of impact (Fig. 13).

In Pincevent, in the M89 residence, refitting associated with the fine stratigraphic study of a cluster allowed to highlight a knapping lesson (Ploux et al. 2014b: 245–248) (Fig. 13). The apprentice gathered some little suitable blocs for knapping outside the habitation. In a first time, we can discern through the reading of the assembled blocks the

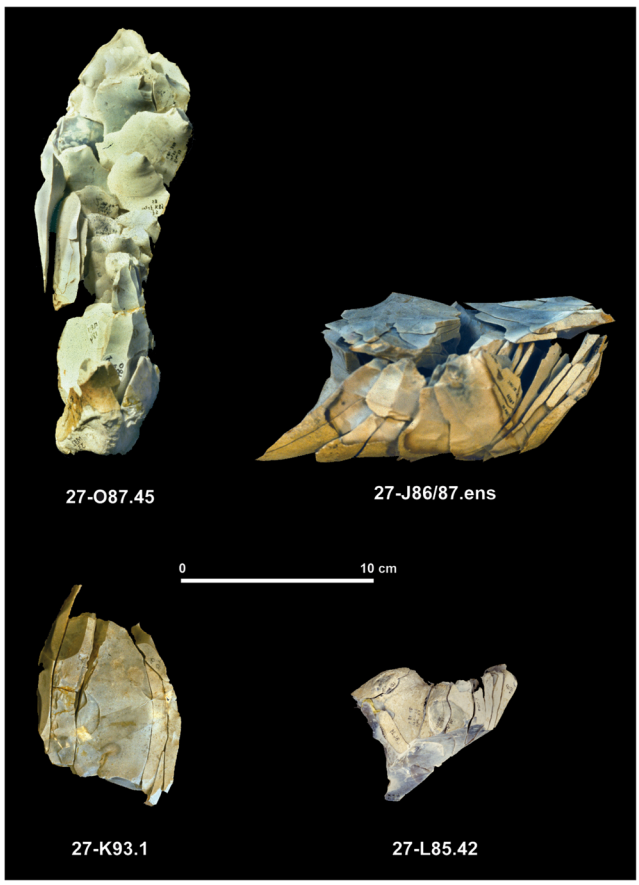

Fig. 18 Examples of lithic productions from unit M89. **a** On 27-O87.45, an experienced knapper conducted a steady and progressive reduction of the core advancing from a production of long blades to a short one of blades/bladelets. **b** On 27-J86/87.ens., an experienced knapper worked along an axis perpendicular to the longitudinal one for a good short production of blades/bladelets. **c** On 27-K93.1, the knapper used two alternate flaked surfaces from two opposite striking platforms for a production of short blades. **d** 27 L85.42 is an awkwardly exploited fragment

inadequacy of his know-how and we observe a wide scattering of waste around his knees. The exercise is interrupted by an experienced knapper who, on a small block, demonstrates how to conceive the core as a volume and, therefore, the sequence of the removals. He also indicates how to position oneself to work. The products of his demonstration are perfectly concentrated and fall on the location of one knee of the apprentice who had to step back. In the following time, the production of the young knapper is much more concentrated because his position must be better. And as the qualitative leap visible in the following debitages is significant, we can assume that the experienced knapper continues to provide advice to the apprentice. Thus, it appears that a skill that is being acquired and not yet stabilized by experience can evolve even during the short time of an occupation such as this one.

Among the productive knappers, we also observe different levels of skill, resulting from the knapper's abilities to build a project, evaluate the potential of the block, follow the conceived pattern, handle one's hammers, and make effective choices at key moments. Experienced knappers know the technique perfectly, adapt a project to the volume of the block they want to process, and master its realization. Just competent knappers will, despite a simple project, reorient their work as they go according to their ability to control or not the hazards of the raw material (Fig. 14). In a well-circumscribed unit, it is thus possible to single them out, then within each of these two groups to identify different knappers from variations in performances (Ploux 1991). It appears that during the short time of an occupation like Pincevent and contrary to what we have seen for apprentices, we can infer a stability of the knowledge of these productive knappers. Of course, the production of a knapper can be variable, qualitatively or quantitatively, and the same more or less concentrated individual could be the author of a variable production that we would divide between two different levels. Similarly, the strength of tradition or education could bring two knappers to some similarity of execution for simple sequences. We are aware of the risks of errors, but we consider that they are marginal, and the exercise does allow some assumptions.

Moreover, ruptures in the *chaîne opératoire*, highlighted by refitting that lead to the association of different places, can have

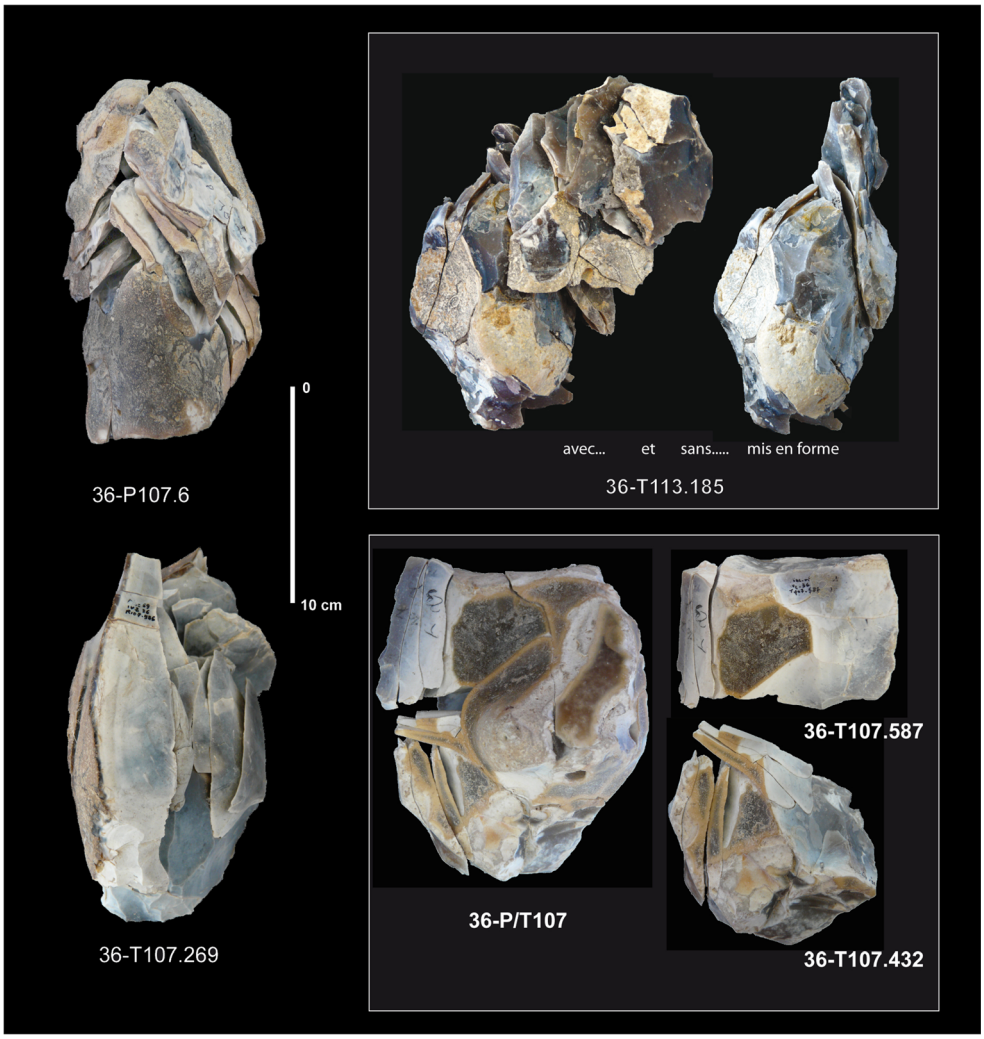

Fig. 19 Examples of lithic productions from the adjacent units V105 and T112 (© Bodu). **a** For 36-P107.6, the natural volume allowed an experimented knapper to engage directly from one striking platform the removal of medium long blades. **b** On 36-T113.185, despite the attention paid by a competent knapper to the shaping out, the production of long blades was weak because the presence of a geode and the use of a striking platform with an angle too much oblique. **c** On 36-T107.269, an experienced knapper exploited, from two successive opposite striking platforms, the flaked surface on the whole length during the first stage, and only one part during the second one. **d** The fragments 36-P/T107 of the same core were carefully exploited by the same competent knapper for a production of shorts blades/bladelets imposed by the two volumes

Fig. 20 Habitation 27-M89: around the hearth, the main activity area and, at the foot of a granite slab, the permanent knapping station are visible. On the foreground, the empty area to the east of the hearth has been interpreted as the place of a tent

several meanings. It can be movements corresponding to a management of space congestion: the knapper settles, for example, in the periphery to shape his block, then returns to sit in the heart of the habitation for full debitage. In other cases, the rupture of place is accompanied by a rupture of the expertise: to a perfectly controlled production succeeds an incoherent work visible for example in the numerous badly placed impacts points on the striking platform that indicate the work an apprentice who has salvaged for practicing a core abandoned by a productive knapper (Bodu 1993; Karlin et al. 1990; Karlin et al. 1993) (Fig. 15).

The demonstration of an apprenticeship suggests the presence of young Magdalenians, which led us to see the occupiers of Pincevent as families with men, women, adolescents, and children (see also Pigeot 2010). We propose that expert knappers, who make the hunting weapons and a number of household tools, be men. It seems to us that among the merely competent knappers, who mainly make domestic tools, we can find men, some of whom are not destined for becoming experts, but also women who were probably able to knap the tools they needed in their daily tasks.

By applying this frame of reference to the refitting done in each habitation, we have identified knappers whose skills we have assessed and that we can count. We first separated the

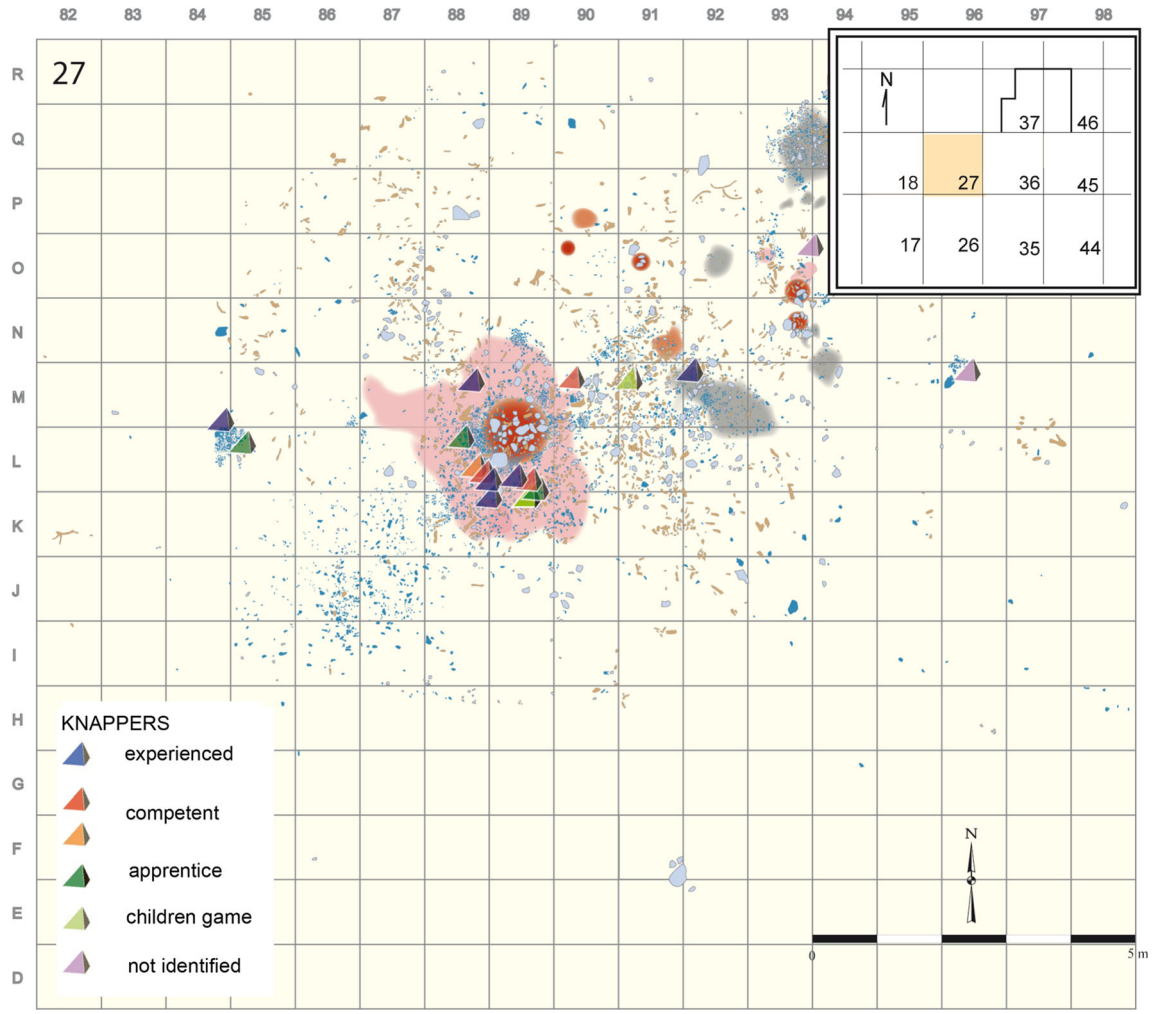

Fig. 21 Habitation M89: distribution plan of the remains and location of the knapping stations

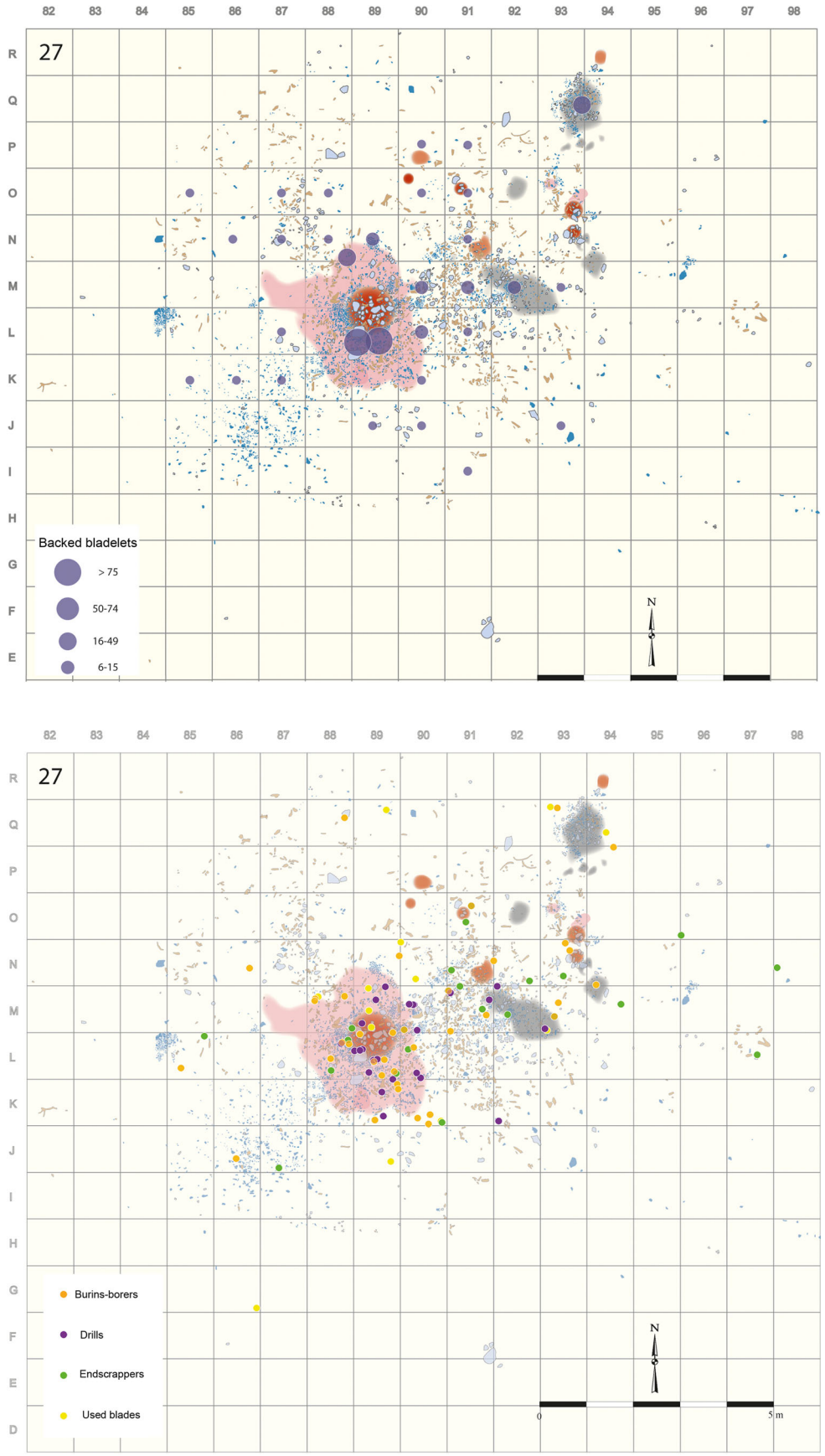

Fig. 22 Habitation M89. **a** Distribution map of the backed bladelets. **b** Distribution map of the domestic tools

productive sequences from the apprentice's sequences so as to have two significant sets, because putting on the same level a learner's exercise and a productive sequence would not make sense (Fig. 16). Of the 233 knapping sequences carried out in the residences, 77 are or could be the work of knappers with little or no skill, which is about one-third of the total. We can deduce that young people, adolescents and children, must have been quite numerous in the camp, even if the production of some less attentive and even incompetent adults is mixed in our evaluation. In the remaining 156 sequences, we seem to recognize more than twenty knappers, more being competent than expert (Table 2). Their numbers vary according to the different habitations: two productive and two children in E74 (Fig. 17), three productive and two children in M89 (Fig. 18), five productive in V105 and three in T112, plus three to five young people for these two residences (Fig. 19).

To consider a number of occupiers per dwelling, we must add, quite arbitrarily, to those knappers identified by their production, individuals not involved in the debitage. Our calculation was based on the mass of remains specific to each habitation. Overall, this gives a rough estimate of about 30 people who do not divide equally between the four residences (Table 2).

Is there a way to organize one's living space specific to the Magdalenian families of Pincevent, or does everyone do as they see fit?

Living space

Let us look at the most central M89, which has the advantage of being neatly circumscribed and remote from its neighbors (Ploux et al. 2014b). The asymmetry in the distribution of the remains with respect to the hearth is clear with an empty area to the west and a dense zone to the east (Fig. 20). A strong concentration of flint waste corresponding to several knapping episodes is located to the southwestern edge of the hearth: it marks the main knapping station probably set up from the

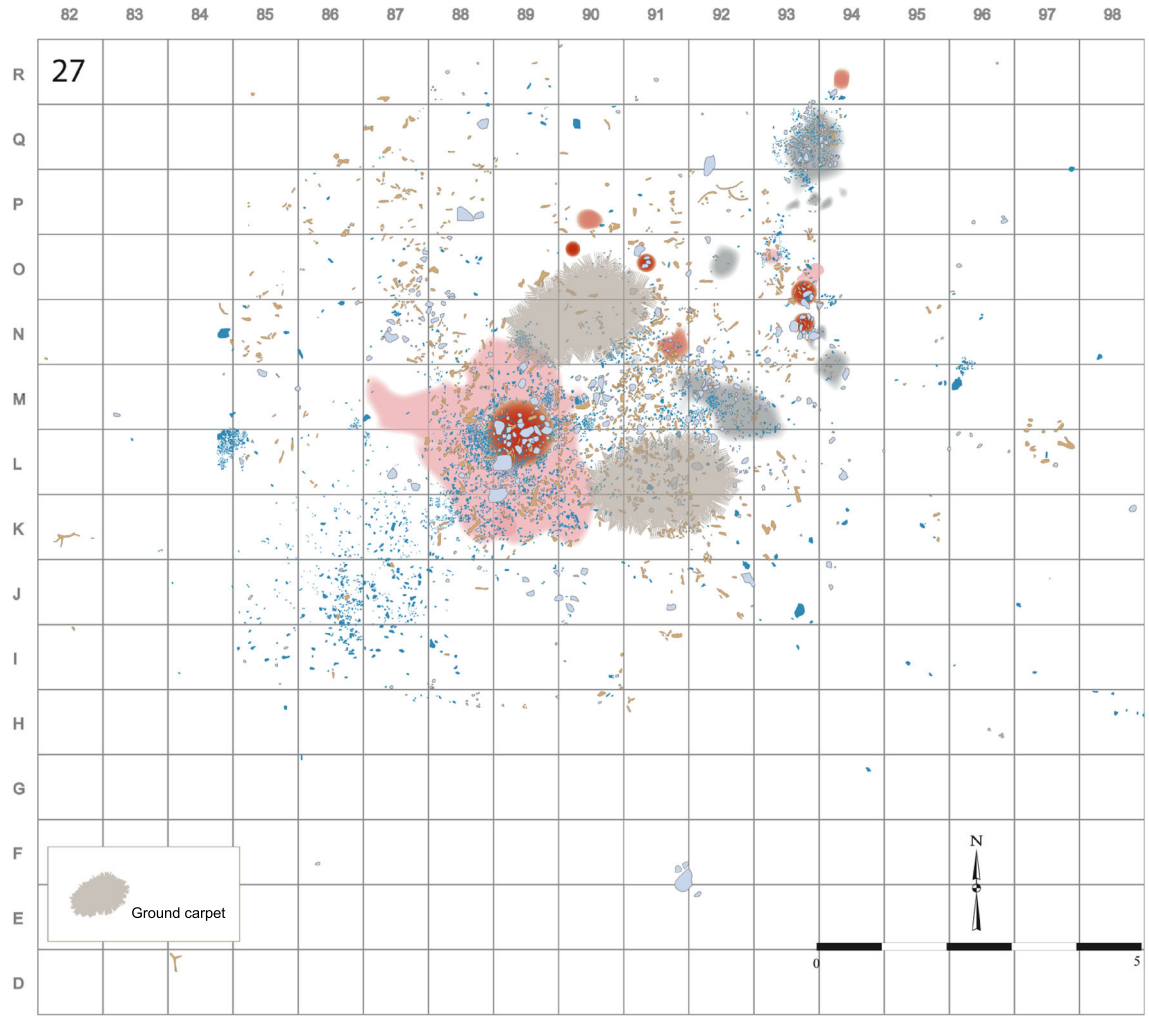

Fig. 23 Habitation M89: synthetic plan showing proposals for the location of the two external ground carpets

Fig. 24 Habitation E74: main activity area around the hearth

beginning of the occupation because it is being part of an organization of the inhabited space. Some occasional stations disperse to the north (Fig. 21). It is at the main station, as shown by the refitting, that the backed bladelets intended for weapons used outside the camp were made. Besides, there are scattered domestic tools in all the working areas where they were used, regardless of where the knapping sequence from which they originated was carried out (Fig. 22). There are also two more empty areas east of the hearth, delineated by remains forming an arc, which suggests that the ground was protected by something. We have assumed that it was hides spread on the ground for the duration of the occupation. These two "carpets" would have been the places where the occupiers would settle daily to carry out various tasks, the production waste being pushed outward making the observed arcs of remains. A passage between the two carpets seems to have been preserved in order to facilitate the circulation towards the large area of external dump located to the east (Fig. 23).

Residence E74, occupied by a smaller social unit, nevertheless obeys the same organization and follows almost the same orientation (Fig. 24). There is a central area of activity

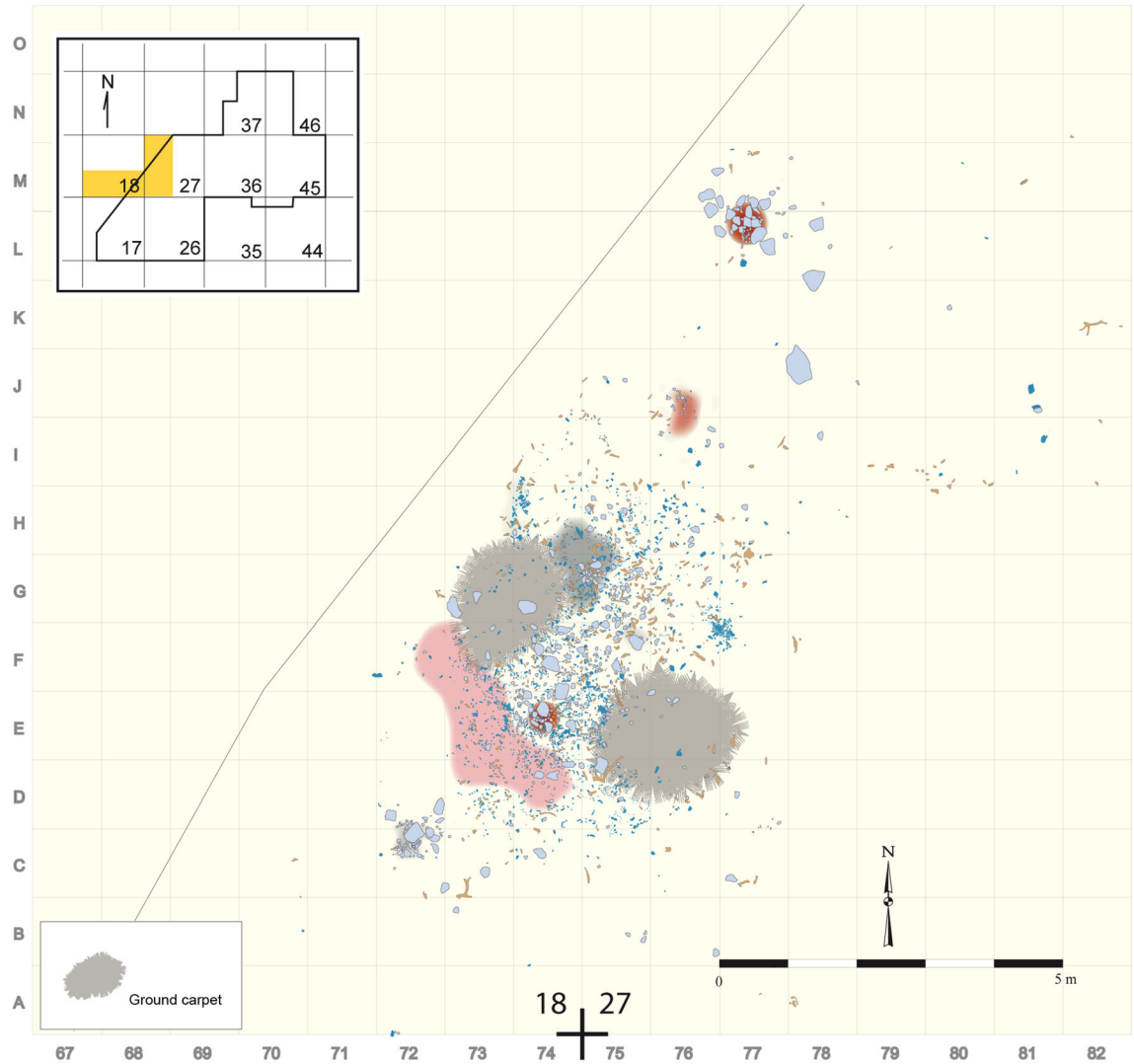

Fig. 25 Habitation E74: synthetic plan showing proposals for the location of the two external carpets

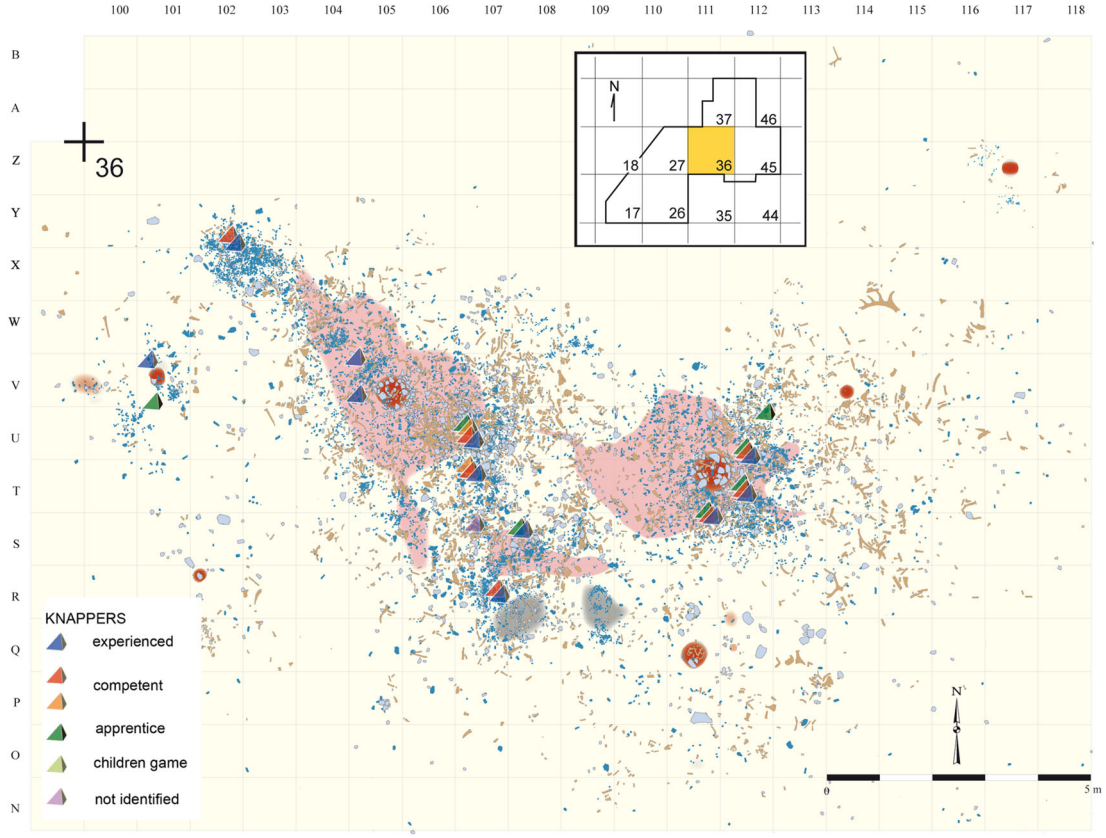

Fig. 26 Habitations V105 and T112: distribution maps of the remains and location of the knapping stations

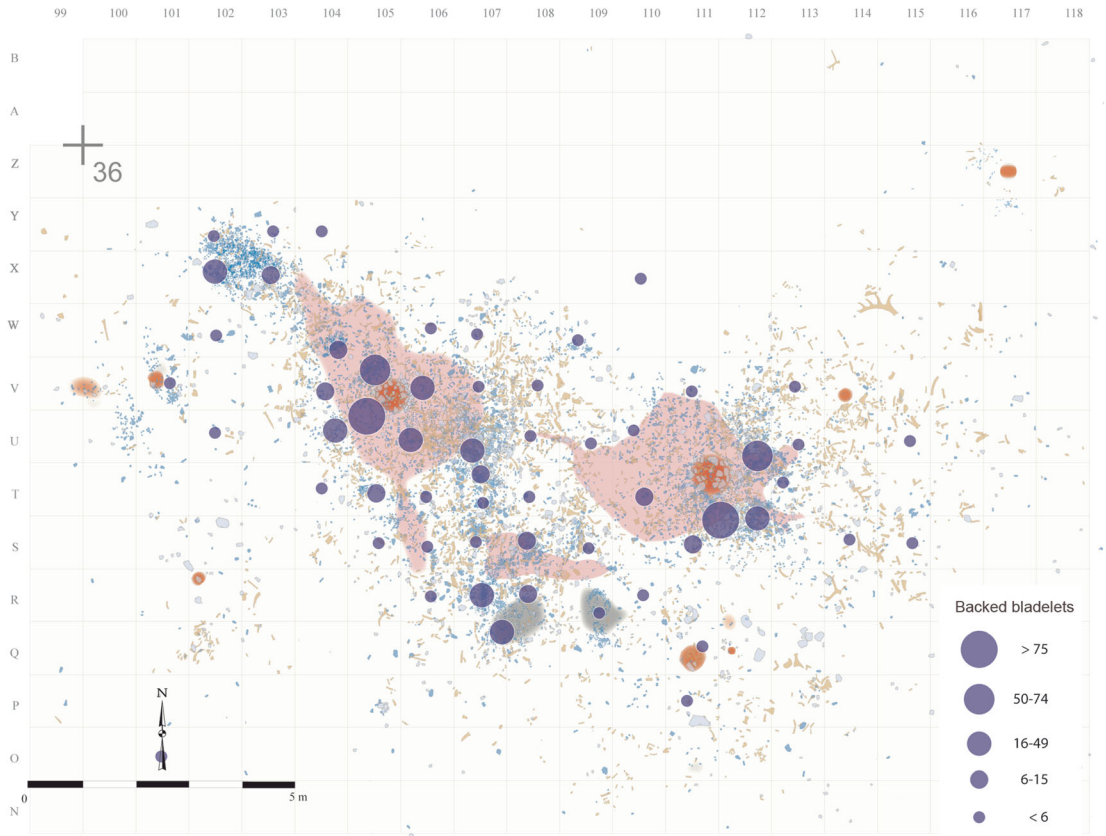

Fig. 27 Habitations V105 and T112: distribution map of the backed bladelets

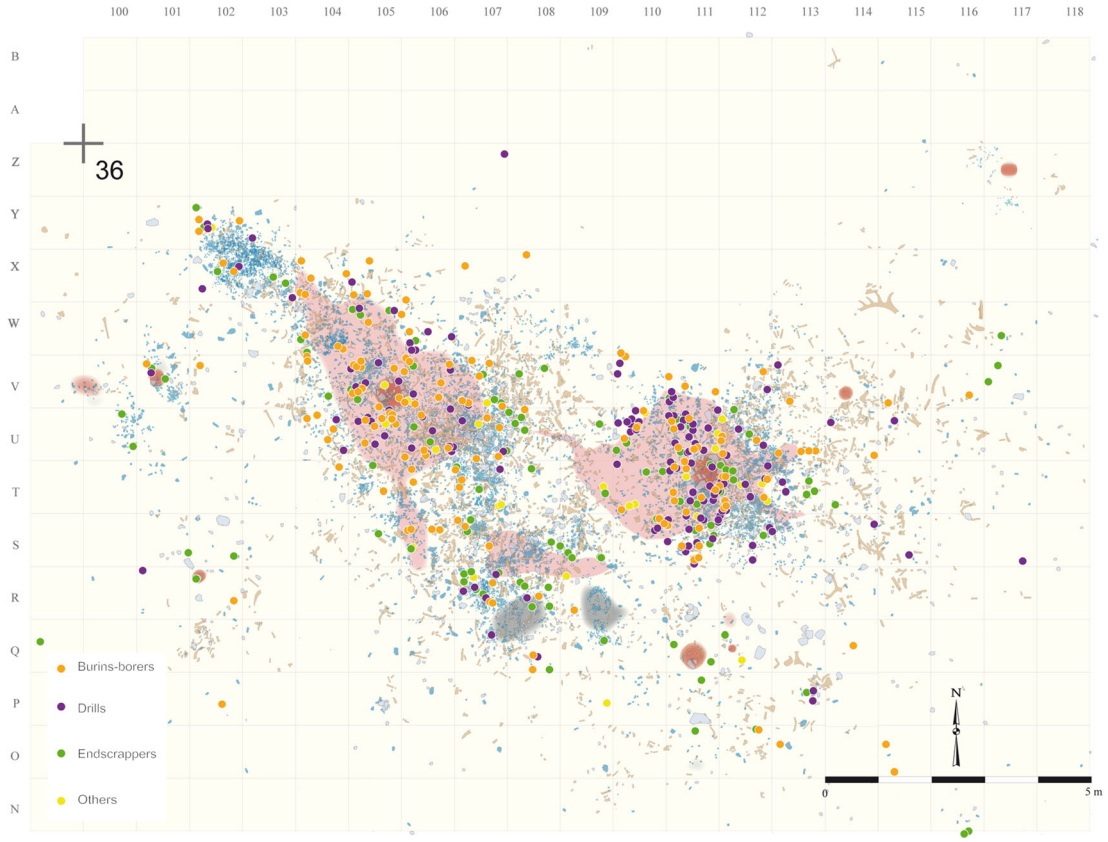

Fig. 28 Habitations V105 and T112: distribution map of the domestic tools

around the hearth with a southwesterly knapping station where the backed bladelets were made, a garbage dump located about the same distance from the domestic hearth as the M89 main dump, and lateral peripheral activity areas (Julien et al. 2014d). Here again, we assume the presence of two workstations on carpets leaving a large evacuation passage between them (Fig. 25). This residence differs from the previous one by a significant number of large stone items for furniture use to which are added those which, after use, were taken to the other units.

Understanding the organization of habitation units V105 and T112 is more complicated because of their proximity (Julien et al. 2014e). The V105 main knapping station is well placed on the western edge of the hearth as for the two habitations already shown and has, like them, been cleaned several times, particularly towards the long strip of lithic remains that extends from south to north between the two residences V105 and T112 (Fig. 26). On the other hand, the T112 knapping station is placed east of the hearth, and refitting shows that everything has remained in place. Occasional stations also occupy the central long strip common to V105 and T112. Backed bladelets were made at the two main stations, to the west of the hearth for V105, and to the east for T112 (Fig. 27). In unit V105, domestic tools are widely distributed around the hearth as before, while in T112, they are concentrated on the surroundings of the hearth, particularly to the north and the south (Fig. 28). A. Leroi-Gourhan had proposed that the extension of the large central strip of lithic waste had been constrained by the presence of the rear wall of the T112 tent, placed to the west of the hearth like the others (Leroi-Gourhan and Brézillon 1972; Julien et al. 1987). In this case, the knappers of T112 would have worked looking into the opening of their habitation that hid their view. We are now proposing another hypothesis. If we observe the distribution of ocher and flint in the space west to the T112 hearth, we see that it delimits two empty spaces. We propose to see in them, once more, the existence of two carpets like those placed in the two residences E74 and M89 (Fig. 29). This would explain that the lithic waste and the knapping activities were confined to the western edge of these carpets and that the domestic activities of T112 were mainly carried out west to the hearth on carpets, apparently shared with the occupiers of V105 who, otherwise, would not have benefited from this type of set up.

Nature and morphology of residential shelters

The network of refitting tends to show that the daily life of a social unit was spent outdoors: domestic hearths and domestic activities were outside. It is highly probable, however, that each family had built a shelter in this early autumn camp. Largely open on the living space, these would be made by a part of the large winter tent (probably some poles and some

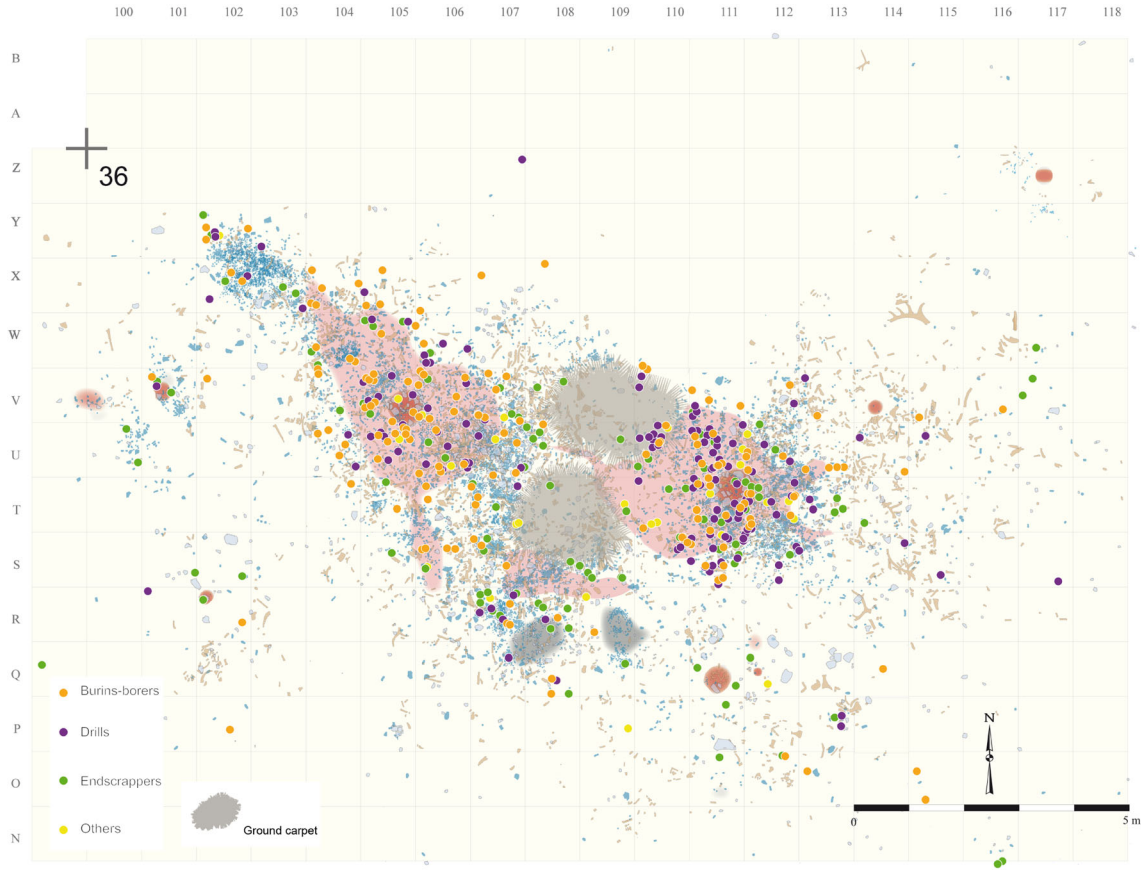

Fig. 29 Habitations V105 and T112: synthetic plan showing proposals for the location of the two common carpets

elements of the skin cover) which was, as we know from the study of the level IV0 winter camp, fully closed around a central hearth (Bodu et al. 2006; Karlin and Julien 2012). If we accept this hypothesis, the autumn tents of residences E74, M89, and V105 would have been placed above the relatively clear spaces we observed to the east of the domestic hearths, perhaps also covered by a carpet of skin. The location of the T112 tent remains to be found: we know it cannot be located to the west of the domestic hearth, since this space was occupied by two working carpets, nor to the east, where an extensive butchery area has been identified. A number of observations led us to propose the existence of a tent a few meters further south, behind a smaller hearth, Q111. If so, the tent was open to the south towards the river and not to the east like the other three.

It seems that we can propose that the Magdalenian families of Pincevent obeyed certain rules in the organization of their living space. But stronger than these rules, others that governed the social relationships in some cases forced to different organization. Thus, the V105 family is at the same time following the respect of the traditional rules of space organization and needing to integrate the installations imposed by its proximity with the T112 family. The latter differs from the other three not only by an opposite working station but also by a separation between the domestic space and the sleeping area (Fig. 30). We still have to understand the meaning of these differences: does this correspond to different statuses?

Approach to the organization of a society

Comparison of activities in each residential unit

The remains found in each of the residential units are of a similar nature: osseous remains, flint, stones, domestic tools, and weapon components. The comparison of their respective quantities and their relative representation makes it possible, first of all, to better understand the significance of the activities developed in each of the families, and thus to know whether they have all behaved in the same way.

We have seen previously that the V105 unit had the highest number of remains and that T112 and M89 were apparently of equivalent scale while E74 was significantly poorer (Table 1). When one then attempts to evaluate the relative importance of the activities carried out in each unit, according to the number of products and artifacts found there, one observes that not all of them are represented in *same* proportions (Fig. 31). For example, domestic tools (endscrapers, burins, borers) are

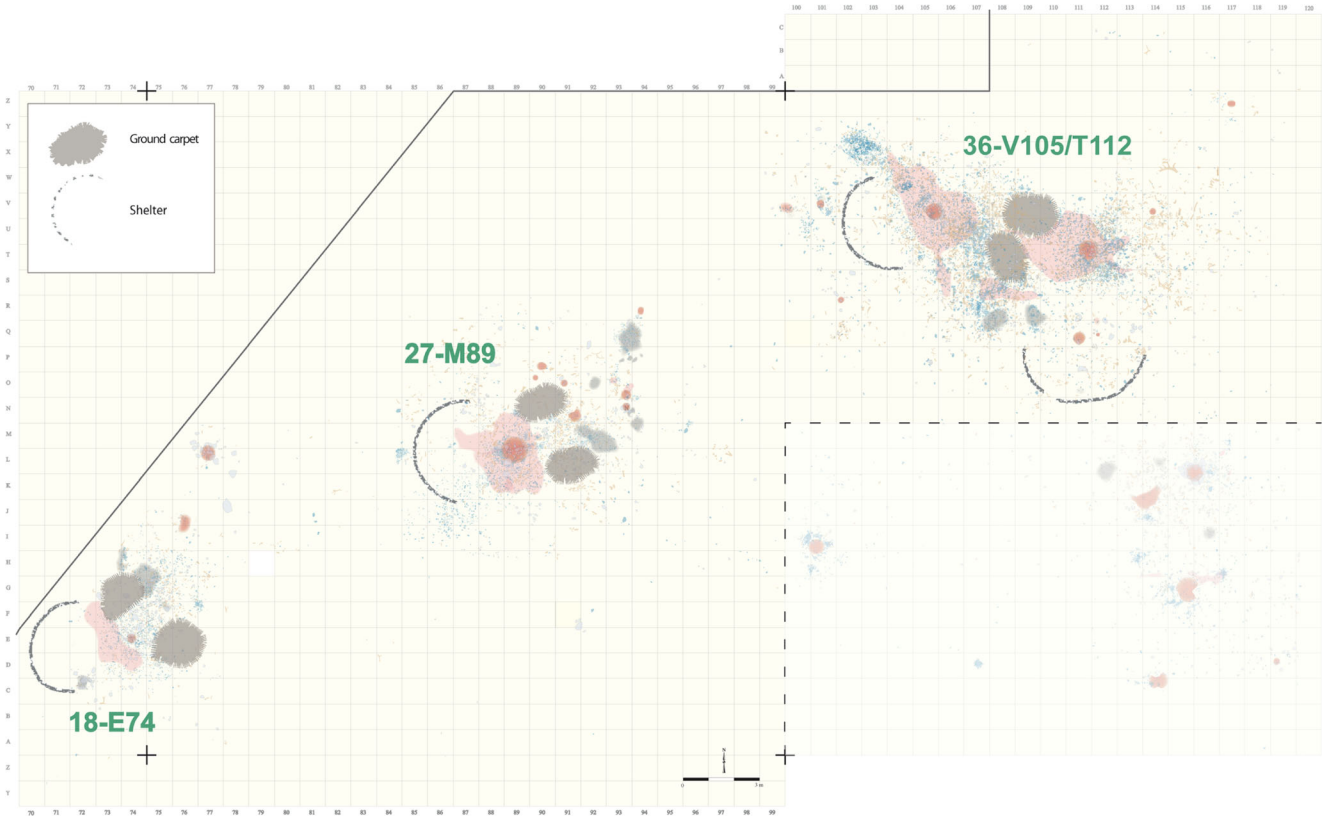

Fig. 30 General map of the residences with the location of the shelters

proportionally more numerous in T112 than in the other units. Conversely, the backed bladelets, components of hunting weapons, dominate in M89 and are proportionally less numerous in T112. To these backed bladelets can be added, for comparison, the relative number of reindeer antler spear points (Table 2), which completes the hunting equipment kept in each unit (and which, without doubt, only indicates used weapons). They are more numerous in M89 ($n = 8$) than in V105 ($n = 6$) and even more so than in T112 ($n = 2$). Their absence in E74 is of little significance since the total number of remains there is relatively small.

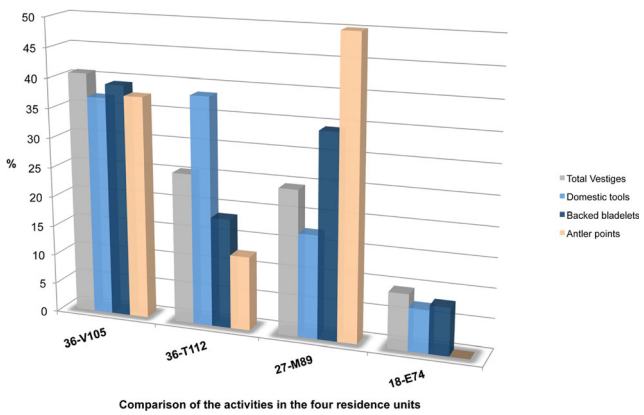

Fig. 31 Relative representation of domestic tools, backed bladelets, and spear points according to the habitations

Reindeer bones that refit between them and belong to the same individuals are distributed among the residences. It can be concluded that the product of the hunt was shared between the families. However, this sharing only concerns adult and juvenile reindeers. Kept whole in each unit, fawns probably did not undergo the same treatment as adult reindeers, neither during their recovery nor during their cutting up. When these thirteen fawns are removed from the total count of animals, it is observed that the minimum number of adult and juvenile reindeers is roughly correlated with that of the hunting weapon components in units V105 and E74, many in the former, few in the latter. On the other hand, there is an overabundance of reindeers compared with hunting weapons in T112 whereas in M89, it is the opposite since, in relation to the components of hunting weapons, the number of reindeers is much lower (Fig. 32).

Relationships between the units

The connections highlighted for each category of remains between the four units show circulations, transportation, or even sharing (Enloe 2003). But they do not always have the same intensity nor the same meanings. Thus, the greater or lesser intensity of the refitting reflects a greater or lesser intensity of the connections, which leads us to see two groups of families (Fig. 33).

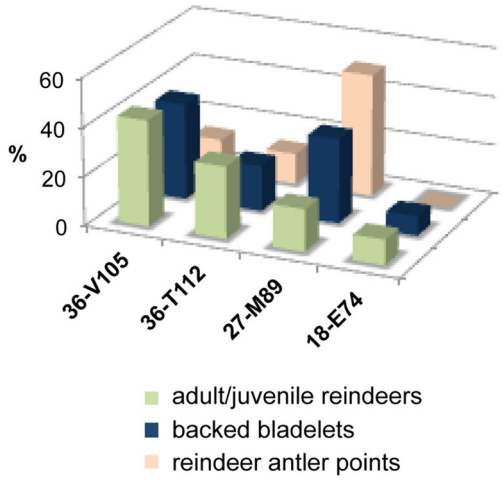

Fig. 32 Hunting indicators: comparison of the representation of the minimal number of adult and juvenile reindeers with regard to that of the backed bladelets and reindeer antler points in each habitation

Families V105 and T112

The very strong network of all-category connections between adjacent residences V105 and T112 reflects the close social complementarity between the two families. Some current examples in Siberian camps show that when two nomadic families pool their domestic space, it is because blood or alliance ties unite them. And usually one is positioned back from the other, thus displaying a dependency (Karlin and Julien 2012). This could be the case here and indeed there are indications that the two families did not have the same status. While the V105 family oriented their tent in the same way as the M89 and E74 tents, and in their spatial continuity, the T112 family did not do the same thing. It settled at the eastern end of the camp and, unlike the others, it separated its workspace from its resting space, the latter being set back and facing south towards the river that the reindeers had to cross. Another particularity, in his workspace related to the T112 hearth, the knapper settled facing west, thus watching the succession of the three other residences. It is likely that the two working carpets, set up in the middle position between the T112 and V105 hearths, allowed to share a number of manufacturing activities, reinforcing the idea that the two families were linked. But the special installation of the T112 family suggests that it had a dominant status over the V105 family.

Families M89 and E74

It is perhaps the circulation of numerous flint products, highlighted by the refitting, which best reflects the relationships between M89 and E74. From the often ordinary nature of the blades and tools that are transported, it seems that we can infer a circulation of adults and young people who come

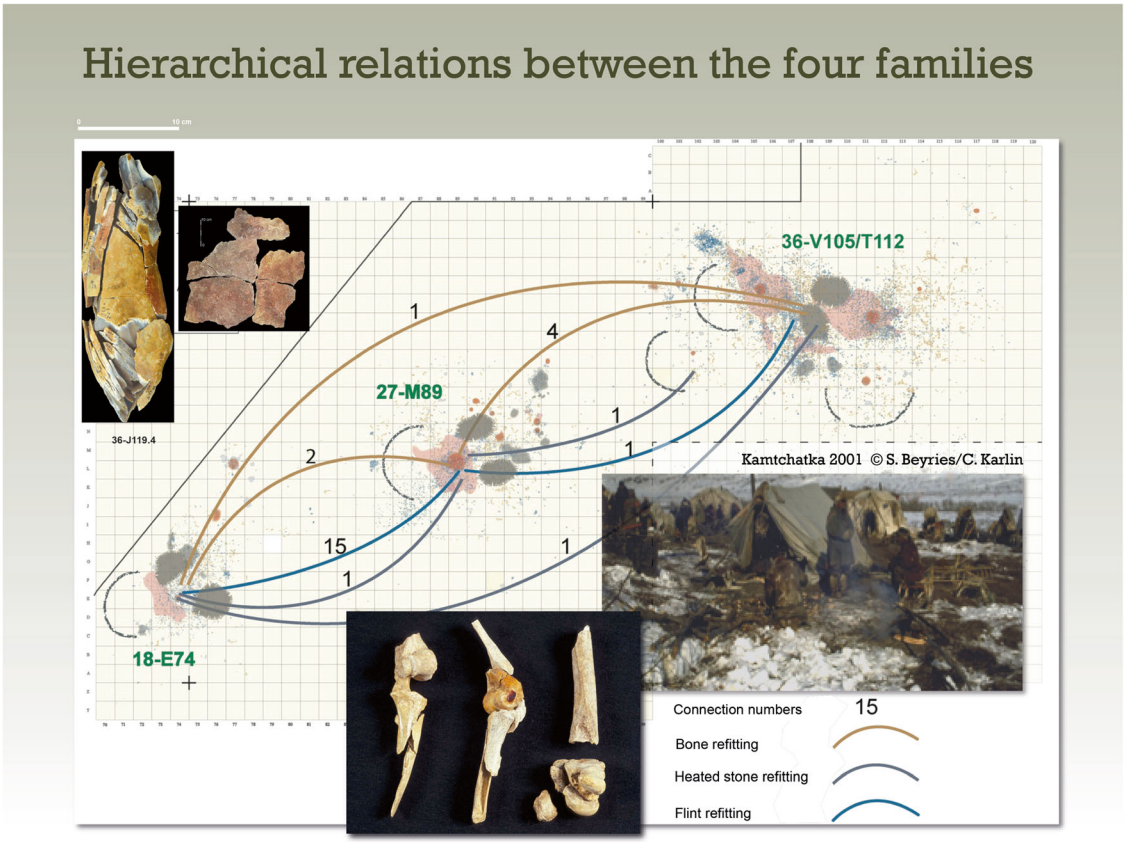

Fig. 33 Map of the relationships between the four habitations, identified from bone, stone, and flint connections, appearing as hierarchical relationships

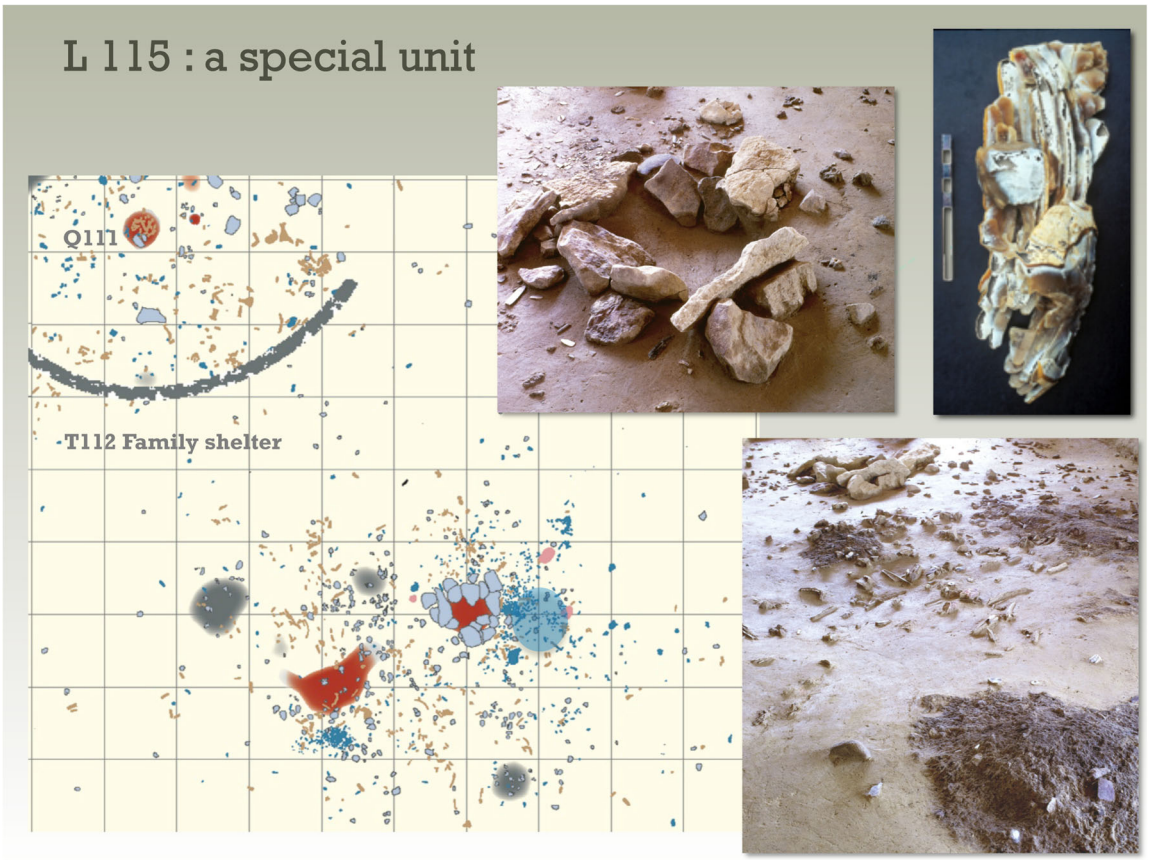

Fig. 34 **a** Map of unit 36-L115, oriented to the opposite of three of the residential units. **b** Overall view of the unit with the hearth at the back and to the west, two of the ashy clusters and a flat hearth on the right. **c** Hearth L115 whose basin lined with large slabs was totally emptied from its ashes. **d** The refitting sequence 36-M118.1 showing the great expertise of the knapper (© Bodu).

and go between the two residences in a sort of cohabitation. We would then have a form of getting closer together similar to that which unites the V105 and T112 families, probably not to the same extent but giving, nevertheless, the supremacy to M89 by the number of occupiers and the higher intensity of manufacturing.

The estimation of the number of individuals, which we have sought to correlate with the products of hunting and processing activities, shows that these two groups were of different size, with just under twenty individuals in V105/T112, and more than ten in M89 and E74. What were the relationships between these two groups?

Families M89 and V105-T112

Between M89 and the group V105-T112, the links are few and the circulation of lithic products simply testifies to neighborhood relations. However, four reindeer sharing were identified by refitting: three mandibles and a front leg, found in the space of T112 and coming from quarters brought in M89.[3] It seems that the M89 hunters, whose weapons were, as we saw, relatively numerous, gave the T112 family a few pieces, including mandibles with their tongue, as well as the radius-ulna which is richer in marrow, still to date, among Siberians and Inouits, both chosen delicacies, keeping for themselves the rest of the animals and, in particular, the skulls with the brains and the fleshy part of the humerus. No sharing in the other direction (from T112 to M89) has been identified, and considering that the minimum number of reindeers found in M89 appears to be lower than what could be assumed from the number of hunting weapon elements, we can accept that the M89 hunters donated reindeer quarters to the dominant T112 family.

Families E74 and V105-T112

Between the families E74 and V105/T112, the circulation of products is even rarer: no flint, only one granite plate brought towards T112. But, for the reindeer, we observe the same pattern of distribution as before with a pair of maxilla in E74 refitting with a pair of mandibles found in the common space of units V105 and T112.

[3] This rare evidence is the tangible witness of sharing that, without doubt, must have been more common

This would mean that the families M89 and E74 did accept a particular status of the master of the residence T112 whose social unit, as we have seen, appears different from the others, and with whom the community of the camp maintained relationships of allegiance. According to the smaller number of weapons, it may be assumed that this individual was less active in hunting, but that his experience led him to organize collective hunting strategies. We proposed to consider him as the "patriarch," a denomination that expresses the perceived difference between unit T112 and the other three, without, however, indicating the true organization of the group.

A singular unit of occupation

The analysis of unit L115 seems to support this hypothesis (Bodu et al. 2014). Located 3 m to the south at the rear of the supposed tent of the "patriarch," it is singular in all its characteristics: little material, a hearth basin surrounded by very large slabs placed obliquely and found entirely emptied of its combustion waste, three ash clusters showing these cleanings (Figs. 34 and 35). As for unit T112, the organization of the deposits with a relatively empty area to the east and a dump to the west is reversed compared with that of the other three residences. It is the same for the knapping station also placed to the east of the hearth: it is marked only by a single knapping sequence but it is considered as one of the most elaborate camps, remarkable by the efficiency of the choices made by the knapper. By the high degree of expertise it shows, it recalls the quality of the debitages carried out in unit T112. This inverted organization and the degree of skill of the knapper, two characteristics recalling T112, lead us to see here a space where the "patriarch" had a preponderant role. In addition, many relationships with the four residential units, as evidenced by the refitting and connections, also characterize this place. It turns out, indeed, that the very impressive edge of the hearth was formed by plates and blocks of stone brought from these residences, just as the occupiers brought several tools and blades there. On the contrary, they took away in each of their units the laminar products resulting from the debitage carried out in L115. It seems that, contrary to the daily activities around each domestic hearth, something else has happened here, involving all the members of the group. If we accept the idea that the separation between the domestic and the ritual is perhaps not as clear-cut as we often think, it becomes possible to imagine that this central space of the camp had a ceremonial role, in any case a unifying one, gathering the group around the "patriarch."

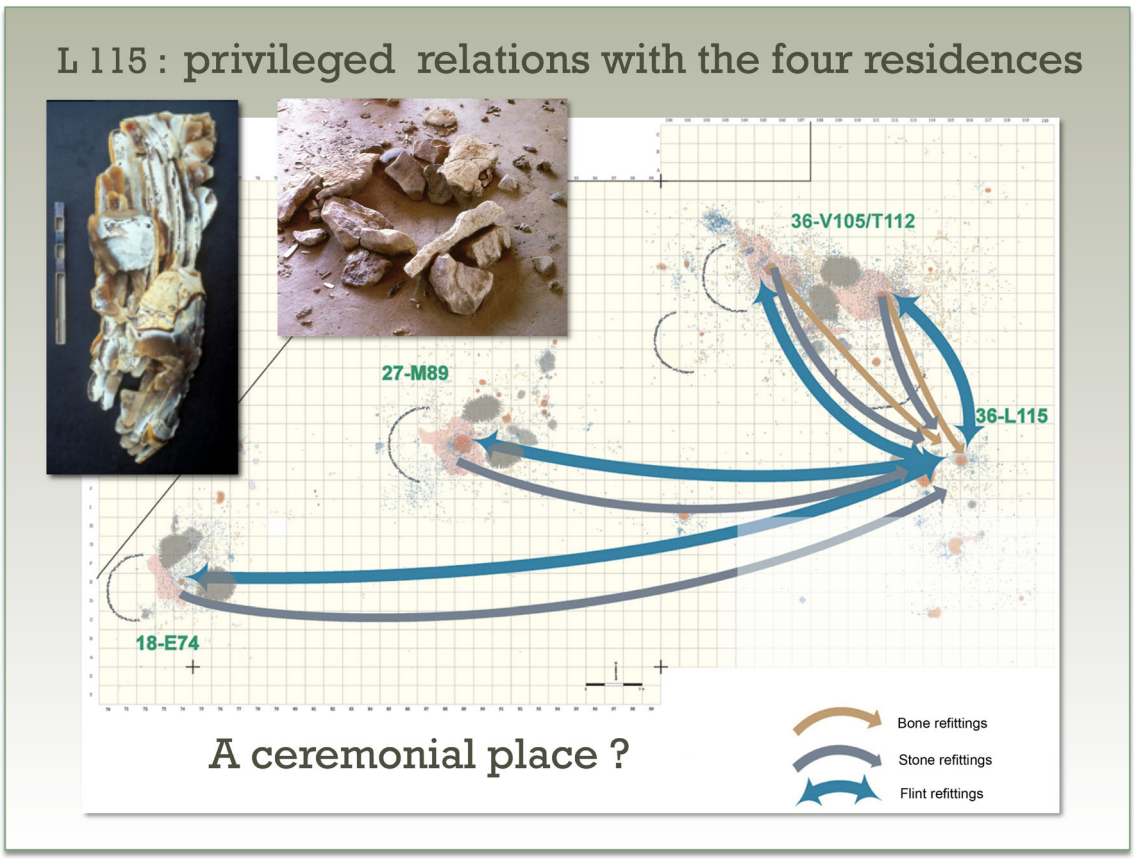

Fig. 35 The bidirectional relationships between L115 and the four residential units. The residents brought to L115 unit fragments of stones to build the slab lined big hearth and they brought back home long blades from the sequence 36-M118.1

It is conceivable that the organization of such a collective hunting in such an important moment of the year necessitated a preparation which was not only material but also ritual to provide successful results. And the "patriarch" could have been involved in both registers.

Conclusion

As we said at the beginning of this article, we intended to provide an image of the group of Magdalenians who came to hunt reindeers on the banks of the Seine River 13,000 years ago. For this, we largely, but not only, relied on refitting that, although essential, is just one of many analytical tools. The mass of remains specific to each habitation and especially the numbers of killed reindeers and numbers of backed bladelets provided an evaluation of the size of each group. Refitting the debitage sequences enabled us to identify in each tent individuals from their performances. It helped us to approach the composition of each residence and suggest a number of occupiers. This allowed us to infer the presence of at least four families, more or less numerous, with men hunters, women, adolescents, and children, knappers or no. Finally, by analyzing the links between the units through flint, stones, and fauna refittings, we outlined, probably in a very fragmentary way, some aspects of the social organization of this group of Magdalenian families, suggesting that certain relationships of dependency existed between them. The organization of the camp and of each family obeyed rules showing that this society was not as egalitarian as we could have imagined for hunter-gatherer societies. This is also what A. Testart deduced from his own studies on the subject in his book "Avant l'Histoire" (Testart 2012), pointing out that, since material wealth does not play any part in societies of hunters-gatherers, they are societies without economical inequalities, but not « equalitarian » societies. As he concluded: "Hunter-gatherer societies are no more egalitarian than ours, they are crossed, perhaps even structured, by dependency relationships and/or power relationships" (2012: 413).

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