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## The First Mesolithic in the French Alps: New data from La Grande Rivoire rockshelter (Vercors range, Isère, France)

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### ABSTRACT

Discovered in 1986, La Grande Rivoire is a rockshelter located in the north of the prealpine mountain range of Vercors (Northern French Alps). It lies at 580 m asl, on the west side of the Furon valley, at the foot of a cliff. The 6-m stratigraphy reveals a continuous chronocultural sequence starting from the First Mesolithic to the Gallo-Roman period. The present communication aims at characterizing the earliest occupation of the site attributed to the First Mesolithic (*ca.* 8500–7000 cal. BC). The new multidisciplinary data are intended to contribute to the understanding of the regional chronocultural evolution.

The deposits are constituted of very rich organic materials, possibly resulting from the degradation and combustion of plant litters. Their natural and/or anthropogenic origin still remains unclear. The excellent state of preservation of the faunal remains (superficially covered of an ashy encrustation) and the bone refittings would indicate a low post-depositional impact on the faunal material in this sector. The highly intentionally fragmented long bone remains indicate (intensive?) carcass exploitation of various large game species, among which red deer seems to predominate. Plant remains analysis gives also information on wild picking products, especially hazelnuts. Osseous material industry is dominated by waste products occurring from sectioning action of red deer antler by notching. Few examples of bone and tooth working highlight the use of removal by diffuse percussion during shaping. Preliminary observations conducted on the lithic assemblages show that domestic tools are mostly manufactured on local raw materials of poor quality. Exogenous raw materials of better quality are mainly used for the fabrication of microliths using the microburin technique; the latter tending to disappear at the end of the sequence. Usewear analysis on arrowheads shows that triangles are present throughout the sequence and always hafted as barbs while Sauveterre points and segments are only present in the oldest decapages.

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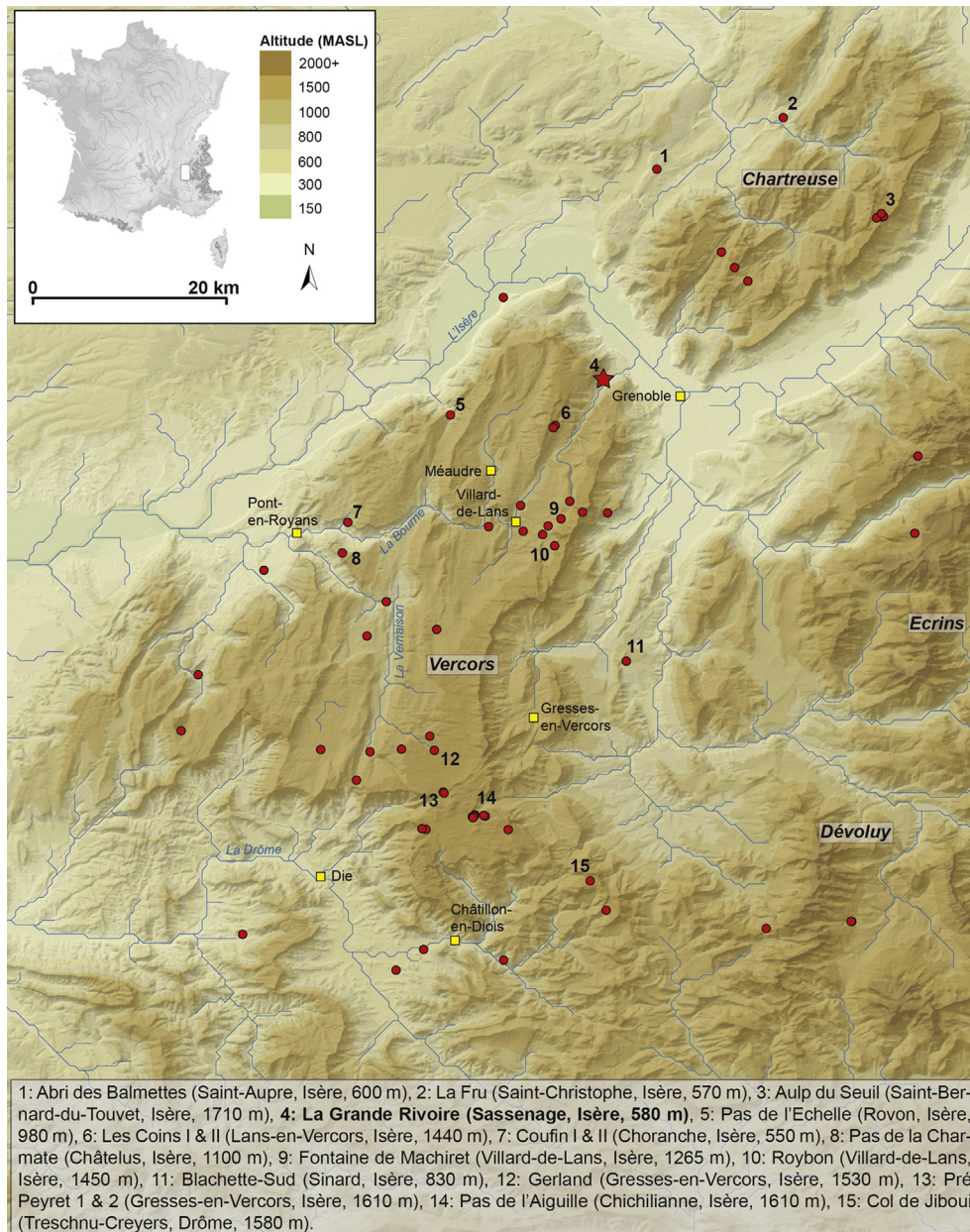
E-mail addresses: [alex.angelin@gmail.com](mailto:alex.angelin@gmail.com) (A. Angelin), [anne.bridault@mae.u-paris10.fr](mailto:anne.bridault@mae.u-paris10.fr) (A. Bridault), [cap.valence@wanadoo.fr](mailto:cap.valence@wanadoo.fr) (J.L. Brochier), [louis.chaix@bluewin.ch](mailto:louis.chaix@bluewin.ch) (L. Chaix), [chesnauxlorene@yahoo.fr](mailto:chesnauxlorene@yahoo.fr) (L. Chesnaux), [benjamin.marquebielle@yahoo.fr](mailto:benjamin.marquebielle@yahoo.fr) (B. Marquebielle), [lucie.martin@unige.ch](mailto:lucie.martin@unige.ch) (L. Martin), [pierre-yves.nicod@unige.ch](mailto:pierre-yves.nicod@unige.ch) (P.-Y. Nicod), [regis.picavet@paleotime.fr](mailto:regis.picavet@paleotime.fr) (R. Picavet), [dorcas.vannieuwenhuyse@research.uwa.edu.au](mailto:dorcas.vannieuwenhuyse@research.uwa.edu.au) (D. Vannieuwenhuyse).

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### 1. Regional chronocultural background

Located in the French Alps, in the Isère and Drôme departments, the prealpine mountain range of Vercors (Fig. 1) has been the focus of archaeological exploration since the late 1970's (see for instance synthesis by Bintz et al., 1999a, 2008). The research undertaken has



**Fig. 1.** Prealpine mountain range of Vercors and First Mesolithic settlements/archaeological sites. Unnumbered red dots: probable First Mesolithic settlements/archaeological sites. QGIS mapping: A. Angelin (data: Bintz et al., 1999a; Beeching et al., 2000). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

revealed that this area was repeatedly occupied since the end of the Late Glacial and the melting of the glaciers (Bintz et al., 2008). Mesolithic sites are recognized through the region in various types of settlements such as rockshelters and caves located at low- and mid-altitude (below 1000 m asl) and open-air sites situated at high altitude, above 1000 m asl (Bintz et al., 1999a; Picavet et al., 2014) reflecting a dynamic occupation and exploitation of the mountainous environment by Mesolithic people.

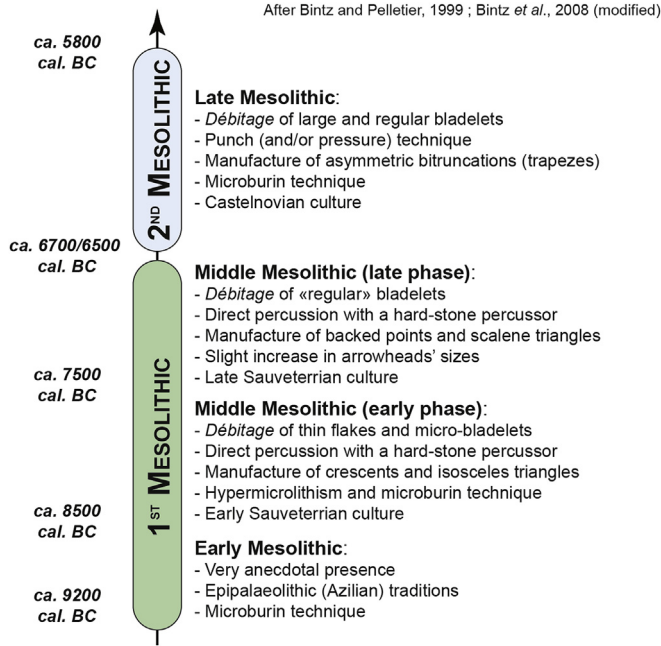
Different chronological phases exist for the Mesolithic period (Kozłowski, 1976; Rozoy, 1978). In this study, we chose to divide the period into a First and a Second Mesolithic following Costa and Marchand (2006) and Marchand (2008). This division values a break between axial points and triangle industries made on

irregular blanks by direct percussion and trapezes made on larger and regular blanks obtained by indirect percussion. However, if this chronological bipartition is used in our study, it is still under debate and will probably be reviewed in the future (Perrin et al., 2009).

The chronological evolution observed in the Vercors assemblages places the First Mesolithic around 9200–6700/6500 BC cal. and the Second Mesolithic between 6700/6500 and 5800 BC cal. (Fig. 2, Bintz and Pelletier, 1999; Bintz et al., 2008):

- The First Mesolithic is divided into three different phases showing different typotechnological characteristics. The Early Mesolithic, in continuity with the Epipaleolithic poorly documented dated and limited to a few settlements in the area. The





**Fig. 2.** First and Second Mesolithic of Vercors chronology. The different phases follow the lithic technology evolution (modified from [Bintz and Pelletier, 1999](#) and [Bintz et al., 2008](#)).

middle phase is divided into two distinctive phases. The early phase (ca. 8500–7500 BC cal.) has hypermicrolithic industries (<10 mm in length) where crescents and isosceles triangles are most represented and scalene triangles complete the assemblages. The microburin technique is well attested. The later phase (ca. 7500–6700/6500 BC cal.) has a more standardized industry and shows the development of scalene triangles and Sauveterre-like points. The microlithism clearly diminishes and fracturation by microburin technique no longer exists.

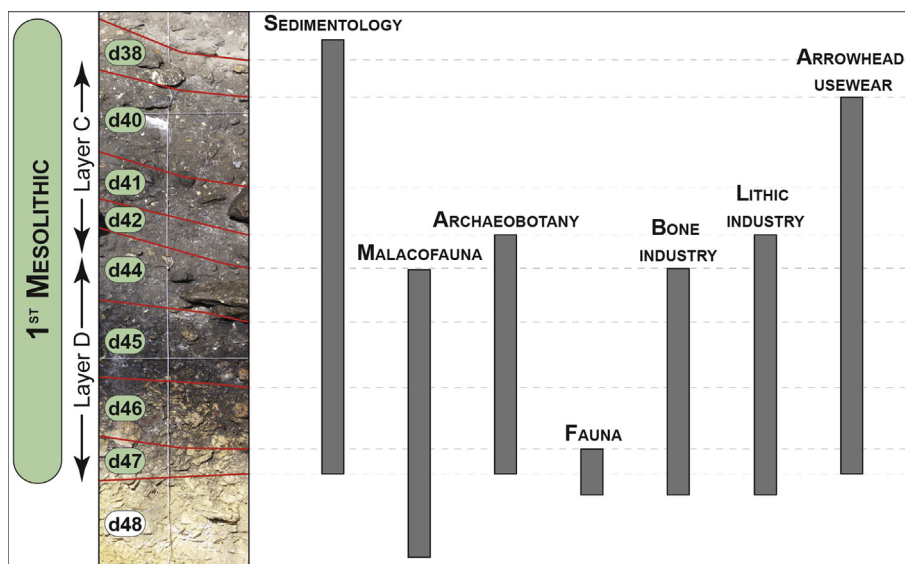
- The Second Mesolithic shows clear typotechnological breaks from the previous period, with the *débitage* of regular bladelets (10–15 mm width) of triangular and trapezoidal section by



**Fig. 4.** View of La Grande Rivoire rockshelter (Isère, France) taken in 2000. The area excavated is located at the bottom of the cliff. Photography: P.-Y. Nicod.

punch technique. They are the blanks for geometrical bitruncations attributed to the Castelnovian culture.

However, building a regional chronological sequence based on archaeological sites located in altitude and mountainous environment is not easy as the sequences are generally compacted, due to low sediment deposition rates (among other factors). This generally creates a palimpsest of successive occupations that it is sometimes difficult to entangle if no typological differences exist in the lithic assemblage. Stratigraphic sequences from rockshelters settlements are thus preferred and taken as reference. La Grande Rivoire rockshelter has a well-developed sequence spanning from the First Mesolithic to Gallo-roman period ([Nicod et al., 2012](#)). In this paper, we present the results of a multidisciplinary approach focused on the First Mesolithic levels in order to refine the understanding of the Vercors regional chronocultural technology evolution. These levels were carefully excavated following the single context method by “*décapages*” with excavation units following the slope of the archaeological deposit layers. All the sediments were water sieved with a minimum mesh of 1.2 mm. The data presented in this paper only cover the area SU16-22 and provide only some results for the First Mesolithic period. La Grande Rivoire being an ongoing excavation, analyses are still in various states of progress ([Fig. 3](#)).



**Fig. 3.** Chronostratigraphic position of sedimentological, palaeoenvironmental, faunal and bone industry and lithic usewear analysis made at this date and presented in this work.



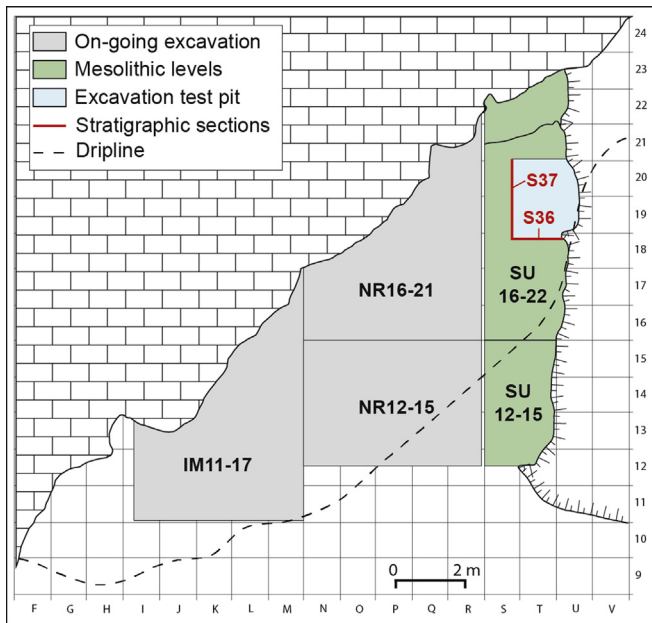


Fig. 5. Site plan of La Grande Rivoire showing the main areas excavated since 1986. In green, the squares where Mesolithic layers have been reached. In red, localization of the stratigraphic sections of the excavation testpit (in blue) done in 1990 revealing the Mesolithic levels. CAD: A. Angelin. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Further research and analysis (such as post-depositional processes, raw material acquisition and territorial considerations, radiocarbon dating, etc.) will complete these preliminary results and give a better understanding of the palaeogeographical and functional dimensions of the site. The aim of this paper is to present the state of our present understanding and the main trends issued from the results of each specialist's contribution.

## 2. La Grande Rivoire rockshelter

The archaeological settlement of La Grande Rivoire (Fig. 1) is a rockshelter in the northern part of the Vercors range, close to the city of Grenoble. The site, located in the Furon valley, which is the main northern access to the mountain range, is facing south and lies at 580 m asl at the foot of a cliff of flint senonian limestone (Fig. 4). The area protected by the overhang is small: only 80 m<sup>2</sup> (Fig. 5).

The site was discovered by chance in 1986, after roadwork was undertaken and a quarry was opened to extract gravel from this area. A rescue excavation was then carried out by Régis Picavet between 1986 and 1994 for five summers (Picavet, 1995, 1999). Given the importance of the chronocultural sequence identified, the Ministry of Culture and the County Council of Isère agreed to start a long-term program in order to excavate the entire archaeological site. Since 2000, excavation has been conducted yearly under the direction of Pierre-Yves Nicod and Régis Picavet.

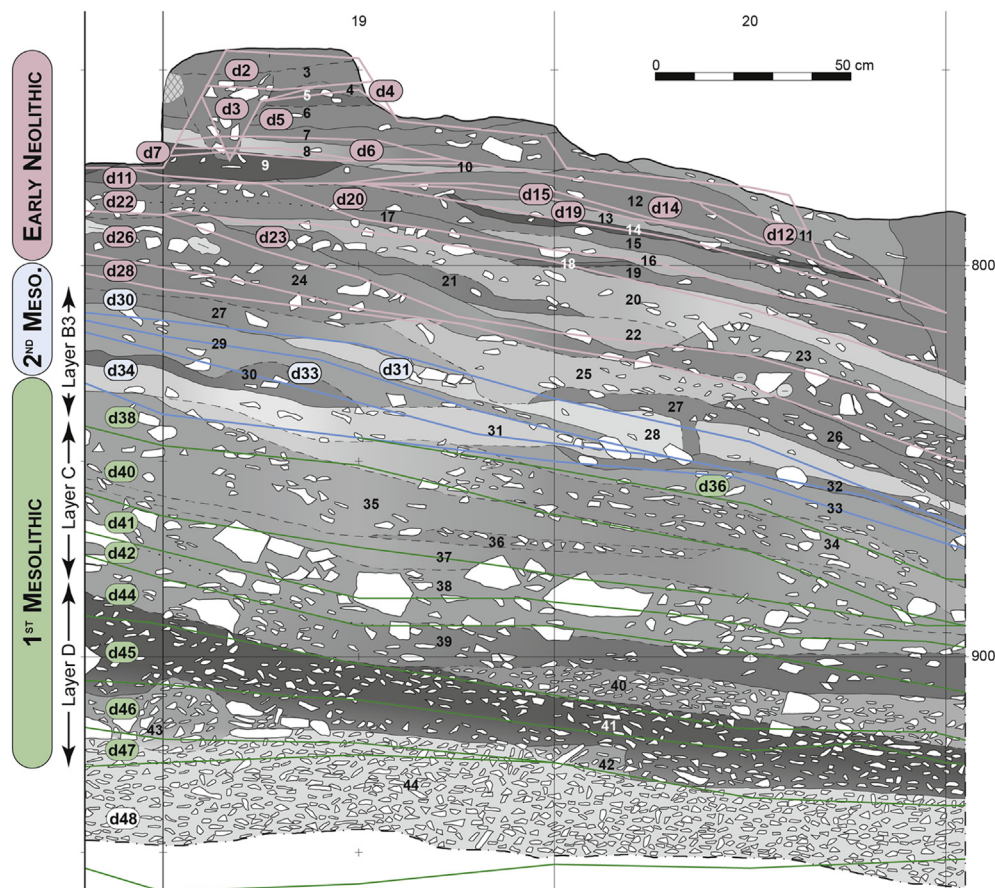
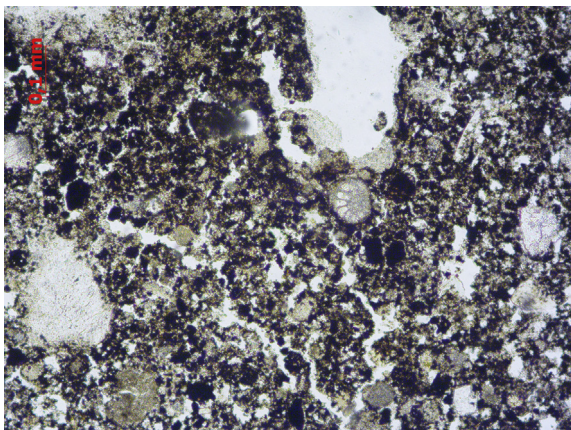


Fig. 6. Stratigraphic section, S37 in squares SU16-21 showing the complex sequence and archaeological levels from the First Mesolithic to the Early Neolithic. Stratigraphical units (US) identified in section are numbered from top to bottom (US3 to US44) and excavation units (with "d" for "décapages") are shown by the colored lines associated with circled and colored number dx (e.g. d42). Each colored line corresponds to the bottom of an excavation unit. Three levels are identified in this section but only the bottom of the sequence is covered in this paper: the First Mesolithic (US33 to 43 and corresponding excavation units d36 to d47). CAD: C. Bernard and A. Angelin. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)



**Fig. 7.** Organo-charred groundmass (micromorphologic thin section in US41, sampled in stratigraphical section S37, photographed in plain polarized light). Photography: J.-L. Brochier.

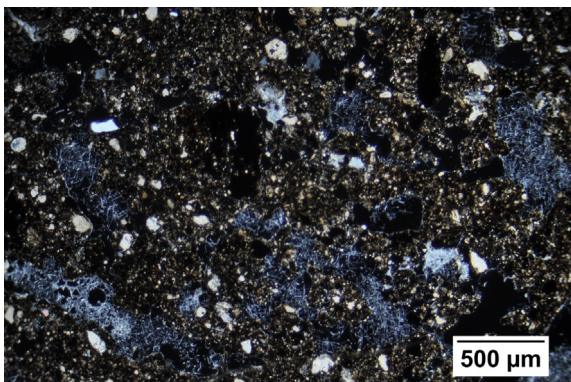
Five meters depth of stratigraphical accumulation has been dug the past fourteen years and can be divided into three distinctive periods (Nicod and Picavet, 2003; Nicod et al., 2012):

- The upper sedimentary sequence is quite rocky and silty and includes levels attributed to the Gallo-roman period as well as Protohistoric and Bell Beaker's Neolithic (2500 BC cal. – 500 AD cal.).
- The middle sedimentary sequence, characterized by a sheepfold sequence showing a very complex stratigraphy with layers of fossilized manure and wood ashes (Nicod et al., 2010), includes late, middle and early Neolithic levels (5200–2500 BC cal.).
- The lower sedimentary sequence includes early Neolithic and Second and First Mesolithic levels (8500–5200 BC cal.). It is characterized by a succession of complex stratification of wood ashes and/or organic matters (Nicod et al., 2012).

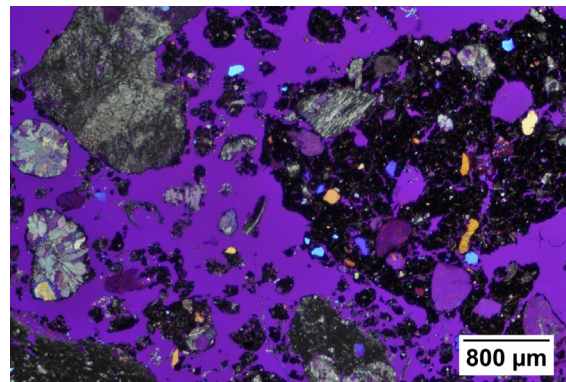
In this paper, we will focus only on the First Mesolithic layers.

### 3. Stratigraphical and planimetric deposit context

Mesolithic levels have been observed and excavated in two areas of the rockshelter, covering approximately 25 m<sup>2</sup> (Fig. 5): excavation area SU16–22, well protected by the cliff, and excavation area SU12–15, less protected and leached out by the rain.



**Fig. 8.** Secondary carbonates needles developed in voids (planimetric micromorphologic thin section sampled in square S20 at the top of excavation unit d44, photographed in cross polarized light). Photography: D. Vannieuwenhuysse.



**Fig. 9.** Calcitic earthworm granules visible on the left (planimetric micromorphologic thin section sampled in square T15 at the top of excavation unit d22, photographed in cross polarized light and gypsum plate). Photography: D. Vannieuwenhuysse.

The excavation testpit carried out in 1990 (squares TU19–20) has allowed to individualize thick chronocultural assemblages (Fig. 6): layer D (approximately excavation units d44–d47 of the recent excavations) and C (approximately excavation units d38–d42 of the recent excavations) for the First Mesolithic and layer B3 for the Second Mesolithic (Picavet, 1995, 1999). The excavation of these levels carried out between 2006 and 2011 in this area of the rockshelter has allowed to define more precisely their sedimentary and cultural components both vertically (analysis of stratigraphic section S37) and horizontally (planimetric excavation of squares SU16–22). Fig. 6 shows the correlation between the stratigraphic units identified on section S37 (USx) and the excavation units (dx) of the planimetric excavation in area SU16–22. Regarding the First Mesolithic levels covered in this paper, we are only interested in stratigraphical units US39 to US41 (corresponding to excavation units d44 to d47) and stratigraphical units US33 to US38 (excavation units d36 to d42).

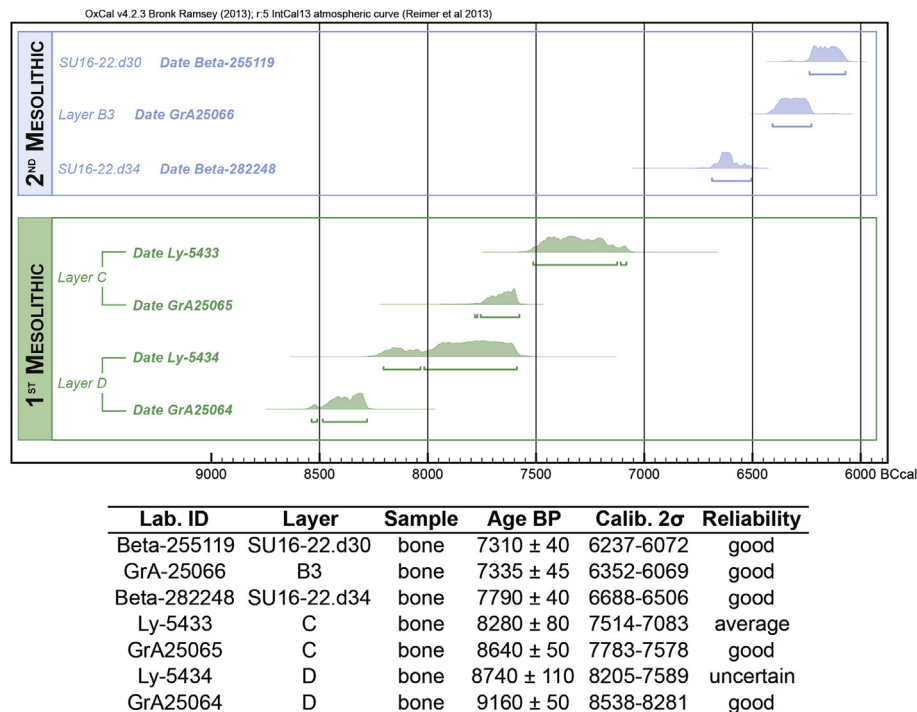
The First Mesolithic layers are characterized by anthropogenic sediment composed essentially of vegetal organic matter, wood ashes and heated stones. Archaeological artifacts are also very abundant and mainly consist of faunal remains and knapped lithic industries as well as very few bone industry elements and personal adornment (perforated *Columbella rustica*). Some anthropogenic features/structures have been identified during the excavation and consist of small concave hearths with a diameter of about 60 cm and of 10 cm depth, which contain charred sediments and heated limestone pebbles.

### 4. Sediment analysis

The First Mesolithic archaeological layers are divided into two major stratigraphical units: a dark black layer (US 39 to 41 of the cut S37, corresponding to excavation units d44–d47 of the area SU16–22) and a brown grey layer (US 33 to 38 of the section S37, corresponding to excavation units d36–d42 of the area SU16–22) (Fig. 7). The analysis of sediment under the microscope (grain size and stone morphology), allowed us to define more precisely their composition (Brochier, 2011; Moulin, 2014; Vannieuwenhuysse, 2014).

The sediments of the early First Mesolithic levels (US39 to US41) are composed of an accumulation of limestone angular pebbles in a dark organic matrix. Both planimetric and stratigraphical microscopic observations of the sediment reveal that only a small amount of this vegetal organic matter is actually charcoal, contrary to what it was expected at first regarding the black color of the sediment. The organic matter is actually composed of highly





**Fig. 10.** Radiocarbon plots and calibrated dates from Mesolithic levels of la Grande Rivoire calibrated at 2 sigmas against IntCal13 (Reimer et al., 2013) using OxCal v4.2.3 (Bronk Ramsey et al., 2013).

decomposed and dispersed vegetal fine organic matter (Fig. 8), with some tissue fragments visible occasionally. The rate of deposition of this layer is slow and is demonstrated in particular by the presence of soil fauna, snail shell, and earthworm granules (Fig. 9) and a least accumulation of angular pebbles than in the underlying layers. Post-depositional processes have been identified such as the presence of secondary carbonates, particularly well developed around the dripline (calcite needle fiber in voids, Fig. 8).

The sediment of the late First Mesolithic (US33 to US38) is lighter due to the presence of ashes and less dark vegetal organic matter. The rate of deposition seems to increase due to a more important accumulation of rock and fine sediments, probably related to more intense human and/or animal movements and trampling. Vertical and lateral variations are observed in the sequence and probably reflect different deposition dynamics and post-depositional evolution of the sediment within the shelter. Natural and anthropogenic inputs (mainly ashes) continue to accumulate and intersperse during the later phases of occupation, varying in lateral and vertical organization throughout the sequence and getting more complex.

## 5. Radiocarbon chronology

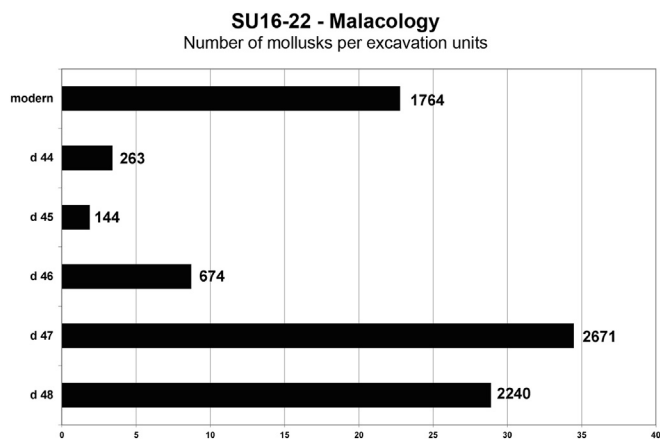
Four radiocarbon dates are available for the First Mesolithic levels (Fig. 10) and were sampled in the layers C (approximately excavation units d38–d42 of the recent excavations; Fig. 6) and D (approximately excavation units d44–d47 of the recent excavations; Fig. 6) of the 1990's testpits excavation. Two of them show a high standard deviation (Ly-5433, Ly-5434; Picavet, 1995, 1999) however two dates (GrA25065, GrA25064; Drucker et al., 2008) done more recently have a better standard deviation. Layer D is dated between 8538 and 8281 cal. BC, an age range corresponding to an early phase of the First Mesolithic. Layer C is dated between 7783 and 7578 cal. BC, which corresponds to a late phase of the First Mesolithic period. Five more samples have been collected in

the recently excavated area (excavation units d38 to d47 of squares SU16-22) and the results are pending. These results will help refine the chronocultural sequence of the First Mesolithic sequence of La Grande Rivoire.

Various specialized analyses were carried out on the finds from the First Mesolithic levels of La Grande Rivoire. Here, we present some preliminary results of the analyses done on the archaeological industries, macrofauna and palaeoenvironmental records from these levels.

## 6. Malacofauna

The study focused on excavation units d44 to d48 of the area SU16-22. The assemblage is composed of terrestrial mollusks. A big difference in number of mollusks per excavation units is noticeable



**Fig. 11.** Number of mollusks per excavation unit for d44 to d48 (squares SU16-22). Data: L. Chaix.



but is probably related to the volume of sediment dug for each excavation unit (Fig. 11). The malacological spectrum analysis shows (Fig. 12):

- The lowest excavation unit (d48) is characterized by the dominance of open-country and mesophilous species. A few species that like warm and dry conditions have also been identified.
- Excavation unit d47 is quite similar from the previous one and show a slight raise in number of woodland species. Steppic and open-country species are still very abundant.
- On the other hand, excavation unit d44 to d46 show a huge development of woodland species and is a decrease of open-

country species. Steppic species are, once again, well represented. The increase of *Cepaea sylvatica* could correspond to a consumption of this gastropod as it has often been observed in Alpine and Pyreneans settlements.

## 7. Archaeobotanical remains

Archaeobotanical analyses were performed on levels d42 to d47 of the area SU16-22 (Table 1), including five samples: two from hearths (F99 and F101) and three from “living floor” (“LF”). The total volume of sediment analysed was 73.3 L and has been water-sieved

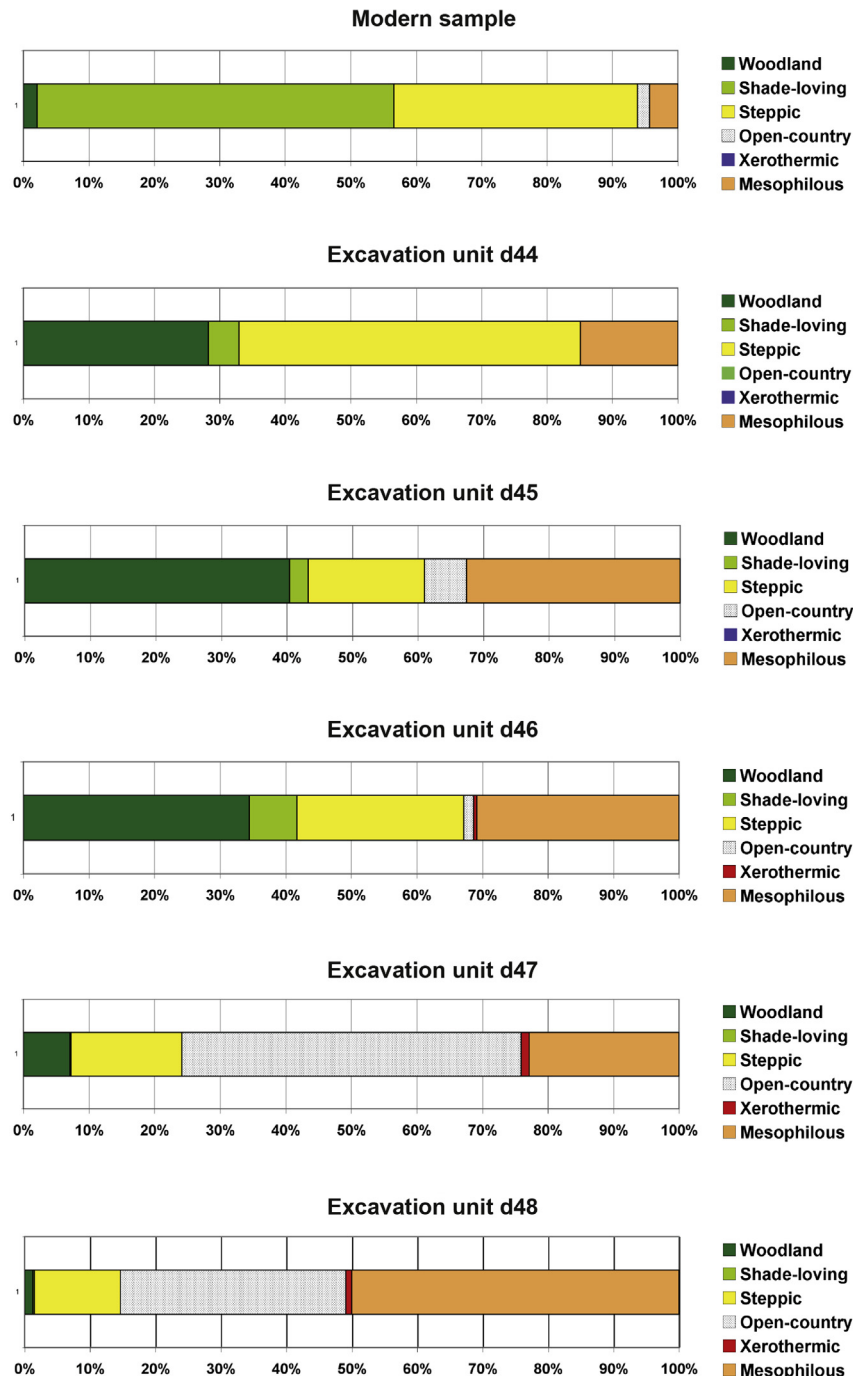


Fig. 12. Comparison of spectrum of mollusks per excavation unit depending on their habitat. Excavation units d44–d48 from squares SU16-22. Data: L. Chaix.

with a minimum mesh of 0.5 mm. Plant remains recovered and collected during the excavation have also been taken into account (“Ex”).

Almost 95% of the plant remains identified (835 items out of 905) are hazelnuts shell fragments (*Corylus avellana*) with only few items of dogwood seeds (*Cornus sanguinea*), elderberry seeds (*Sambucus* sp.), and lime fruits (*Tilia platyphyllos*). The composition of the spectrum does not show any significant variations. Mixed oak forests were already well represented in the region during the end of Preboreal and the Boreal period. The presence of larch (*Larix decidua*) in the assemblage is surprising in this context. If larch can grow almost everywhere, today, its natural habitat is the subalpine range of the intern Alps (Rameau et al., 1993).

**Table 1**  
Plant macroremains identified in Mesolithic levels of La Grande Rivoire from excavation units d42–d47 (SU16-22). Ex: plant remains collected during the excavation; F: hearths; LF: living floor.

Sample reference SU16-22	d47	d47	d46	d46	d45	d44a	d44	d43b	d42	d42	Total
Structure	Ex	LF	Ex	LF	Ex	F101	Ex	F99	Ex	LF	
Volume (litre)	–	21	–	20	–	8	–	12.8	–	11.5	73.3
<i>Cornus sanguinea</i> , dogwood, seed	–	–	4	–	1	–	1	–	–	–	6
<i>Corylus avellana</i> , hazelnut, shell fragment	14	74	433	61	55	2	40	45	55	56	835
Fabaceae, pulse, seed	–	–	1	–	–	–	–	–	–	–	1
<i>Larix decidua</i> , larch, seed	–	–	–	–	–	–	–	1	–	–	1
Pinaceae, twig	–	–	–	–	–	–	–	–	–	1	1
<i>Sambucus</i> sp., elderberry, seed	–	–	–	1	–	–	–	–	–	–	1
<i>Tilia platyphyllos</i> , lime, fruit	–	–	–	–	–	–	–	4	–	–	4
<b>Total identified taxa</b>	<b>14</b>	<b>74</b>	<b>438</b>	<b>62</b>	<b>56</b>	<b>2</b>	<b>41</b>	<b>50</b>	<b>55</b>	<b>57</b>	<b>849</b>
Indeterminata	–	8	–	20	–	–	–	–	–	7	35
Micromammal coproliths (carbonised)	–	–	–	4	–	–	–	17	–	–	21
<b>Total</b>	<b>14</b>	<b>82</b>	<b>438</b>	<b>86</b>	<b>56</b>	<b>2</b>	<b>41</b>	<b>67</b>	<b>55</b>	<b>64</b>	<b>905</b>
Items/litre	–	3.9	–	4.3	–	0.3	–	5.2	–	5.6	

## 8. Macrofauna

The faunal analysis focuses only on the lowest excavation units (d47–d48) of the area SU16-22. The unit d48, corresponding to the rocky substratum of the deposit, is very poor in bone remains (NR = 16), mainly composed of small splinters. However, the material from d47 is abundant (NR = 609, without counting the splinters of less than or equal to 1 cm) and very well preserved.

The numerous refittings (58 in d47, 2 in d48) and matchings indicate that there is not much scattering of the discarded fragments (Fig. 13). Dentals rows from the same individuals or bone from the same animals were all discarded in a close area. The assemblage is likely to result from a single (or few) discarded events with little post-depositional impact on their initial spatial patterning.

The general aspect of the faunal remains is very homogeneous throughout the area and does not differ between d47 and d48. The color of the bones is light beige to brownish beige. Bones surfaces are covered with thin greyish concretions of carbonate (Fig. 14). Very few remains are carbonized or calcined (<1%). The brownish color could result from heat, or from a prolonged contact of the bones with organic matter accumulated locally. Bones discarded were thus not in direct contact with fire, neither in situation of a prolonged combustion. The material is very well preserved: fracture edges are fresh, percussion scars and cut marks are visible. Length distribution of red deer long bone fragments extends between 1 and 21 cm, with 76% of the values between 4 and 11 cm (Fig. 15). The average length of the fragments is almost 10 cm, slightly larger than either of Mesolithic series of Jura (Bridault, 1994). The presence of the smaller splinters and continuous

representation of sizes up to 21 cm prove that all modules have contributed to the formation of this assemblage. The low proportion of small splinters (7% up to 3 cm) nevertheless appears underestimated because of the difficulty of identifying them, while they are numerous in the unidentified (not measured). Our interpretation is that some small modules (mostly unidentified) result from post-depositional fragmentation (i.e. sediment compaction/trampling), while another part comes directly from fresh bone fracturing (i.e. marrow extraction). Their presence indicates that the processing of carcasses would have occurred in the immediate vicinity of the accumulation area, or fracturation waste have been moved using a container (e.g. in a skin, a mat) to be thrown away from the activity area.

The composition of faunal spectrum indicates the predominance of the Red deer (*Cervus elaphus*), represented by 6 individuals mostly adults, and by metapodials and long bones (the most abundant skeletal parts). In contrast, the wild boar (*Sus scrofa*) is represented by one adult and several juveniles. Caprines (Ibex and Chamois) are each represented by one individual. But their identification is likely slightly underestimated due to the difficulty of the specific identification of remains of close skeletal size. The lack of the roe deer (*Capreolus capreolus*) is an interesting pattern already observed in the middle Mesolithic sample from previous excavations (Bridault and Chaix, 1991). This might be a matter of choice of game and/or hunting grounds. It is likely that the proximity of cliffs offered favorable areas for hunting ibex (a craggy areas loving species) and chamois, however more ubiquitous (Bauman et al., 2005). Finally, the presence of two small mammal species specific to aquatic habitats is another interesting fact. The Furon flowing below the site might be a favorable area to trap or hunt beaver (*Castor fiber*) and otter (*Lutra lutra*), as sought for their fur, potentially for castoreum (oily secretion produced by special glands of the beaver), or for their meat. Only the beaver had been identified in the average sample from the Mesolithic excavations by Picavet (Bridault and Chaix, 1991).

## 9. Bone industry

In this paper, the bone industry analysis only focuses on excavation units d44 to d48 of the area SU16-22. Osseous material industry consists of 34 remains (Table 2). Among them, there are only two finished objects. One is a fragment of bone-bevelled tool (Fig. 16, 1), of very little dimensions (7 mm length). The other is a

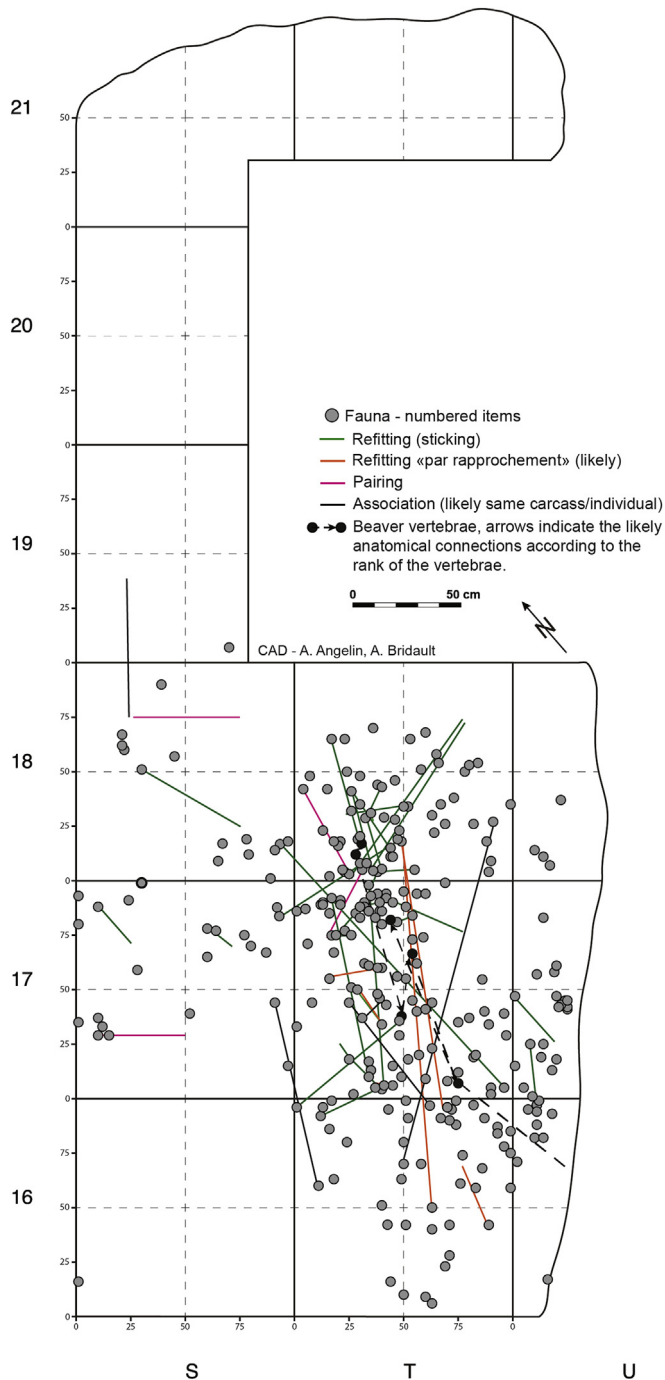


Fig. 13. Planimetric refittings on faunal remains in squares SU16-19 (data from excavation units d47 and d48). CAD: A. Bridault and A. Angelin.

denticulated tool, made of wild boar canine (Fig. 16, 3). Three remains could be finished objects, but identification as such is not certain. Two of them are very small scraped fragments of bone and antler. The last one, made of bone, does not show any use-wear traces (Fig. 16, 2). Thirteen remains are antler *débitage* waste (Fig. 16, 4–6). Sixteen remains are antler fragments that do not present any working or use-wear traces. Nevertheless, they were recorded as a further evidence of the presence on the site of an osseous raw material linked with technical activity. Due to their small dimension, the majority of these fragments were found after sieving.

Table 2  
Osseous material industry from excavation units d44–d48 (SU16-22).

	Bone	Antler	Tooth	Total
Bevelled tool	1	–	–	1
Denticulated tool	–	–	1	1
<i>Débitage</i> waste	–	13	–	13
Indeterminable	2	1	–	3
Fragment	–	16	–	12
Total	3	30	1	34

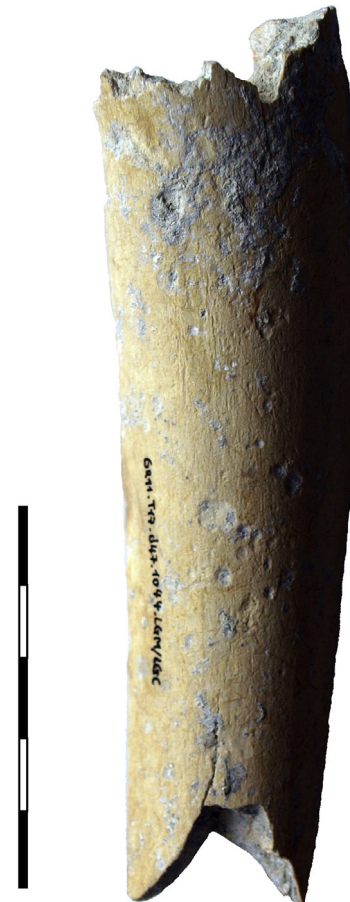


Fig. 14. Red deer bone shaft from excavation unit d47 (SU16-22) showing secondary carbonates concretions. Photography: A. Bridault.

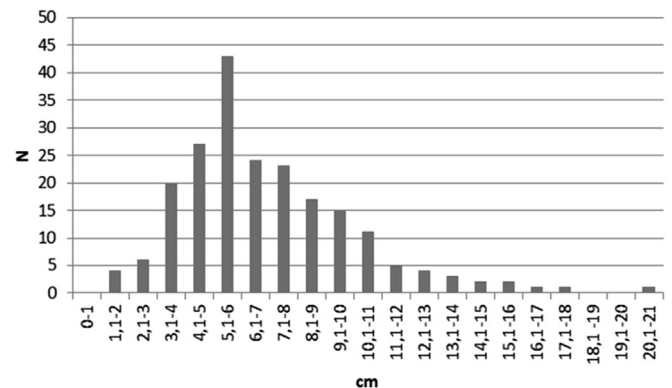
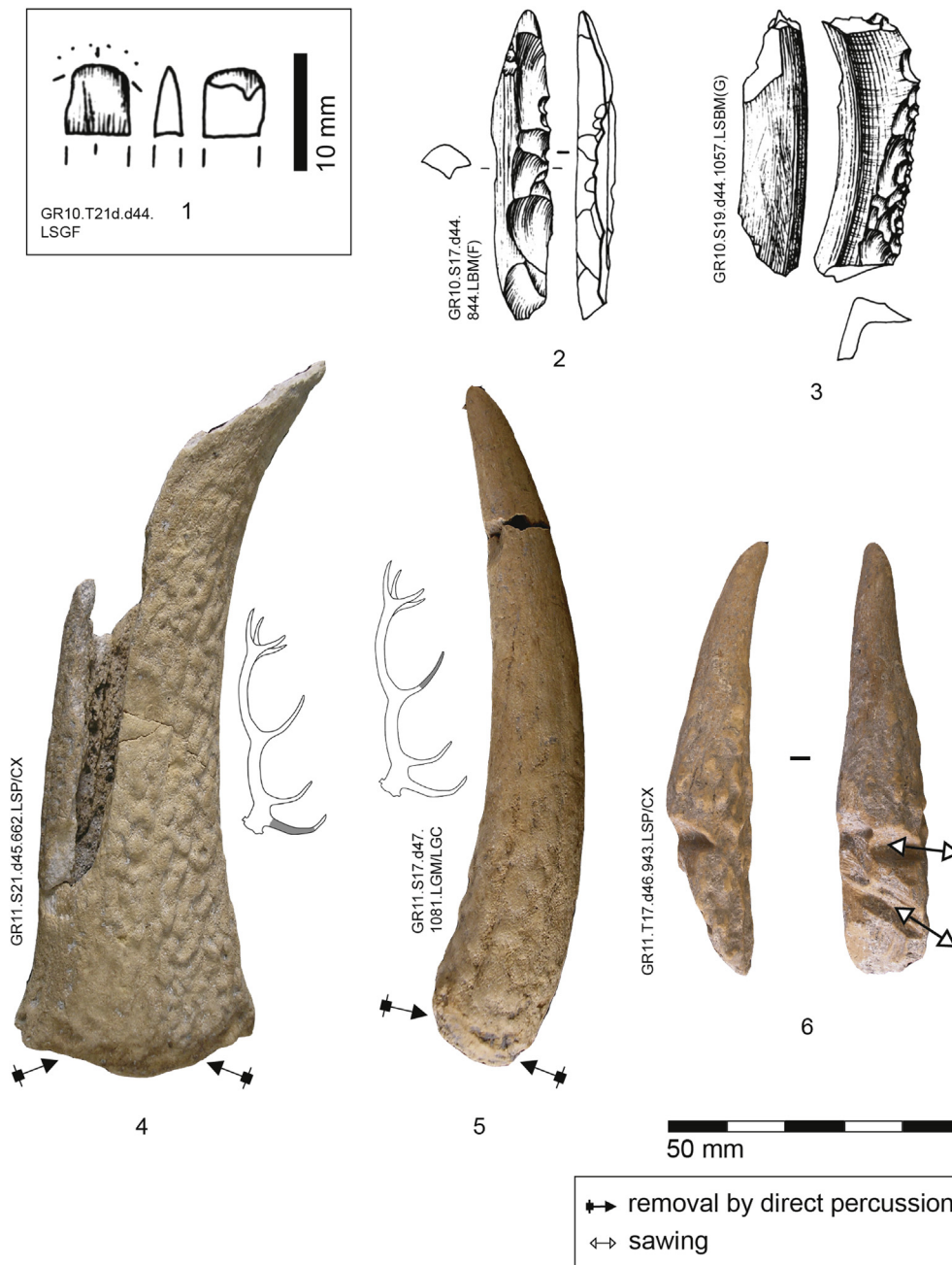


Fig. 15. Length distribution of long bone and metapodial fragments of red deer and deer size (N = 209) from excavation unit d47 (Shapiro–Wilkinson test  $p = 0.001009$  – normality is rejected). Data: A. Bridault.





**Fig. 16.** Examples of osseous material industry from excavation units d44 to d48 (SU16-22). n°1: Bone bevelled tool; n°2: indeterminate bone artefact; n°3: wild boar canine denticulated tool; n°4 to 6: antler waste *débitage*. Photography: B. Marquebielle; drawings: R. Picavet.

Deer antler is the most represented raw material. Due to the lack of basal part of antler, we cannot determinate if it came from shed antler or from hunted animals. The majority of antler remains was found in excavation units d45 to d47. These remains are waste *débitage* and fragments. Bone and tooth remains were found only in excavation unit d44. One indeterminate object was made using long bone of medium or big size animal (Fig. 16, 2). The unique object of tooth was made using lower canine of adult male wild boar (Fig. 16, 3).

The small number of remains and their fragmentary nature allow to give only a partial view of the osseous materials' work carried out on the site. The study of the three bone remains brings information only about shaping of this raw material.

Scraping was used to bevel the active part of one tool (Fig. 16, 1). Removal by diffuse percussion was used to shape edges of flat and stretched piece of bone (Fig. 16, 2). Antler remains bring only information about *débitage*. Tines and beams were cut in two steps: a quick preparation was lead by nicking or sawing then the two parts were detached by bending (Fig. 16, 4-6). Neither blanks nor finished objects were found. Specific aim of antler working remains unclear. Only one remain brings information about tooth working. A lower canine of adult male wild boar has been split. The flat blank thus obtained was shaped by removal by diffuse percussion (Fig. 16, 3). Concerning antler, the presence of *débitage* waste could be an evidence of a local crafting of this raw material.

## 10. Lithic industry

### 10.1. Methodological approach

A typotechnological analysis of all the lithic industry was carried out on the lowest excavation units d42 to d48 of the area SU16-22 (Fig. 2). Excavation unit d48 (n = 51) and d47 (n = 310) contain too few lithic artefacts and have not been taken in consideration for this study. Thus, the analysis presented here only focuses on the most

opératoire(s) to be detailed. Local and regional raw materials show an equal-share in terms of numbers; however, a clear dichotomy can be seen when considering their total weight (close to 80% of local materials and 20% of regional ones). The several local cores and blocks found within the assemblages could explain this important difference in weight. In both assemblages, two distinctive chaînes opératoires of débitage have been identified: one within the local raw material assemblage and one for the regional raw material.

**Table 3**

Lithic assemblage from excavation units d42 to d46 (SU16-22).

Blanks	SU16-22 – d45-46					SU16-22 – d42–44				
	Locals		Regionals		Total	Locals		Regionals		Total
	n	%	n	%	n	n	%	n	%	n
Flakes										
Entires	390	19.4%	213	10.6%	<b>603</b>	141	14.4%	170	17.4%	311
Proximal fragments	98	4.9%	58	2.9%	<b>156</b>	34	3.5%	42	4.3%	76
Other fragments	352	17.5%	267	13.3%	<b>619</b>	165	16.9%	167	17.1%	332
Bladelets										
Entires	50	2.5%	90	4.5%	<b>140</b>	21	2.1%	46	4.7%	67
Proximal fragments	44	2.2%	93	4.6%	<b>137</b>	9	0.9%	38	3.9%	47
Mesial fragments	22	1.1%	101	5.0%	<b>123</b>	4	0.4%	34	3.5%	38
Distal fragments	40	2.0%	106	5.3%	<b>146</b>	8	0.8%	47	4.8%	55
Cores & fragments	38	1.9%	14	0.7%	<b>52</b>	20	2.0%	14	1.4%	34
Tested cores	7	0.3%	1	–	<b>8</b>	8	0.8%	0	0.0%	8
Blocks & fragments	25	1.2%	2	–	<b>9</b>	9	0.9%	0	0.0%	9
<b>Sub-total</b>	<b>1066</b>	<b>53.0%</b>	<b>945</b>	<b>47.0%</b>	<b>2011</b>	<b>419</b>	<b>42.9%</b>	<b>558</b>	<b>57.1%</b>	<b>977</b>
Undetermined	5	–	7	–	<b>12</b>	1	–	3	–	4
Splinters	1583	–	1518	–	<b>3101</b>	691	–	798	–	1489
Debris	351	–	317	–	<b>668</b>	128	–	139	–	267
<b>Total</b>	<b>3005</b>	–	<b>2787</b>	–	<b>5792</b>	<b>1239</b>	–	<b>1498</b>	–	<b>2737</b>

informative and lithic artifacts rich excavation units (d42 to d46). The methodological approach used for the typotechnological analysis follows work previously done on Neolithic period by Binder (1987, 1991), later modified by Perrin (2001, 2009). This type of analysis allows considering a wide range of criteria, such as blank type and shaping technique.

Prior to the techno-functional approach, a lithic artifact refittings and spatial distribution analysis of both lithic and faunal remains have allowed to identify two sets of excavation units and lithic assemblages. It appears that excavation units d42 to d44 can be grouped together, as well as excavation units d45 and d46. The following analysis is based on the grouping of these two distinct assemblages. Raw materials have also been grouped by local or regional provenance. Local raw material was collected nearby La Grande Rivoire and consists of flint nodules present in the limestone cliff. Its color is reddish to grey-brown and has a very poor knapping quality (medium-to coarse-grained rock). Regional raw material was collected on a wider area (from few hundred meters up to 50 km), but restricted to the mountain range of Vercors and perhaps Chartreuse as shown by previous petrographic analysis of raw material found in Vercors prehistoric sites (Affolter and Grunwald, 1999; Bressy, 2003). In contrast with the local raw material, the flint material has various colors and is of very good knapping quality (fine-grained rock).

### 10.2. Lithic dataset overview

The two assemblages defined previously are composed of 5792 pieces of flaked flint for excavation units d45–d46 and 2737 artefacts for excavation units d42–d44 (Table 3). In both cases, abundant splinters and thermally affected debris compose the most part of the assemblage. They are very good evidence for *in situ* knapping activities and enable every step of the chaîne(s)

### 10.3. Lithic artefact production strategies

Through the analysis of cores, blanks and tools, we were able to identify two main chaînes opératoires for both type of assemblages. The first one concerns local raw materials and is directed towards the débitage of flakes by direct percussion, which are then directly used as tools and rarely retouched. The second chaîne opératoire identified concerns regional raw materials and involves the production of small bladelets by direct percussion with a soft-stone percussor that are transformed into backed bladelets such as crescents (only in excavation units d46–d45), scalene triangles and axial backed points. The presence of few microburins in both assemblages raises some questions about their affiliation to the latter chaîne opératoire or whether they are elements of older periods. Indeed, microburin technique is more likely to be linked with isoscele triangle and oblique point manufacturing, missing from these assemblages (Fig. 2).

### 10.4. Reduction sequences on local raw material: débitage of flakes and bladelets

Flake and bladelet cores, although representing a small proportion of the total lithic assemblage (around 2%), are technologically very informative. Judging from the nature of the cortical surfaces remaining on the cores and raw blocks, we can infer the original size and volume of the core (around 60 × 45 mm for blocks and 60 × 30 mm for elongated pebbles). Few blocks show only the extraction of one or two flakes and can be interpreted as blocks tested and probably stocked for further use and/or probably recycled as tools; such as denticulates. The débitage is quite pragmatic with no real side preference but with a constant search for ideal convexities and as long as it allows the extraction of elements of ±30 mm in length. The shaping of the nodules has been done *in situ*

by the removal of simple cortical flakes by direct percussion with, most probably, a hard-stone percussor.

From that point, a main *chaîne opératoire*, oriented towards the extraction of flakes, was identified. Because the raw materials used are of poor knapping quality, the *débitage* cannot be fully controlled. Thus, at some point during the *débitage*, few bladelets are extracted, even though they are not the primary purpose. Based on diagnosis criteria from proximal element (Pelegrin, 2000; Abbès and Der Arahamian, 2002), direct percussion with hard/soft-stone percussor is used for the extraction of both products (surely only soft-stone percussor for bladelets extraction) from plain (extracted by simple flakes) or natural single striking platform (Fig. 17B). Core exploitation is generally not pushed toward exhaustion of raw material and maintenance phases are almost inexistent or only to be linked to *débitage* reorientation. During knapping process, breaks and hinged flakes occur frequently and a new striking platform is opened on a distinctive side. Although not directly

related to maintenance process, a few flakes show a clear shift in the orientation of *débitage* using one of the flanks as a new striking platform. The angle formed by the previous striking platform and the *débitage* surface is then used a guided “crest” (Fig. 17E). Finally, depending on the volume and block knapping quality, the *débitage* can be geared towards multipolar exploitation on various successive platforms (Fig. 17A). Few blocks and rejected cores are then recycled and retouched as denticulates.

The assemblage of tools for excavation units d45–d46 on local raw materials consists of 75 retouched artifacts (58 on flakes and 17 on bladelets), which represents some 3.7% of all the lithic material (splinters and thermal debris are not taken into account). The one from excavation units d42–d44 consists of 24 retouched artifacts (18 on flakes and 6 on bladelets), which represents some 2.4% of all the lithic material. From both assemblages, since any blank, disregarding its position within the *chaînes opératoires* is used as a tool; we prefer the term use of *débitage* rather than production to

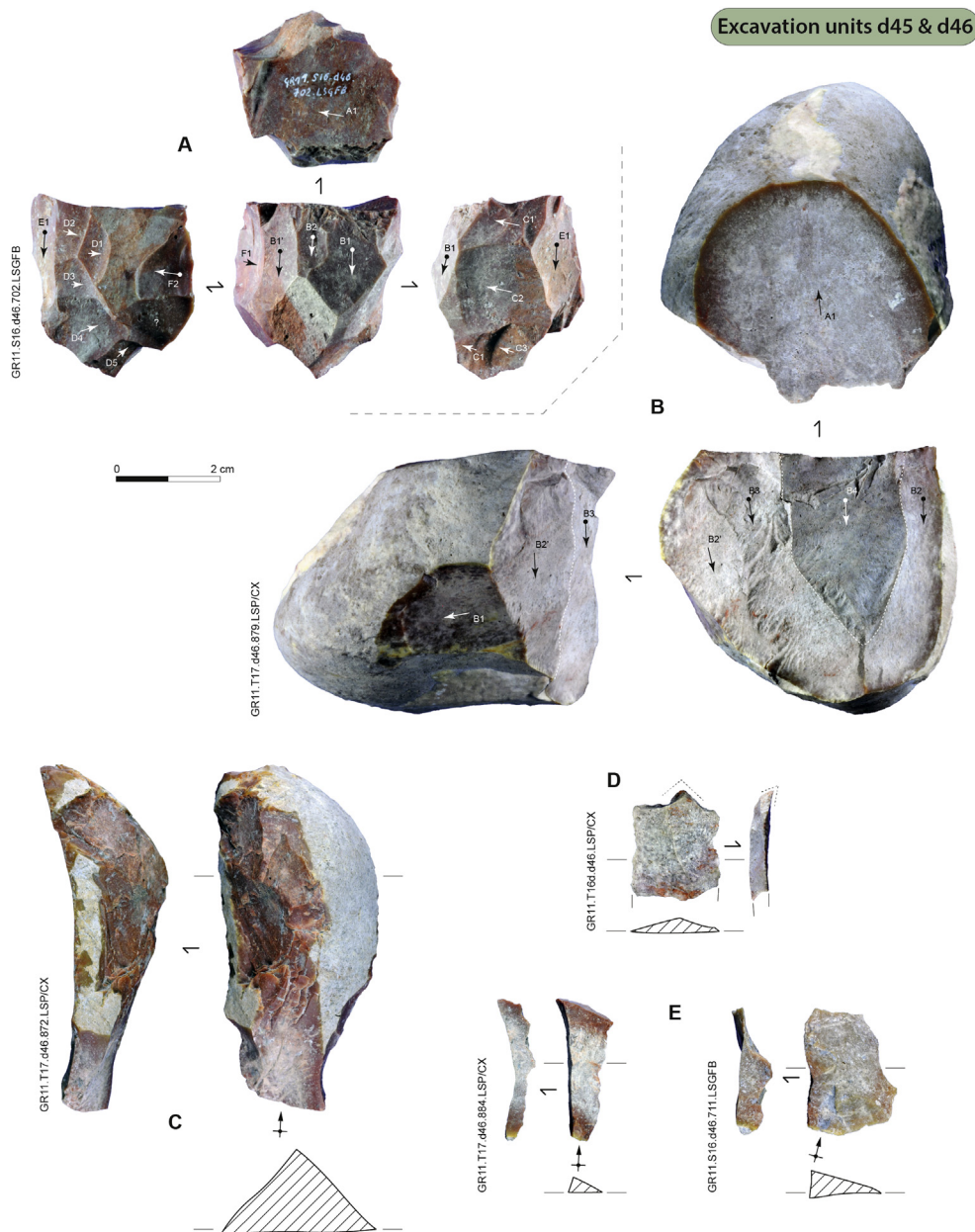
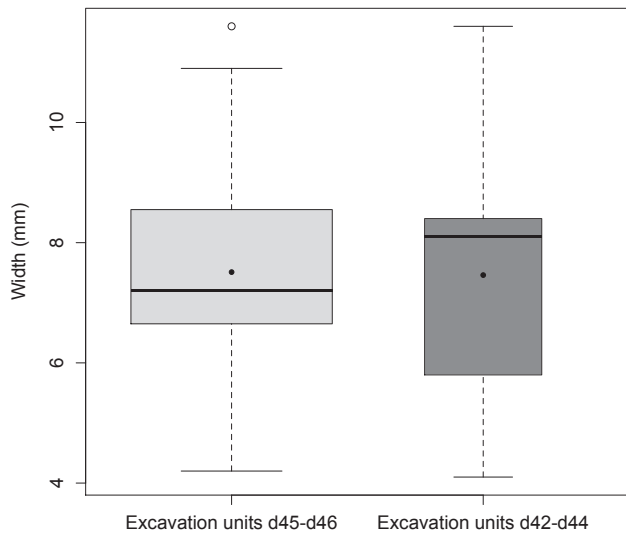


Fig. 17. Excavation units d45 and d46 (SU16-22). Examples of local raw material industry. A: multipolar core; B: unipolar core; C: shaping flake with irregular side removals; D: small drill by backed edges on flake; E: *débitage* reorientation flakes. Photography and CAD: A. Angelin.



### SU16-22 - Excavation units d42-d46

First-line bladelet's width

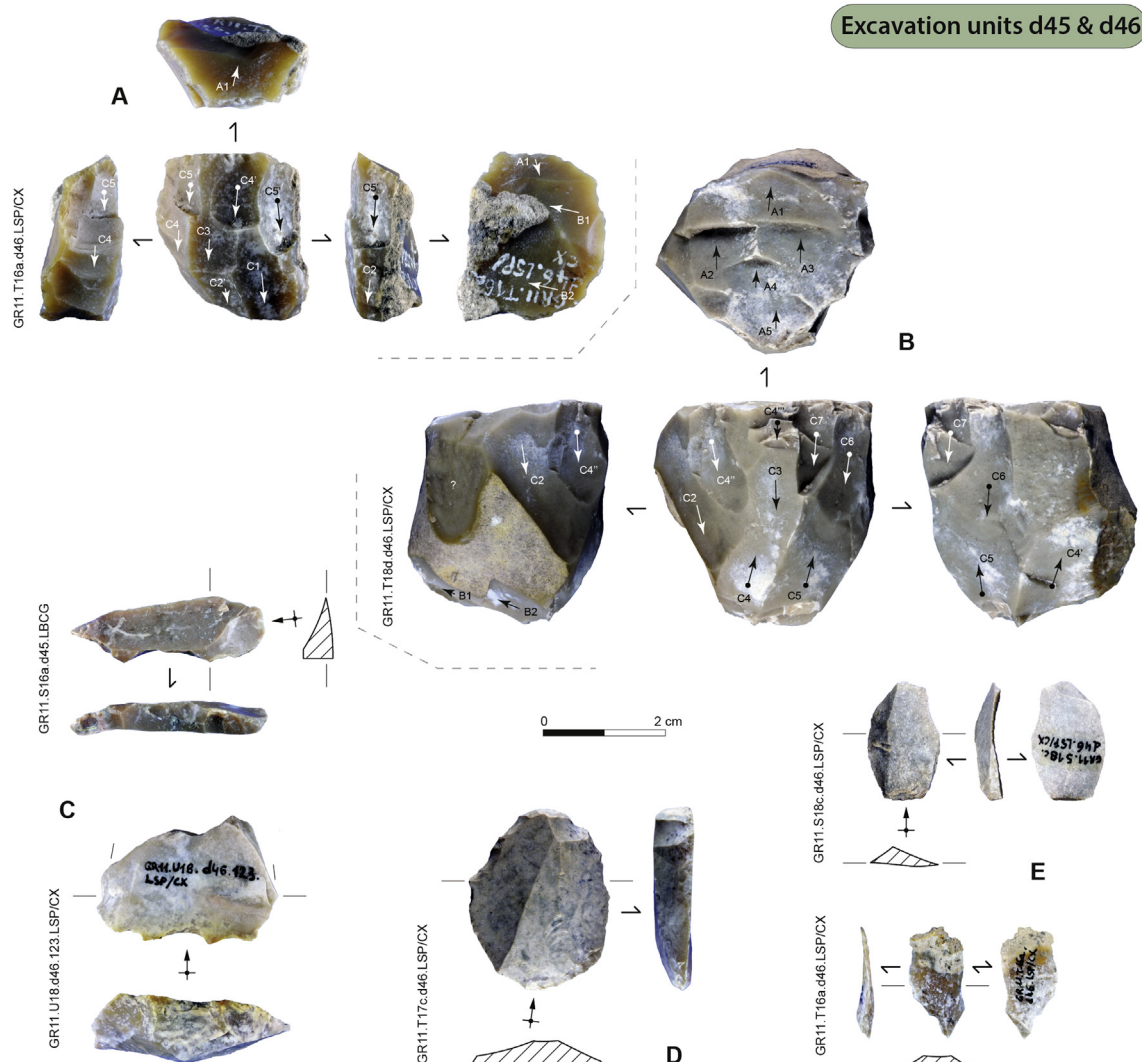


**Fig. 18.** Boxplots of first-line bladelets width. From excavation units d42 to d46 (SU16-22). Both groups show a normal distribution (Shapiro–Wilkinson test) and are not significantly different (t Student test). Data: A. Angelin.

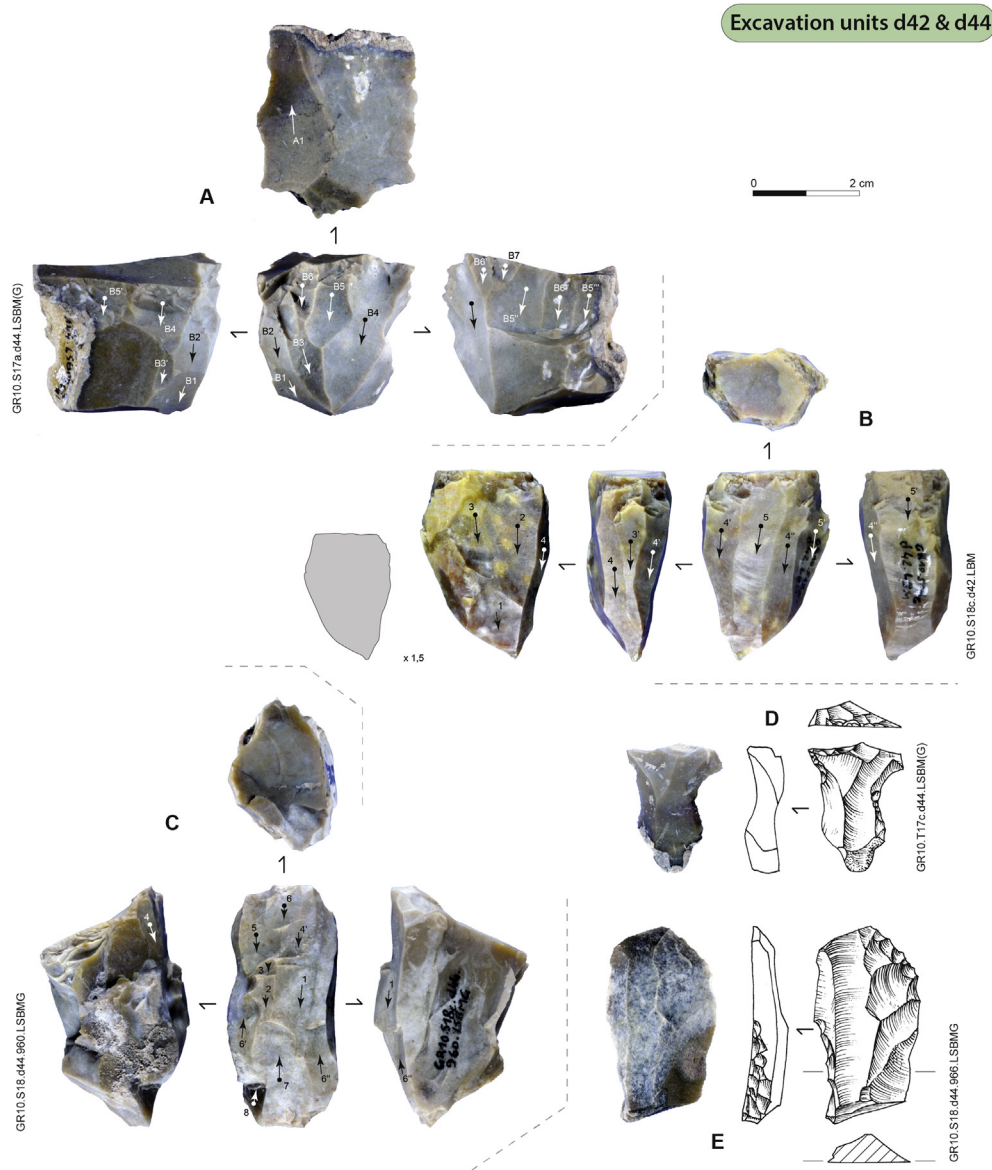
qualify this reduction sequence, as there is statistically no first-line production of flakes. Among tools, irregular side removals (simple use of flake's sharp edges; IR Types; Fig. 17C) constitute the most important part of the assemblages. Rare retouched artifacts consist of few end-scrapers (GR Types) and backed-flakes/bladelets (BA Types; such as lithic drills Fig. 17D).

#### 10.5. Reduction sequences on regional raw material: production of bladelets

The absence of shaping flakes (cortical ones) from the First Mesolithic layers in regional raw material, suggests that the shaping of nodules is done elsewhere (maybe in a non yet excavated zone, or directly in the raw material extraction sites), which makes difficult to conceive their original sizes and volumes. The *débitage* is much more controlled and aimed at the production of bladelets from unipolar cores (Figs. 19AB and 20AB). First-line production and morphometric data indicates that the goal of bladelet *débitage* is the selection of short, narrow and thin bladelets ( $20 \times 7.5 \times 1.6$  mm average; Fig. 18). Proximal ends observations shows an almost systematic abrasion (75%) and punctiform butts are predominant (60%), followed by plain and crushed butts. Bulbs are often diffuse and sometimes scarred. This is highly representative of a direct percussion approach, using a soft-stone percussor



**Fig. 19.** Regional raw material industry from excavation units d45 and d46 (SU16-22) – Early phase. A–B: unipolar core; C: core rejuvenation flakes; D: end-scraper on flake; E: microburins on bladelets. Photography and CAD: A. Angelin.



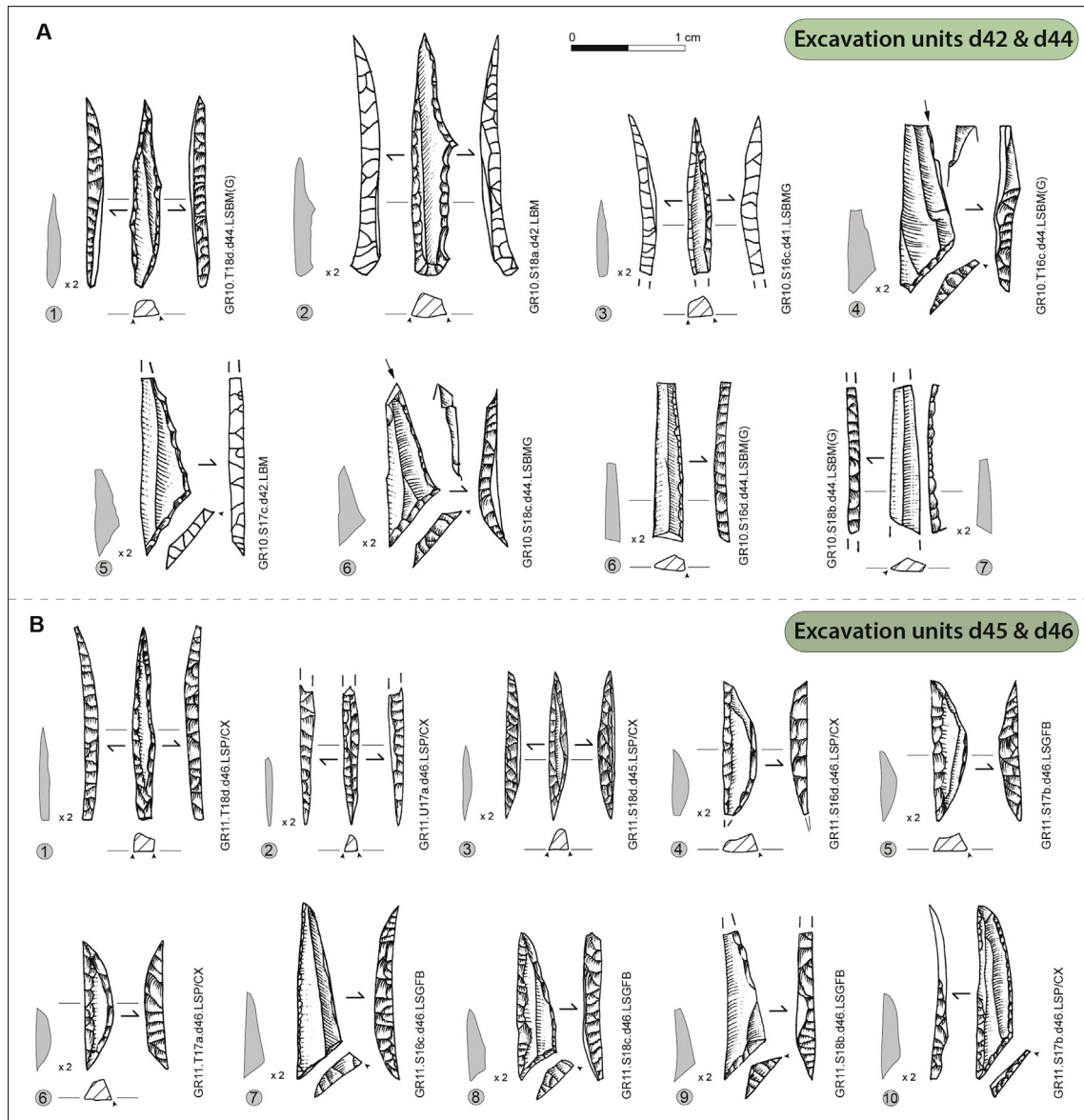
**Fig. 20.** Regional raw material industry from excavation units d42 and d44 (SU16-22) – Later phase. A–C: unipolar core; D: truncation on flake; E: side-scraper on flake. Drawing (D): R. Picavet; photography and CAD: A. Angelin.

(Pelegrin, 2000; Abbès and Der Aprahamian, 2002). Also, given the morphology of the desired products, direct percussion does not allow a constant monitoring of the production. Thus, several bladelets and flakes involved in the *plein débitage* process are also extracted and quite heterogeneous, morphometrically bigger.

Bladelet cores are very well maintained. The angle and the surface of the striking platform were revived by removal of “tablet” flakes from the platform surface perpendicular to the flaking surface (Fig. 19C). Other maintenance involves the removal of plunging flakes to correct mistakes on the flaking surface of the core (such as hinged removals) as well as to correct longitudinal convexity/curvature, or *carène*. The opening of a small secondary striking platform is often the case allowing correcting that same longitudinal convexity. Few partial crested bladelets have been identified and can be related to flanks and the flaking surface maintenance. The production is pushed to its maximum or stopped when facing accidents. Bladelet productions are sometimes so extensive that there is a loss in the *débitage* control/management. The lack of maintenance of the latter leads to a short production of flakes following a multipolar system of

exploitation. No such first-line production of flakes on regional raw material has been identified. Regional flakes are restricted to technical/maintenance purposes and are strictly second-line products.

The assemblage of tools for excavation units d45–d46 on regional raw materials consists of 219 retouched artifacts (77 on flakes and 142 on bladelets), which represents some 10.8% of all the assemblage’s lithic material (splinters and thermal debris are not taken into account). The one from excavation units d42–d44 consists of 110 retouched artifacts (36 on flakes and 74 on bladelets), which represents some 11.3% of all the assemblage’s lithic material. First-line products are selected for the manufacture of microliths by backed and/or truncated retouches (BA Types; Table 4). In addition, few microburins (MB Type;  $n = 3$ ; Fig. 19E) could attest of a partial use of this technique. On excavation units d45–d46, several types are represented such as axial points (BA11A/C Types, including Sauveterre-like points;  $n = 24$ ; Fig. 21, B1–3), crescents (BA11B Type;  $n = 24$ ; Fig. 21, B4–6) and scalene triangles (BA12B Type;  $n = 20$ ; Fig. 21, B7–10). Morphometric study indicates a mean of  $12.8 \times 3.6 \times 1.5$  mm for the BA11 A/C Types,  $11.4 \times 3.5 \times 1.6$  mm for



**Fig. 21.** Microlithic arrowheads. A: Excavation units d42 and d44 (SU16-22). 1–3: axial points; 4–6: scalene triangles; 6–7: longitudinal edges. B: Excavation units d45 and d46 (SU16-22). 1–3: axial points; 4–6: crescents; 7–10: scalene triangles. 2:1 scale (figures in grey are 1:1 scale). Drawings: R. Picavet.

the BA11B types and  $13.3 \times 4.2 \times 1.6$  mm for the BA12B types. This data also demonstrates the homogeneity of the artifact assemblage. The microlithic assemblage for excavation units d44–d42 shows the same representation as described in the underlying microlithic assemblage, and interestingly, crescents (BA11B Types) have almost completely disappeared ( $n = 2$ ). Other types consist on axial points (BA11A/C Type, including Sauveterre-like points;  $n = 24$ ; Fig. 21, A1–3), scalene triangles (BA12B Type;  $n = 22$ ; Fig. 21, A4–6) as well as longitudinal backed edges (BA14 Type;  $n = 2$ ; Fig. 21, A7–8).

Morphometric study indicates a mean of  $15.0 \times 3.8 \times 1.7$  mm for the BA11A/C types and  $12.6 \times 4.6 \times 1.6$  mm for the BA12B types. In addition, few microburins (MB Type;  $n = 2$ ) found within the assemblage could attest of a partial use of this technique. Any second-line products such as maintenance bladelets and flakes involved in the *plein débitage* are often to be used as tools such as irregular side removals (IR Types). Few retouched artifacts consist of end-scrapers on flakes (GR Types; Fig. 19D), side-scrapers (RA Types; Fig. 20E) and truncations on flakes (TR Types; Fig. 20D).

**Table 4**

Distribution of arrowheads types from excavation units d42 to d46 (SU16-22). Codings after Perrin (2001, 2009).

Arrowheads types	Codes	d45–d46		d42–d44		Total n
		n	%	n	%	
Axial points with one backed edge	BA11A	11	11.0%	7	13.5%	18
Crescents	BA11B	24	24.0%	2	3.8%	26
Axial points with two backed edges	BA11C	13	13.0%	11	21.2%	24
Scalene triangles	BA12B	20	20.0%	22	42.3%	42

(continued on next page)



Table 4 (continued)

Arrowheads types	Codes	d45–d46		d42–d44		Total n
		n	%	n	%	
Scalene triangles with two backed edges	BA12C	4	4.0%	0	0.0%	4
Undetermined fragments	BA13	25	25.0%	8	15.4%	33
Longitudinal edges	BA14	2	2.0%	2	3.8%	4
Axial points with a truncated edge	BA16	1	1.0%	0	0.0%	1
Total		100	100.0%	52	100.0%	152

10.6. Lithic general considerations

The typotechnological study carried out on excavation units d42–d46 allowed us to identify two sets of excavation units and lithic assemblages (d42–d44 and d45–d46) as well as two main

chaînes opératoires (Fig. 22). For both assemblages, a first chaîne opératoire concerns local raw materials and is directed towards the débitage of flakes and sometimes bladelets *in situ*. Products are then directly used as tools, rarely retouched. The second chaîne opératoire identified concerns regional raw materials.

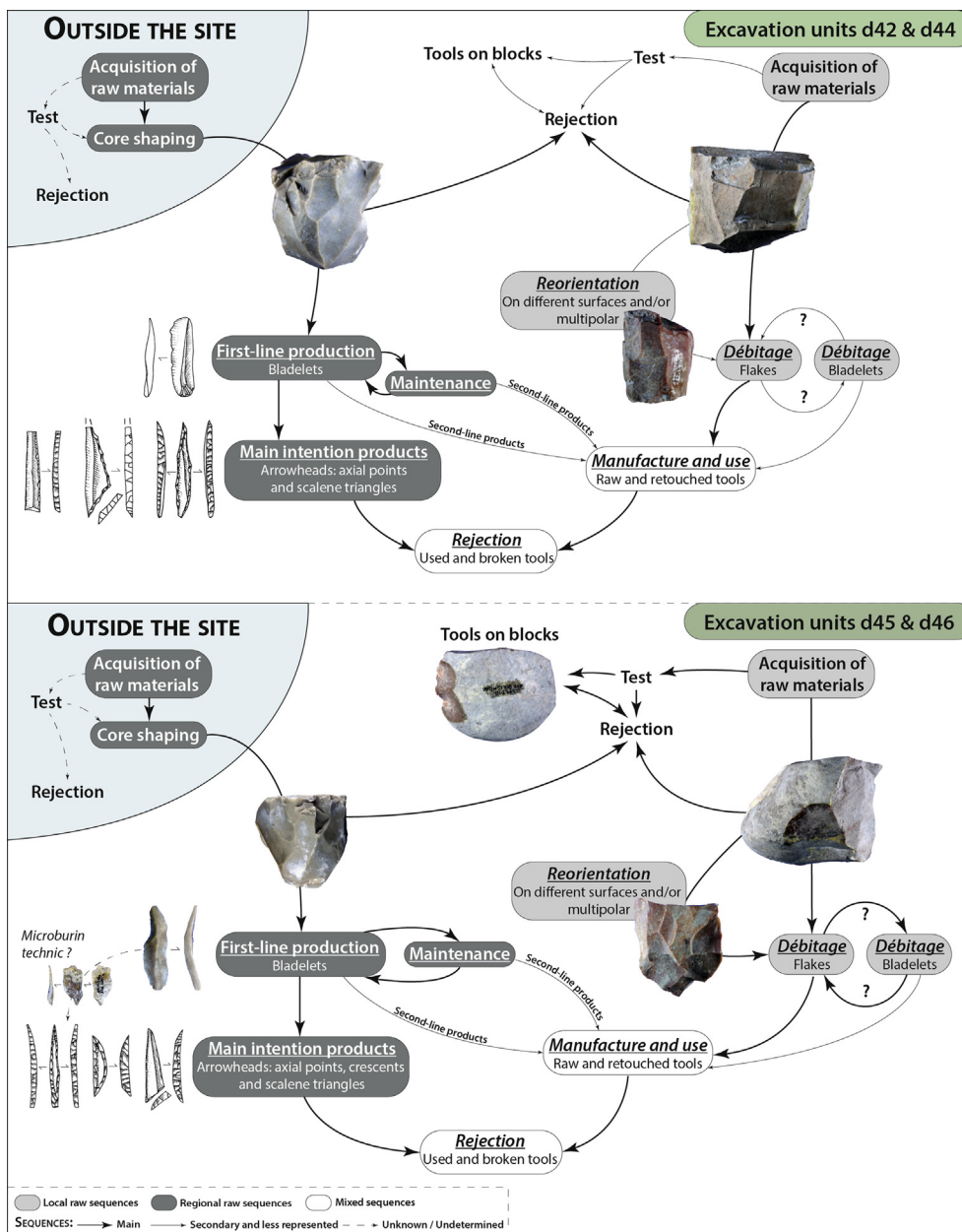


Fig. 22. Schematic restitution of the different chaînes opératoires identified in both assemblages of La Grande Rivoire lithic industry (SU16-22, excavation units d42–d44 and d45–d46). Photography and CAD: A. Angelin.

Through the absence of cortical and shaping artefacts, it appears that blocks are prepared elsewhere, in a non yet excavated zone, or directly in the raw material extraction sites. It involves the production *in situ* of small are irregular bladelets that are transformed into backed bladelets such as crescents (only in excavation units d45–d46), scalene triangles and axial backed points. Second-line products, such as maintenance flakes, are often directly used or retouched.

### 10.7. Microliths usewear analysis

Usewear analysis was performed on microliths from excavation units d39–d47 of the area SU16-22. The results presented here focus only on the analysis of microlithic arrowheads. By reconstructing the different manufacturing methods and use of microliths, some questions were raised about their actual functionality. A better understanding of the different fracturation processes, damages and use-wear identified was necessary. In order to answer these questions an experimental project was carried out. Microliths were manufactured and then submitted to a series of tests reflecting practical use and life of the artefact such as arrow shots and trampling. Different configurations were tested with different positions of the arrowhead on the arrow shaft and all modifications recorded. A comparative study of the prehistoric and experimental

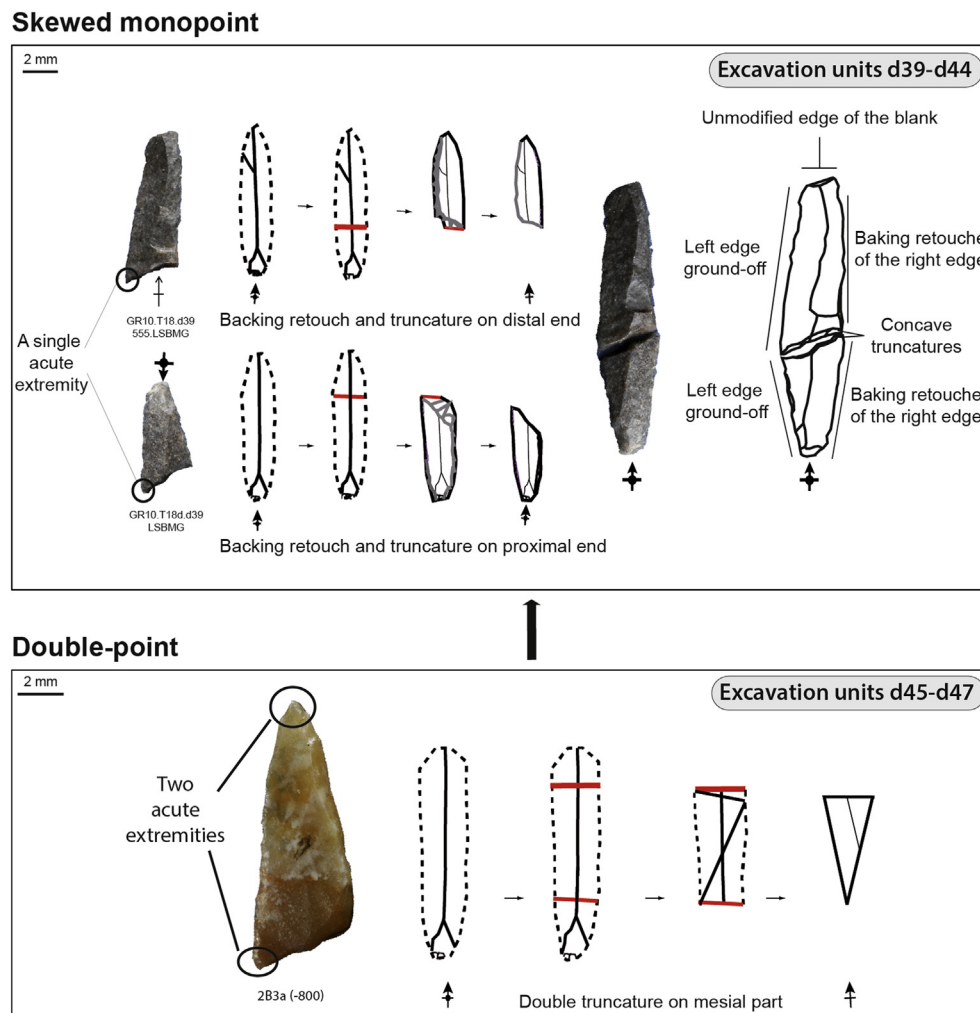
assemblages was then carried out to observe the differences between the archaeological and fac-simile use-wear traces (Chesnaux, 2013, 2014a, 2014b).

The main observation of these experiments is that only few triangles show impact fractures attesting of their use as barbs. It reveals that most of the damages observed are in fact fabrication fractures. Microliths were probably manufactured *in situ* but for a differed use. Our analysis also reveals other interesting facts on the evolution of functioning and shaping of arrowheads shafted as barbs. A certain simplification of shaping of arrowheads shafted as barbs is perceptible through time (Fig. 23). During the Early phase of the First Mesolithic (d45–d47), we obtain a “double-point” (cf. Fig. 23; Chesnaux, 2013, 2014a) by two truncations. In the later phase (d39–d44), the shaping of the bigger tip is abandoned and the shaping of two barbs (skewed monopoint) from a unique blank is observed.

## 11. Discussion

### 11.1. Sedimentological considerations

The differences in sediment composition observed between the bottom and the top of the First Mesolithic levels needs to be taken in consideration in the artifacts assemblage interpretation.



**Fig. 23.** Schematic evolution of the manufacturing of barbs during the First Mesolithic (SU16-22, excavation units d39 to d47). Scalene triangles of the top result from the same lamellar support. Photography and CAD: L. Chesnaux.

Indeed, low deposition rate can create archaeological palimpsests that are sometimes difficult to entangle. Excavation units d44–d46 of the area SU16–22 (corresponding to the stratigraphic units US 39 to 41 of the section S37), show a slow rate of deposition and the accumulation of high quantity of fresh and vegetal organic matter decomposed *in situ*. It is yet difficult to clarify the part of organic matter naturally accumulated or/and brought by the occupants. In the latter case, whether they were used as plant litter (associated with combustion features) still need some discussion. On the other hand, the excavation units d36–d42 (corresponding to the stratigraphic units US33 to 38 of the section S37) have probably a better time resolution due to a faster rate of sedimentation induced by a more important accumulation of rock and fine sediments, itself probably related to a more intense human and/or animal movements and trampling. These differences in deposits could also point to changes in patterns of occupation within the rockshelter. The change from a very organic sedimentation to one with a high proportion of ashes probably also implies changes in the way the rockshelter was occupied.

### 11.2. Past-environment and food strategies

The archaeobotanical and archaeofaunal results bring interesting data on the site's catchment and environment. The malacological analysis shows the presence of mainly open-country species in excavation units d47–d48. On the other hand, and in parallel to changes observed with sedimentology as well as the importance of human occupation, open-country species tends to disappear while a huge development of woodland species may be observed in excavation units d44–d46.

Results from the archaeobotanical analysis obtained for the whole sequence of the First Mesolithic (d42 to d47) do not show any evident change in the botanical spectrum over time. Hazelnut shells were by far the most frequent edible plant species recovered, which is often the case on Mesolithic sites across Europe (e.g. Holden et al., 1995; Zapata et al., 2002; Bouby, Surmely, 2004; Bishop et al., 2013). This dry fruit is a rich source of lipid and it can be stored without any special process. Moreover, hazel plays a preponderant role in the first deciduous forests in the region (Thiébaud, 1999). Other species are very scarce but they grew around the site and were gathered mainly for diet or for economical uses like for fuel or light (e.g. dogwood, Lieutaghi, 2004). One “exception” is the presence of a single seed of larch: it indicates that inhabitants of la Grande Rivoire visited also other territories in crystalline Alps, not so far from the site, around a day's walk.

The composition of the faunal assemblage from the units at the base of the sequence is characterized by the association of the currently hunted large game species during the Mesolithic – red deer and wild boar, and the two wild caprine species (ibex and chamois), frequent in the faunal spectra of Alpine areas. Together with aquatic and riverine species (beaver and otter), the spectrum points to a variety of habitats exploited and perhaps of territories visited. The absence of roe deer as well as common small fur species (pine marten, badger, wild cat) is a noticeable pattern not yet understood. The evolution of the faunal spectra will be discussed later in connection with environment, and/or cultural change or site function.

These various contributions describe the different environments visited by the occupants of La Grande Rivoire rockshelter. Malacofauna is strictly micro-local whilst archaeobotanical and fauna deal with regional sourcing and food strategies. Indeed, the acquisition of plant species and hunting of large-game species in different habitats (rupicol, aquatic and forest) show a supply territory more or less distant from the site of La Grande Rivoire, as for example the presence of typical vegetal species from crystalline

Alps such as larch. These observations can be put in relation to lithic raw material acquisition strategies. Prior studies (Affolter et al., 1999) have shown that regional raw material are mostly acquired from the mountain range of Vercors and its surroundings (north: Val de Lans and south: Diois) but do not exclude further provenance (Chartreuse, internal Alps, etc.).

### 11.3. Chrono-cultural trends

In some ways, work of osseous materials at la Grande Rivoire fits well with first elements of definition about the work of osseous materials in the southern half of France, which appear to be highly unified throughout all Mesolithic time (Marquebielle, 2014): three raw materials have been worked (bone, antler and wild boar canine), antler have been cut after a preparation by nicking or sawing and wild boar canine has been split before shaping and use. In others ways, First Mesolithic remains of La Grande Rivoire present specific features such as shaping by diffuse percussion of bone and wild boar canine and the abundance of antler *débitage* waste in the composition of the osseous material industry.

Concerning the first point, the very low number of remains does not allow to consider shaping by diffuse percussion as a cultural or chronological characteristic. The second point evokes the situation of two sites of Quercy region: La Grotte du Sanglier (Séronie-Vivien, 2001) and Le Cuzoul de Gramat (Lacam, 1944). On these sites, dated First and Second Mesolithic respectively, the majority of the osseous material industry is antler *débitage* waste. Technological analyse of these remains has allowed to propose they were both specific antler crafting (Marquebielle, 2014). In the current state of research, it is premature to say that the relative abundance of antler *débitage* waste at La Grande Rivoire could be interpreted in the same way. This hypothesis will be discussed as excavation work will progress, to determine to what extent could the osseous material industry reflect an *in situ* antler craft during the First Mesolithic occupation of La Grande Rivoire. We will also cross data with faunal analysis to try to precise the procurement sequence of raw material: reuse of alimentary waste or specific acquisition, by hunting or gathering (notably in the case of deer antler).

Study of lithic technology has not shown any difference nor significant evolution on both assemblages presented in this paper. Main productions are geared towards a *débitage* of flakes, essentially on raw materials of poor quality. Products are directly used (rarely retouched) as domestic tools. Beside flake *débitage*, blade-lets products are obtained from cores of much better quality for the manufacture of microlithic arrowheads. Typological trends and especially microlithic arrowheads show an important variability regarding shaping intentions. Our study has shown that scalene triangles and axial points (including Sauveterre-like points) are found throughout the sequence. However, crescents, present in large number in excavation units d45–d46 of the area SU16–22 have completely disappeared in excavation units d42–d44 (Angelin, 2014b). In numerous regional settlements, crescents are regularly found with isoscele triangles and microburins and are a marker of an early phase of the First Mesolithic. This typological evolution between these both assemblages is also perceptible with use-wear analysis and shaping intentions (Chesnaux, 2014a).

Finally, technological and typological aspects of the lithic industry, together with some regional comparisons, allow us to place both assemblages in a regional chronological sequence of the First Mesolithic where:

- Excavation units d45–d46 of the area SU16–22 could be placed at the end of the early phase of the Middle Mesolithic (Fig. 2). It is characterized by the presence of numerous crescents working as “double-points” and shaped by two direct truncations



(Chesnaux, 2014a), few microburins and the absence of isoscele triangles. Such productions and typological aspects are attested in the mountain range of Vercors such as level C2 of the Pas de la Charmate (Fig. 1; Bintz, 1995a), and in numerous open-air loci (Bintz et al., 1999a) such as Pré Peyret 1, Machiret (Fig. 1; Picavet et al., 2014) or Gerland (Fig. 1; Angelin, 2014a). They have also been identified in Chartreuse, such as in the lower assemblage of the Balmettes (Fig. 1; Monin and Pelletier, 2000) and in layer 5b of the area S4-5 of Aulp du Seuil site 2 (Fig. 1; Bintz et al., 1999b).

- Excavation units d42–d44 of the area SU16-22 can be associated with the beginning of a later phase of the First Mesolithic. A technological continuity is perceptible but a clear typological break is observed with the significant reduction in number of crescents, replaced by numerous scalene triangles. This phase is also attested in layer C2 of the Pas de la Charmate (Fig. 1; Bintz, 1995a), layer E4 of the Pas de l'Échelle (Fig. 1; Bintz, 1995b) and in numerous open-air loci such as the Pas de l'Aiguille (Bintz et al., 1999a), Pré Peyret 1 and Les Coins 1 (Fig. 1; Picavet et al., 2014). In the mountain range of Chartreuse, layer C2 of the Aulp du Seuil site 1 (Fig. 1; Pelletier et al., 2000) has shown many similar industries.

## 12. Conclusions

Based on the periodic division proposed by G. Marchand (2008) for the First and Second Mesolithic, the recent excavations in the lower sequence of La Grande Rivoire rockshelter have created new interesting data on the alpine First Mesolithic and a better understanding on the lifeways of Mesolithic people in this mountainous area of France. Analyses done on these early occupation layers are not yet fully completed but preliminary results allow characterizing them already from a sedimentary, economical, technological and chrono-cultural point of view.

Subsistence economy, in the lowest levels, relies largely on the red deer hunting and the collection of hazelnuts. So far, any difference has been observed from a technological viewpoint concerning lithic assemblages from the two phases. Interestingly, sedimentology and spatial distribution analysis, lithic retouched assemblage composition and bone work technology as well as usewear analysis allow dividing the beginning of the First Mesolithic sequence in two distinctive phases. It shows an early phase (excavation units d45–d47 of area SU16-22) marked by the presence of several crescents shaped by two truncations, few microburins and plenty of deer antler industries. From a cultural point of view, this phase shares plenty of French southern regional characteristics and could be attributed to the end of an early phase of the Sauveterrian culture (Valdeyron, 1994). The later phase (excavation units d42–d44 of area SU16-22), in clear continuity with the previous one, shows a significant reduction in number of crescents in its assemblage, a change in shaping intentions and the first appearance of bone and tooth industry. This phase shares characteristics with a late phase of the Sauveterrian culture (Valdeyron, 1994).

Our understanding of the Mesolithic occupation in La Grande Rivoire is still in progress as only a small part of the excavation has reached these levels. In terms of functional and palaeontological interpretation, more work need to be done to connect this site within its regional Mesolithic occupation network but the preliminary results presented in this paper shows already that La Grande Rivoire Mesolithic levels share some similarities with others sites in the mountainous area, reflecting a seasonal exploitation of high altitude environment. Future analysis of the rest of the Mesolithic levels from la Grande Rivoire, along with new radiocarbon dating (in progress) will also allow to establish a better chronocultural sequence for the second half of the 9th millennium

and the 8th millennium in the French Alps and refine our interpretation of the site.

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