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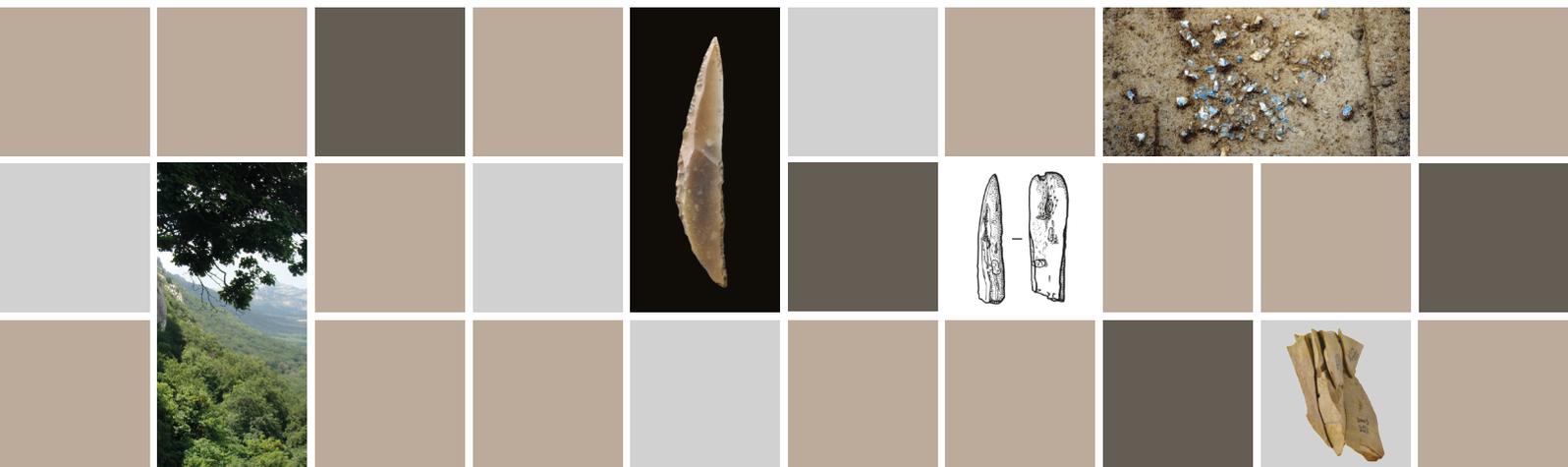
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**TECHNIQUES AND TERRITORIES**

**New Insights into Mesolithic Cultures**



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## FOREWORD

**Auréade HENRY, Benjamin MARQUEBIELLE, Lorène CHESNAUX**

The young researchers round-table project “Techniques and Territories: new insights into Mesolithic cultures” arose from a meeting of doctoral and post-doctoral researchers working on the Mesolithic. This meeting was held in November 2011 at the MAE (Nanterre, France) and organized by G. Bosset (Paris I – UMR 7041 ARSCAN) and B. Marquebielle (Toulouse II - UMR 5608 TRACES). It highlighted the growing number of young researchers participating in interdisciplinary research on the Mesolithic and the concomitant need for meetings entirely devoted to this period, which would bring together the community of Mesolithic researchers.

The young researcher’s round-table in Toulouse thus made this inter-disciplinary, -institutional and -generational project concrete, in large part through the diffusion of finished or on-going research, university theses and field operations.

Over two days, twenty papers and nine posters were presented in two sessions. The first session addressed techniques in the broad sense (manufacturing and production strategies, and skills) and their role in the in the definition of the Mesolithic and its lifeways. The second session was dedicated to research news. In both sessions, the number of presentations was equally divided among young researchers (Master’s and PhD students and Post-Doctorates) and researchers affiliated with various institutions (CNRS, Universities, Inrap, and private rescue archaeology companies). This event also attracted non-French participants (presenters and auditors) from Algeria, Italy, Portugal, Spain and Switzerland.

During the general discussion, the participants unanimously agreed upon the need to structure research at a national level through continued meetings dedicated to the Mesolithic. The next round-table project was proposed at this time, “Au cœur des gisements mésolithiques”, organized in Besançon in 2013 by C. Cupillard, S. Griselin and F. Séara. We hope that this effort, which aims to facilitate exchanges between Mesolithic researchers and to increase the visibility of this community, will continue in the future.

From a scientific perspective, one of the contributions of this round-table was to incite serious discussion on the epistemological status of the Mesolithic. Much remains to be done to improve the recording of this period, as well as to revive its originality, through complementary research questions (Human-environment relationships, techno-economic behaviors, mobility and territorial strategies, emergence and evolution of Mesolithic societies, Neolithization processes, etc.). Since the work of J.-G. Rozoy, fundamental in the sense that he sought global vision of Mesolithic lifeways, different general models have been proposed, the inefficacy of which (denounced by Kozłowski and others) was well understood. The desire to go beyond the general consensus led to a reconsideration of the value attributed to cultural divisions made based on lithic typology alone, and more precisely, the typology of microliths. The exclusively environmental hypotheses for the emergence and evolution of the Mesolithic have been revised with a clearer perception of the processes of adaptation of different groups in different environments. The variability and complexity of practices

is now explored through a more local and interdisciplinary approach to the archaeological record, leading to a (re)construction of the interpretative and cultural models. The constitution of reliable actualistic reference bases is now often and integral element of this approach.

The publication of these proceedings, consisting of fourteen articles, reflects these new priorities.

### **“Techniques and territories” session**

Following these trends, G. Marchand presents the Early/Late Mesolithic transition with an emphasis on the complexity of the phenomena that lead to the proposition of this division. Questioning the validity of traditional “cultural geography”, he reminds us that a material culture is comprised of multiple elements and that it is therefore necessary to consider all material remains and their societal implications.

Based on data from five open-air sites in the north and east of France that yielded abundant and homogeneous assemblages, F. Séara insists on the importance of extensive lithic refittings. In addition to a better understanding of the spatial organization of Mesolithic sites, this method enables an evaluation of the variability of lithic production strategies and their palethnographic implications.

L. Chesnaux presents her thoughts on the evolution of preparation procedures in the manufacturing of triangular geometric microliths, drawing on a techno-functional study of two lithic assemblages from the Early Mesolithic, which reveals significant differences.

A. Henry and I. Théry-Parisot address fuel use and management and propose research directions aimed at showing behaviors associated with fire, thus contributing to our understanding of the specificity of the Mesolithic.

N. Valdeyron offers some elements for reflection on the exploitation of vegetal food resources.

T. Ducrocq relies on interdisciplinary data to present a brief summary of the complex evolution of the Mesolithic in northern France.

M. Reversat inventories the archaeological data available from 26 Mesolithic sites in the Brive and Quercy regions to begin addressing questions concerning the roles of these sites and their implications in terms of mobility strategies and/or complementarity between sites.

E. Defranould, through a study of the lithic industry of the site of Combe-Grèze (Aveyron),, addresses the question of technical skill transmission between the Late Mesolithic and the Early Neolithic in order to better understand the role of the Mesolithic foundation in the emergence of a production economy.

### **“Research news” session**

D. Visentin, F. Fontana and S. Bertola present the lithic artifacts from an occupation attributed to the Early Mesolithic on the Pô Plain in Italy, whose study suggests the importance of domestic activities.

D. Nukushina presents the results of a new study of the lithic assemblage associated with the Amoreiras shell midden in Portugal, in which she challenges earlier chrono-cultural attributions.

A. Bénard and C. Guéret discuss the contributions of new research on archaeological data associated with decorated rock shelters in the southern Ile-de-France region.

L. Bassin, looking for possible Neolithic influences, addresses the evolution of Swiss lithic productions at the end of the Mesolithic

S. Guillon discusses the main factors underlying vegetation dynamics at the Mesolithic / Neolithic transition in South-eastern France based on palynological data.

H. Reis presents preliminary results from the study of the Paco Velho 2 shell midden in Portugal, contributing to discussions on the Mesolithic / Neolithic transition.

## **Acknowledgements**

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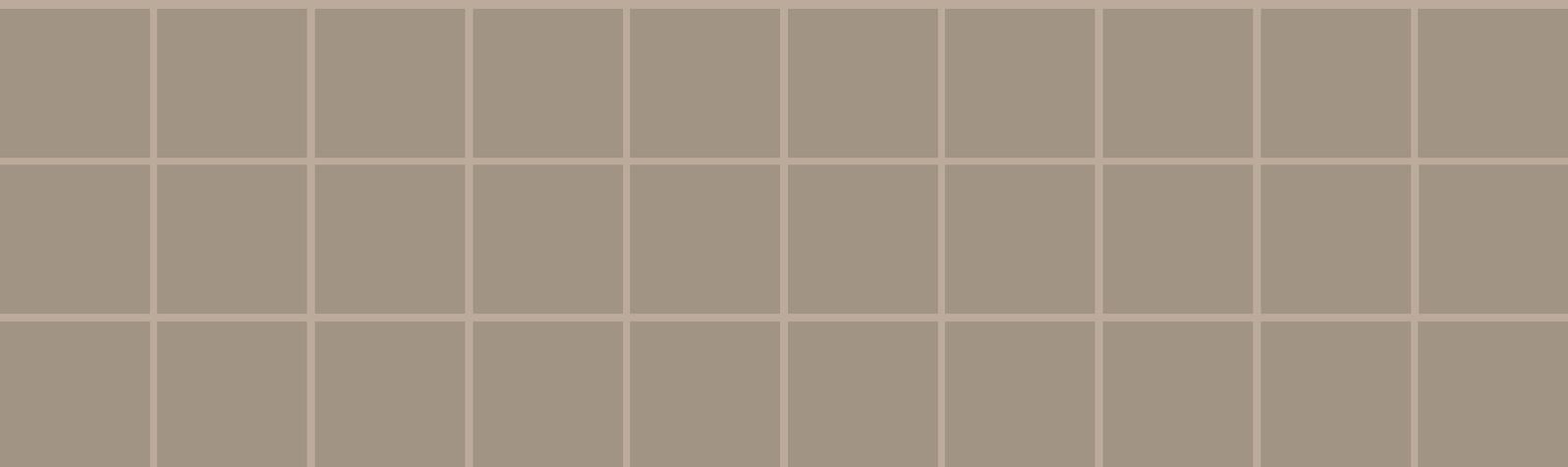
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# **TECHNIQUES AND TERRITORIES**



## BEYOND THE TECHNOLOGICAL DISTINCTION BETWEEN THE EARLY AND LATE MESOLITHIC

Grégor MARCHAND

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## BEYOND THE TECHNOLOGICAL DISTINCTION BETWEEN THE EARLY AND LATE MESOLITHIC

Grégor MARCHAND

### Abstract

*At the beginning of the 7<sup>th</sup> millennium BC, from Tunisia to Scandinavia and the Alps to the Atlantic, the technical baggage of Mesolithic societies underwent profound changes. Flaked artifact styles, tool types, weapon hafting techniques and the volumetric principles of stone flaking were modified by more than simple adjustments to the percussion techniques commonly used, with pressure flaking and indirect percussion replacing direct hard hammer percussion. This division of the Mesolithic in Western Europe has more to do with the technology used to transform lithic raw materials than with tool typology. This observation was in fact not lost to some archaeologists of the last century, such as E. Octobon and J. G. D. Clark, who accorded less importance to punctilious arrowhead classifications than to the general structure of flaked productions, or S. K. Kozłowski who described Mesolithic Europe as being split into two successive typological “trends” (the S and K components). In this article, I first present a summary of the changes observed in the early 7<sup>th</sup> millennium, as well as the enduring features of Mesolithic material culture. I then examine possible correlations with paleo-environmental and social phenomena to show that for the moment there are no clear links to these factors. While the ultimate goal is to clearly define this vast change in civilization, it is now necessary to work at more restricted spatial and temporal scales to enhance our understanding of this fundamental phenomenon in the history of techniques on the European continent.*

### Keywords

*Prehistoric Culture, France, Mesolithic, techniques, typology.*

Throughout the 20<sup>th</sup> century, one of the main objectives of research on the postglacial period by French authors was to attribute lithic assemblages to “cultures”. Starting in the mid 1980’s, the development of the technological approach to lithic industries led to an inevitable revolution in research concepts and manners of describing stone artefacts. In France, the application of this approach to the Mesolithic was delayed until the early 21<sup>st</sup> century, awaiting the maturation of a new generation and a change in paradigms. Two families of techniques, succeeding each other in time, then appeared in France and in some bordering countries, which I proposed to designate as the First and Second Mesolithic (Marchand, 2008). What are the bases of this distinction? What do they mean and why are they important? Are they accompanied by changes other than technical ones? And finally, how do they shape our understanding of societies and their evolution, as well as the models that we construct of them? To change words is to change perspectives, and to overturn the accepted hierarchies of analysis criteria. It is also to explore other historic scenarios teetering at the edge of Neolithization.

## 1 - The limitations of the “French” stylistic geography

The identification of different technical and stylistic groups among the Mesolithic lithic industries of a given area, and their denomination based on an eponymous site or region, was a very popular scientific process in the 1920's in France, and one that is perpetuated today in an approach that I will refer to here as “cultural geography”. While the designation of such entities responds to a need for communication between researchers, the choice of distinguishing criteria and the importance accorded to them are never neutral. The limitations of this practice are clearly seen in the variable composition of the entities created by different researchers. The contents and spatial extension of the Tardenoisian, Sauveterrian or Castelnavian, for example, vary depending on the publication. The absence of objective definitions shared by all authors obviously leads to problems, but these fluctuations also depend on the complexity of the cultural and social phenomena observed. Criticizing this classificatory system can moreover be seen as denying the “common sense” underlying the apparent efficacy of such a culturalistic organization since specialists of lithic industries can indeed easily observe differences in tool types in different regions, and non-random recurrences of assemblages through time. Yet as Mesolithic archaeology progresses in areas between the eponymous regions, these supposed intermediary zones reveal other dynamics that differ significantly from the outdated model of expansions starting from a center and diffusing toward the always indebted peripheries. The results of recent excavations and surveys clearly call for a reworking of this “cultural geography”.

A few of the postulates of these studies are also quite embarrassing... Though in 1978 J.-G. Rozoy (1978) insisted on taking into account multiple elements to describe archaeological entities, later approaches restricted their focus to arrowheads (Thévenin, 1995; Ghesquière, 2012). A small part of the human activities, and probably only a part of the Mesolithic society, is thus overemphasized in current models. In addition, this spatialization of stylistic “signifiers” incorporates a concept of territorial continuity and more or less strict notions of borders. Shifts in meaning are thus inevitable, and the distribution of an object type will thus become the cultural or ethnic signature of a population, without regard for the modes of diffusion of an object other than this display of identity (exchanges, trophies, functional adaptation of a tool). The Mesolithic culture thus begins to resemble a nation-state, especially when audacious lines and amorphous bubbles on maps emphasize – at least unconsciously – astonishing parallels between social, political and cultural entities, which obviously have nothing to do with each other. If we agree to broaden our perspectives to include materials other than stone, such as bone, techniques such as indirect percussion, procedures such as blade fracturing via notches (the microburin technique), behaviors such as the use, or not, of specific stones, or manners of burying the dead or organizing habitations, the mapping of cultural features becomes seriously muddled! Even if hunter-gatherer societies had territorial practices, they were certainly different from those of nation-states and their reflection in material remains is probably more varied than what we proclaim in studies of the Mesolithic in France: arrowheads are not battle flags, they were used and diffused according to specific rules whose homogeneity through time we can only presume.

The last obvious limitation of this classic manner of practicing cultural geography is that these entities are presumed to evolve in broad supraregional phases, and here as well, the simplified system currently adopted is far from reliable. It is largely inspired by the work of A. Thévenin, conducted during the 1990's and based on variations in the shapes of some arrowheads, both in space (at different scales) and time. He proposed the following sequence: during the Early Mesolithic, isosceles triangles; the Middle Mesolithic, scalene triangles; the Late Mesolithic, trapezes with abrupt retouch; and the Final Mesolithic, trapezes with flat retouch and so-called “evolved”

arrowheads. This evolution was then linked with palynological chronozones: the early phase of the Mesolithic thus developed in conjunction with the Preboreal, the middle phase with the Boreal, and the late and final phases with the Atlantic. Whether intended or not, this is to say that weapon elements mutated in conjunction with climatic changes (the contrary being a hypothesis that no one would dare put forward...). This weak consensus poses significant problems:

- segmenting a civilization and historic phenomena based on variations in the length of a truncation (isosceles vs scalene), or based on the development of a hafting technique (abrupt vs inverse retouch) can no longer be accepted. These criteria concern only an infinite part of the technical systems currently known and strongly limit our perception of human complexity;
- defining *a priori* three or four evolutionary phases, rather than seven or twelve, requires explanation;
- correlating minor typological changes in hunting weapons with climatic changes is dangerous from a conceptual point of view.

Envisioning the origin and development of cultures from a different perspective, based on their material remains, is a valid research objective requiring that we clearly distinguish the tools of analysis employed. We must also detach ourselves from evolutionary, economic and paleo-environmental suppositions in order to focus on the information contributed by each method and each analysis tool, as the mixing of categories can be very detrimental. We can begin this process of restructuration by taking a detour into the history of research in order to exhume other perceptions of these cultural phenomena and other denominations, which are always instructive and sometimes foundational.

## **2 - Tardenoisian vs Sauveterrian: the relevant debate of our predecessors**

### **A - Discontinuity**

After the notion of an intermediary period between the Paleolithic and Neolithic laboriously emerged at the beginning of the 1880's, under the instigation of G. de Mortillet, researchers began to focus on the distinctions that could be made concerning this period. The industries of the first postglacial millennia were qualified as a degraded form of Paleolithic and remained in the shadows until the commanding officer F.-C. E. Octobon (1881-1969) extracted the concept of a Tardenoisian period from this amorphous gangue in publications realized between the two world wars ("the Tardenoisian question"). He did not change his mind on the nature of the process, which according to him could be attributed to a mix of intruding populations and evolutions continuing into the heart of the Neolithic (Octobon F.-C. E., 1921, 1926). In his mind, this was a short phase represented by small camp sites, which would be diluted upon contact with the first occupants.

In 1928, L. Coulonges distinguished a new technical entity based on his excavations in the eponymous district of Sauveterre-la-Lémance; the stratigraphies revealed by this work led him to situate this new entity before the industries with trapezes (Coulonges L., 1935). Coulonges, and then F.-C. E. Octobon, adhered to a triple division of the Tardenoisian, beginning with a pure phase (Tardenoisian I), followed by a Mesolithic/Neolithic phase (Tardenoisian II), and gradually dissolving into the Neolithic (Tardenoisian III). While L. Coulonges thought that the newcomers brought the Neolithic fauna with them, F.-C. E. Octobon was more cautious and proposed different possibilities, including that sheep and goat may have been present at the same time as hunted fauna.

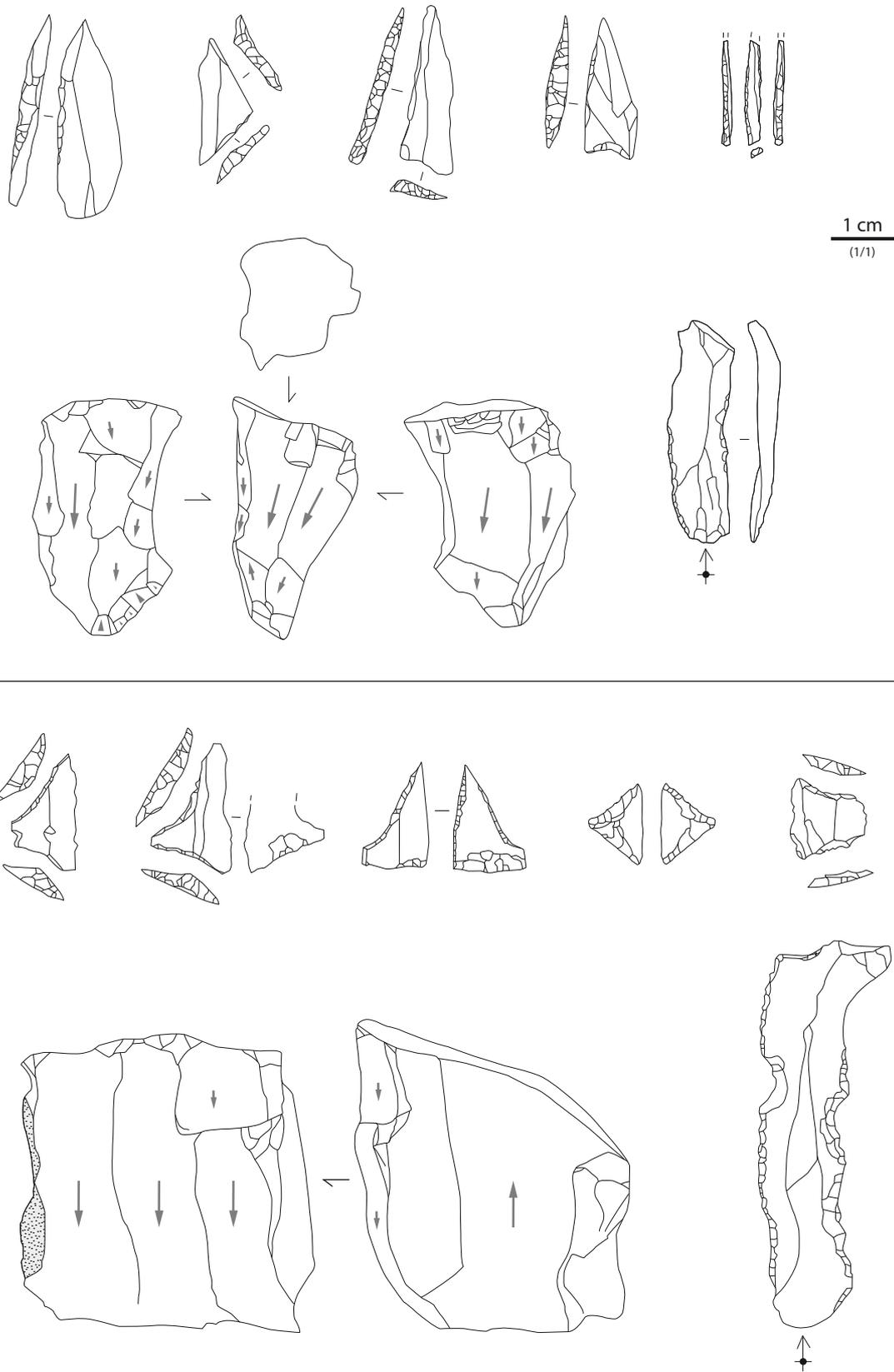
The hypothesis that either the entire Mesolithic, or the Tardenoisian alone, originated in Africa was largely accepted by the Prehistorians in the early 20<sup>th</sup> century, with the idea that a new settlement of the continent was made possible by the warming climate. Though he is not familiar with the African continent, S. K. Kozłowski still retains the possibility of a migration from south to north when he speaks of “pushes” (also called intercultural trends during the 1970’s and 1980’s) during the 8<sup>th</sup> millennium BC for the Sauveterrian, and then during the 7<sup>th</sup> millennium for industries with trapezes (Kozłowski, 2009). This time, however, the subject was technical trends, instead of human beings: in any case, migration hypotheses are no longer fashionable in archaeology, perhaps being diluted by the racial archaeology promoted by the national-socialist ideology.

Seemingly independent of each other, C. Barrière in 1954 and J. G. D. Clark in 1958 proposed syntheses of these trapeze industries at the continental scale. The former continued to support an internal structuration of the Tardenoisian similar to that developed by L. Coulonges or F.-C. E. Octobon, but insisted that the origin of these industries was in southwestern France, arising from a Sauveterrian substrate. He again proposed this hypothesis in a publication of the excavations at Rouffignac in the early 1970’s. For the latter author, this dispersion of functionally innovative weapon elements could reflect the extension of a trend that was a precursor to the Neolithic, accompanied by the development of livestock farming in some regions, and arising from several possible sources.

## B - Continuity

Until the mid-20<sup>th</sup> century, it was thus clear to archaeologists that lithic industries made on regularized blades followed industries judged to be more rustic and that this was the most remarkable archaeological feature of this period. The true epistemological rupture must be credited to J.-G. Rozoy, who gave regional definitions to the preceding notions from the perspective of a cultural mosaic and continuous, long term development (Rozoy, 1978). The emergence of new, more regularized flaking modalities and trapezes would thus correspond to a very gradual intercultural phenomenon with an uncertain geographic origin, which would have occurred at around 6 600 BC. In such a continuum, the technical distinction of the Late Mesolithic was diminished. The idea of a major change returned a few years later in the writings of J. Rousot-Larroque who saw in the Tardenoisian of L. Coulonges and F.-C. E. Octobon, the reflection of an autochthonous Neolithization process known as the “Roucadourian cycle” (Rousot-Larroque, 1977), the archaeological foundations of which were later strongly criticized (Marchand, 1999).

In the current geographic zone of France, there are in effect two broad groups of lithic industries that succeed each other in time (figure 1). Earlier researchers named them the Sauveterrian and Tardenoisian, or component S and component K. J.-G. Rozoy distinguished major flaking styles, the most remarkable being the Coincy and Montbani styles: in this last point resides the very essence of the distinction that we propose between the First and Second Mesolithic. In France, the use of the terms “Early” and “Late” could be confused with the former system and we therefore proposed in 2004 to designate these entities as the First and Second Mesolithic (Marchand, 2008). This distinction evidently corresponds to that between the Early Mesolithic and Late Mesolithic used in northern Europe, and we thus use these terms in this English language publication. It will now be useful to understand the criteria underlying this distinction, before considering the new questions it raises for research.



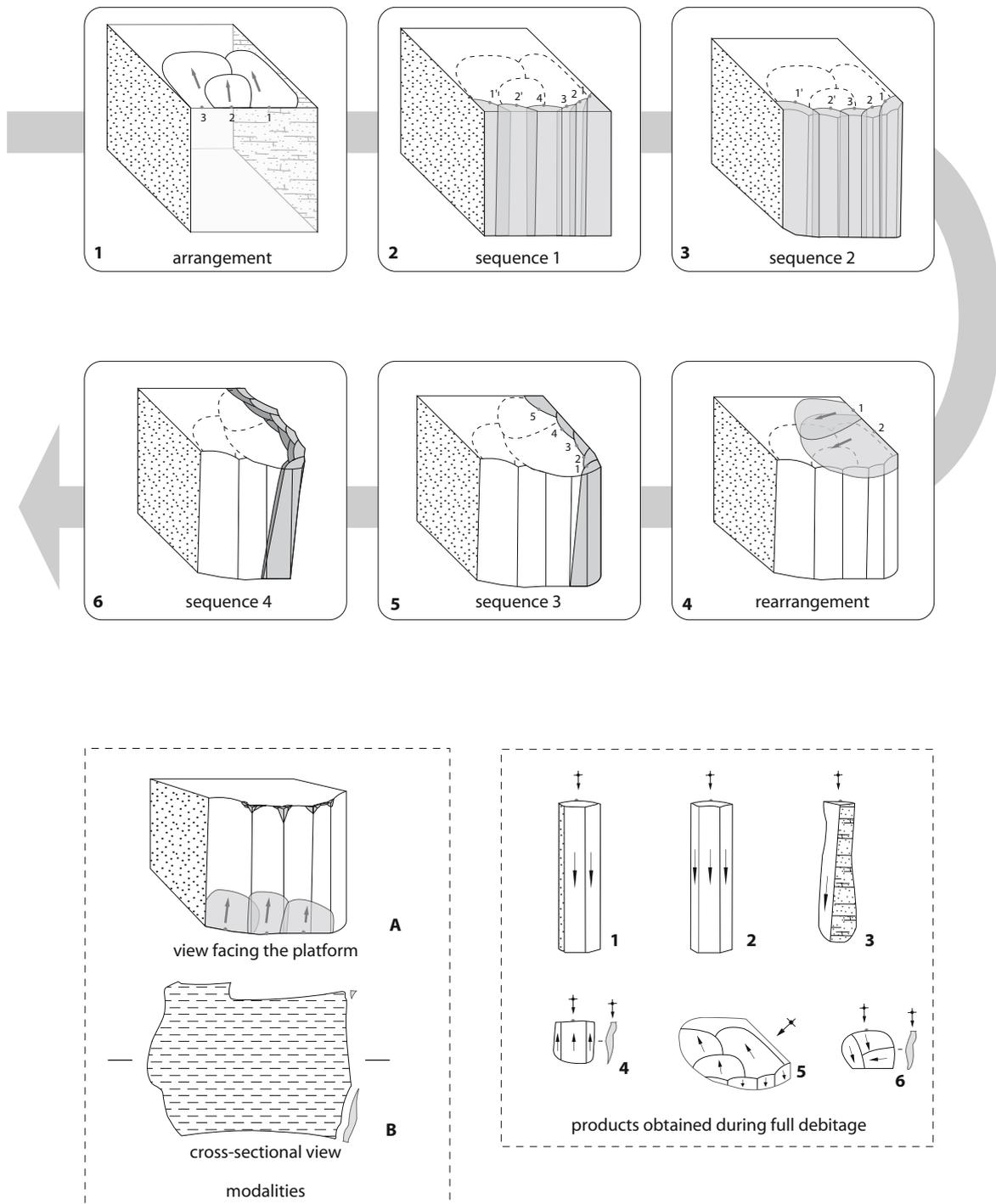
**Figure 1** - The lithic industries of the Late Mesolithic (below) are distinguished from those of the Early Mesolithic (above) by laminar flaking using pressure or indirect percussion techniques, trapezoidal bi-truncations, cores with frontal flaking and notched blades (CAD: G. Marchand).

### 3 - Early and Late Mesolithic: a mainly technical distinction

#### A - Flaking techniques and methods

During the Early Mesolithic, the generalization of flaking with a stone hammer was accompanied by the manufacturing of short bladelets with sinuous ridges. Very diverse flaking methods were employed; the differences concerned the initial volume (large flakes, block fragments, raw blocks, alluvial cobbles), the number of striking platforms (most often one principal one, less often two or three), and the extension of the flaking onto one of the sides of the core or around its perimeter. Many types of direct hard hammer percussion were employed, with the use of a “soft stone” (soft limestone or sandstone) at the very beginning of the Early Mesolithic, and a “hard stone” (flint, granite, quartzite, quartz, etc.) for the rest of the period. This question of the nature of the hammerstone used was highly discussed first for the Final Paleolithic in the Paris Basin (Valentin, 2000), and then more recently for the Mesolithic (Paris *et al.*, 2012), with a convincing demonstration of changing practices through time. While this distinction is valid for a sedimentary basin where sandstone is often the available stone with an ideal tenacity, the question remains open for other geological substrates, where definitions of the rather imprecise notions of “soft stone”, “semi-soft stone” and “hard stone” will surely be more varied. In the Centre-Ouest of France and Brittany, only direct hard stone percussion has been identified (Michel, 2009; Nicolas *et al.*, 2012). The striking zone also underwent changes, such as in the abrasion or not of the lip, the angle of the striking platform and the movement of the hammer (internal or marginal). These parameters are obviously not independent: an inclined platform (thus with an acute angle) will incite a circular percussion movement and a strengthening of the striking zone by careful abrasion of its protruding lip. All of these variations in volumetric conceptions, techniques, modalities and procedures most often correspond to collective and normalized practices, and thus to stylistic territories that have rarely been designated as such, while maps showing the distribution of different arrowhead types abound...

During the Late Mesolithic, the flaking objective was to manufacture thin (in section), wide blades with parallel edges and a straight profile. In all known geographic zones, the core flaking surface forms an acute or orthogonal angle with the two sides of the core, hence the name *table resserrée* (narrowed surface) (figure 2). The flaking advances from the front, meaning that volume is reduced not by turning around the core, but by parallel planes. When the flaking is finished, the convexities are reduced and the general morphology is flat. The striking zone is relatively narrow (four to six blades wide) and can thus be created on many types of supports: blocks, slabs, flake edges or small cobbles. Though this volumetric concept is the easiest to implement and is adaptable to many support types, there is no strict technical determinism; on other continents, flaking methods with peripheral extensions (also called circular or conical) were preferred in technical systems in which regular blades were obtained by pressure flaking or indirect percussion. We can nonetheless remark that with this method of frontal flaking on a narrow surface, it is easy to obtain blades with regular ridges and moderate convexity, which are wide and, especially, thin in section, perhaps explaining its success in Late Mesolithic flaking conceptions. Blades were detached by the pressure technique in the Castelnovian in Provence (Binder, 1987) and around the western Mediterranean basin (Perrin *et al.*, 2009). Further north, indirect percussion (with a punch) was frequently used in the Centre-Ouest (Marchand, 1999, 2009), the Paris Basin (Allard, 2007), the Jura (Séara *et al.*, 2002) and Portugal (Marchand, 2001). Both techniques enable a precise application of force on a small surface and thus better flaking control. The preparation of the striking zone is sometimes accompanied by micro-faceting, such as in the Centre-Ouest, the Jura and Portugal. This procedure probably helped to stabilize the punch, but it is apparently not indispensable and is very rare, or even absent, in other industries.



**Figure 2** - Illustration of the laminar flaking sequences of the Late Mesolithic at the site of Essart in Poitiers, showing the sequences (above) and procedures sometimes used (below left) and the products obtained during full debitage (below right). A narrow volume is selected, framed by a cortical side or a fissure or a previous flaking surface; the striking platform is created by the detachment of successive flakes, and the initial laminar flaking begins (sequence 1: the products retain on their upper face the traces of the anterior history of the volume), full laminar flaking phase (sequence 2: the flaking sequences continue, most often from a frontal direction), maintenance of the striking platform by the detachment of flakes and partial rejuvenation tablets, initiated from the future flaking surface (the new flaking surface is orthogonal to the first one), initial laminar flaking (sequence 3: the products retain the marks of the anterior history of the volume on their upper face), full laminar flaking phase (sequence 4: with a frontal advancement and a convergent rhythm for the removals; the sequences can succeed each other) (CAD: G. Marchand).

From the Early to the Late Mesolithic, we cannot speak of a revolution in flaking methods in comparison to the amplitude of changes that occurred with the later Neolithization. During the Mesolithic, the preparation of volumes never required great skill since the blade detachment surfaces could be easily created on appropriate convexities with no initialization crest. In both the Early Mesolithic (Guilbert, 2003) and Late Mesolithic (Marchand, 2009; Séara, Bostyn, 2009), large blocks were managed by heat or mechanical fracturing. Flakes were produced in addition to thin blades and bladelets, but the latter were made through integrated *chaînes opératoires* (reduction sequences). There was very little core maintenance during flaking, most often limited to distal neo-crests, lateral removals to maintain the transverse convexities, or the creation of a second striking platform to maintain the longitudinal convexities. Throughout the Mesolithic, the distribution of blanks intended to be retouched into tools not drastically change either. The question of an autonomous production of blades must be addressed, but it concerns facies in both the Early (blades with basal notches in the 9<sup>th</sup> millennium in middle of France) and Late Mesolithic (backed blades from the 6<sup>th</sup> millennium in southern Brittany). The technical distinction between the lithic productions of the Early and Late Mesolithic is significant only in the architecture of the core and the techniques used, as well as in the most emblematic tools, arrowheads.

## B - New tools, new functions?

Triangles, points, backed bladelets and segments are all present in the Early Mesolithic in the zone that we address here. Trapezes appear in the Late Mesolithic. We sometimes find them in association with the preceding types, but it is difficult to resolve the fundamental question of how this innovation was integrated into the previous tapestry due to rather mediocre sedimentary contexts, which could imply the mixing of non-contemporaneous industries.

The development of notched blades is another significant feature in the changes that are observed in Mesolithic tools during the Late Mesolithic. Also known as Montbani blades, we find them associated with trapezoidal arrowheads in France, northern Italy (Broglia, 1975), Spain (Fortéa Pérez, 1973), Portugal (Roche, 1972; Marchand, 2001) and the Upper Caspian of the Maghreb (Camps, 1975; Camps-Fabrer, 1975). Recent usewear analyses show that these notches were more likely made by bending retouch or percussion than by use, and that they were used to scrape mostly vegetal materials (Gassin *et al.*, 2013). The other tools are not highly standardized, making it difficult to compare them with tools from the Late Mesolithic.

## 4 - From technique to history

### A - A phenomenon in space and time

The temporal aspect of this distinction is apparently due to a diffusion of industries with blades and trapezes. Today we have a clearer picture of it thanks to a research program led by T. Perrin (Perrin *et al.*, 2009). This work showed that a development in southern Italy at around 6 800 BC – itself perhaps linked to environmental and social changes in Tunisia (Rahmani, 2003) – was followed by a rather rapid expansion leading to a distribution around the periphery of the Mediterranean between 6 600 and 6 200 BC, and an arrival on the Atlantic shores a bit later. Its ultimate epigones would travel as far as Germany and Denmark. To the north, around the Baltic Sea, the frequent use of the pressure technique on conical cores to obtain long blades reflects other cultural dynamics originating from the Russian plain as early as the 9<sup>th</sup> millennium BC (Sørensen *et al.*, 2013), that would eventually be mixed with the dynamic described here. In Central and

Eastern Europe, a similar extension of technical innovations very different from those developed in the west is thought to have occurred, also with a dynamic from the south to the north, but with a much less reliable chronology (Kozłowski, 2009: 526). S.K. Kozłowski thus distinguishes the “Castelnovisation A” in Western Europe from the “Castelnovisation B” in Central Europe. These diffusions would have followed favorable routes, the first by the Rhone Valley, called the “*Via Imperialis*”, and the second by the “Tartar Road”, from the Black Sea to the Vistula Basin.

Within the same geographic zone associated with industries with blades and trapezes during the Late Mesolithic, there are sometimes more than two groups of Mesolithic technical traditions. There are three, for example, in the southern Pyrenees:

- 10 600-8 200 BC: micro-bladelet tradition;
- 8 200-6 500 BC: horizon with notches and denticulates;
- 6 800-5 500 BC: industries with geometric arrowheads.

Industries with flakes and choppers interrupt the “leptolithic” trend in technical traditions in both Spain (Fortéa Pérez, 1973; Alday, 2006) and Portugal (Araújo, 2012), and have no parallel with the traditions known in France. North of the Seine and up to the north of the Rhine, the industries with “*feuilles de gui*” (“mistletoe leaf” arrowheads) could represent a technical tradition that would have existed between the Early and Late Mesolithic, between 7 200 and 6 600 BC (Ducrocq, 2001), but its nature remains to be clarified. Neither of these cases has consequences for the industries with trapezes, but rather for what occurs before, and therefore for the foundations of the transition. The Early and Late Mesolithic thus consist of technical distinctions that we would elsewhere refer to as techno-complexes or techno-groups, existing in a very specific history and place.

## **B - The terms of the transition in France**

In France, regular blades and trapezes suddenly appear at around 6 600-6 500 BC in levels 15 and 16 at Baume de Montclus (Montclus, Gard; Rozoy, 1978; Darmedru, Onoratini, 2003; Perrin *et al.*, 2009). This phenomenon concerns only symmetric trapezes with abrupt retouch, like on the Italian peninsula. More generally for the southern half of France, the work of D. Binder (1987) and N. Valdeyron (2000) favors models of a gradual transition.

In Atlantic France, three small sites on the Pointe Saint-Gildas (Préfailles, Loire-Atlantique) yielded an association of large scalene triangles and asymmetric or symmetric trapezes, accompanied by the soft hammer percussion technique and a semi-turning flaking organization more similar to those of the Early Mesolithic than the Late Mesolithic (Marchand, 1999; Dupont *et al.*, 2007). The radiocarbon dates, which are either very early or from stratigraphic locations that were poorly located or disturbed by the “oceanic reservoir effect”, appear to indicate an attribution to the mid-7<sup>th</sup> century BC. In the marshes of the Gères Valley, in Surgères (Charente-Maritime), the site of La Grange also yielded an association between an industry with asymmetric or symmetric trapezes with abrupt retouch and thin scalene triangles, found in compacted sedimentary levels (Laporte *et al.*, 2000). Finally, a fireplace excavated by R. Joussaume in the Abri des Rocs at Bellefonds, in the Seuil du Poitou, contained trapezes and a wide scalene triangle (Marchand, 1999; Michel, 2011). This fireplace was dated to 6 500-6 200 BC. These assemblages clearly contribute to our knowledge of the emergence of industries with trapezes in north-western France by showing us that they culminated in the mid-7<sup>th</sup> millennium BC. Unfortunately, their respective sedimentary limits prevent us from delving further into the nuances of the question.

## C - The invisible environmental influence

Though there is no doubt that the distinction between the Early and Late Mesolithic is cultural, it is relevant to look for possible links between climatic variations and the diffusion processes of their technical objects across Western Europe. From the start, the Atlantic chronozone was designated as contemporaneous with the development of trapeze industries, but the regional variants of corresponding ecosystems are particularly broad, extending from the Mediterranean zone to the shores of the Baltic. There are thus a multitude of different environmental adaptations, requiring analyses to be fragmented. Another climatic event cited by some, the abrupt cooling of 6 200 BC, is sometimes considered as the initiator of this movement, though without explaining its relationship to the tools or flaking methods at this time. Meanwhile, our current knowledge indicates that the Late Mesolithic emerged well before this cold snap, but it is possible that the rather brutal environmental change accentuated the social and technical mutations that developed in France during the second half of the 7<sup>th</sup> millennium. Though it is logical to suppose that an event such as this could have had an influence on food resources, and thus on human migrations, they would forcibly have been different depending on the geographic zone since while the Mediterranean basin was affected by an aridification, the shores of the northern Atlantic experienced an increase in humidity and decrease in temperatures.

## 5 - Beyond the techniques

As observed by our predecessors, the development of industries with trapezes and regular blades is clearly distinct from that of earlier industries. Its intrusive nature appears undeniable and a wave of diffusion from the south-east to the west can be shown. Claims for domestic animal remains in some Mesolithic sites have become less frequent with the progress of new studies of the archaeological levels concerned. It now appears certain that hunting is the only activity responsible for the faunal spectra found in the habitat sites of the Late Mesolithic. A stronger dependence on aquatic environments, river or sea, seems to have developed, but we must be cautious until this claim can be supported by large-scale geomorphological analyses. In Western Europe, we see the emergence of a system associating technique, style and function, consisting of the manufacturing of wide and regular blades using indirect percussion or pressure flaking techniques, the use of trapezoidal arrowheads in association with a new hafting method, and notched blades, all of which are related to new functions. Such a broad technical mutation incites its use as a major discriminating factor for understanding evolutionary processes at the supra-regional scale. This is just a first step, now calling for other reevaluations of the chrono-cultural classifications currently in use.

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## VARIABILITY OF LITHIC FLAKING STRATEGIES:

### Factors and Meaning

**Frédéric SÉARA**

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## VARIABILITY OF LITHIC FLAKING STRATEGIES:

### Factors and Meaning

Frédéric SÉARA

#### Abstract

*Lithic flaking strategies were defined based on the study of large lithic assemblages from well-preserved sites, sometimes with flaking concentrations. In these contexts with good potential for the realization of complex refittings, I was able to obtain very significant results. This analysis method, often ignored in analyses of Mesolithic assemblages, revealed previously unknown features in both the spatial organization and technology of the assemblages studied. These data are integrated into a chrono-cultural framework that constitutes a solid reference base. The determination of raw material types and their origins, a research axis that is well established in the region, contributed greatly to our interpretations. It is thus possible to address the question of the potential relationship between procurement distances and flaking strategies. The variability of the flaking strategies represented by the most significant refitting groups, composed of nearly one hundred pieces, does not appear to be very significant. Four broad, unequally represented, strategies were defined and raise the question of their justification based on criteria of a very different nature.*

#### Keywords

*Eastern France, open-air sites, raw materials, refittings, lithic flaking strategies, First Mesolithic, Second Mesolithic.*

Our ability to define the variability of Mesolithic lithic flaking strategies is dependent on the available data, which are admittedly highly variable themselves, depending on the region. They are variable not in their number, since Mesolithic occupations in all contexts are distributed in a rather homogeneous manner across the entire territory, but more so in terms of their nature, which more or less contributes advantageously to this theme.

Though most studies yield useful information, their partial nature, inherent to the conditions under which many assemblages were constituted, strongly limits our ability to define the lithic flaking strategies. We nonetheless have no intention to neglect these data, on the contrary, since they have now benefit from new information obtained through the now frequent analysis of well-preserved open-air sites.

### 1 - Study context and objectives

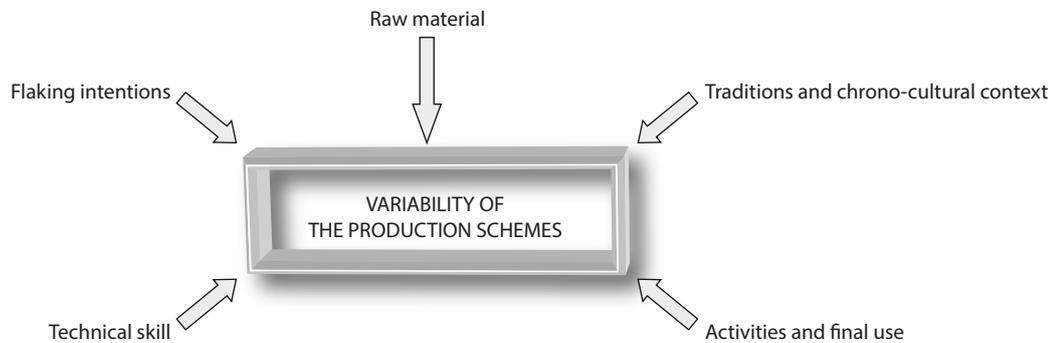
The sites of Ruffey-sur-Seille, Choisey (Séara *et al.*, 2002), Dammartin-Marpain in the Jura (Séara, 2008a, in press), Pont-sur-Yonne in the Yonne (Séara, 2008b) and Lhéry in the Marne (Bostyn, Séara, 2011) ([figure 1](#)) all share the common feature of having data that are well adapted to precise definitions of their flaking strategies (Pelegrin *et al.*, 1988). It is therefore also possible



- |  |   |
|--|---|
| 1 Les Basses Veuves, Pont-sur-Yonne (Yonne)                    | 18 La Croix de Bagneux, Mareuil-sur-Cher (Loir-et-Cher)           |
| 2 Le Haut des Nachères, Noyen-sur-Seine (Seine-et-Marne)       | 19 La Guériverie, Langeais (Indre-et-Loire)                       |
| 3 La Presle, Lhéry (Marne)                                     | 20 La Prairie d'Ingrandes, Ingrandes-de-Touraine (Indre-et-Loire) |
| 4 Les Closeaux, Rueil-Malmaison (Hauts-de-Seine)               | 21 L'Essart, Poitiers (Vienne)                                    |
| 5 Le Marais de Merlemont, Warluis (Oise)                       | 22 La Grange, Surgères (Charente-Maritime)                        |
| 6 La Grippe, Lihus (Oise)                                      | 23 La Grande Pièce, La Vergne (Charente-Maritime)                 |
| 7 Le Marais, Conty (Somme)                                     | 24 La Pierre-Saint-Louis, Geay (Charente-Maritime)                |
| 8 Le Marais, Thennes (Somme)                                   | 25 Al Poux, Fontanes (Lot)  |
| 9 Le Marais, Boves (Somme)                                     | 26 Le Camp de Jouannet, Réalville (Tarn-et-Garonne)               |
| 10 Les Baquets, Saleux (Somme)                                 | 27 Le Gournier, Montélimar (Drôme)                                |
| 11 Étouvie, Amiens (Somme)                                     | 28 Blachette-Sud, Sinard (Isère)                                  |
| 12 Le Petit Marais, La Chaussée-Tirancourt (Somme)             | 29 A Daupharde, Ruffey-sur-Seille (Jura)                          |
| 13 Gravières, Hangest (Somme)                                  | 30 Aux Champins, Choisey (Jura)                                   |
| 14 Les Varennes, Val-de-Reuil (Eure)                           | 31 Prairie du Milieu, Dammartin-Marpain (Jura)                    |
| 15 Déviation, Saint-Pierre-du-Bû (Calvados)                    | 32 La Croix Audran, Carnac (Morbihan)                             |
| 16 La Canne, Pannes (Loiret)                                   | 33 Rue Farman, Paris (Hauts-de-Seine)                             |
| 17 Le Chêne des Fouteaux, Saint-Romain-sur-Cher (Loir-et-Cher) | 34 La Haute-Île, Neuilly-sur-Marne (Seine-Saint-Denis)            |

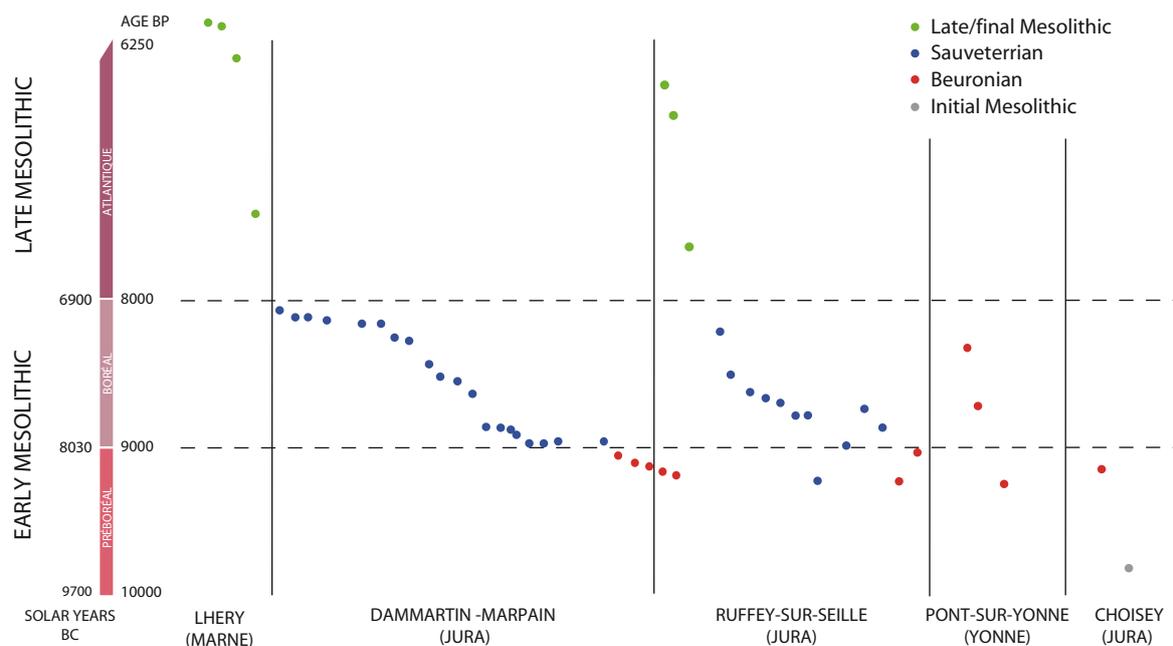
Figure 1 - Locations of the main open-air sites recently excavated and the sites studied (Séara, © Inrap).

to address their representativity and variability while beginning to consider the role played by certain determinant or supposed factors. The goal of continuing research will be to seek correlations between the chronological, cultural, lithological frameworks and the function and durations of occupations. (figure 2).



**Figure 2** - Factors considered in the evaluation of the variability of lithic flaking strategies (Séara, © Inrap).

In addition to the vast geographic zone concerned by these sites, covering part of eastern France, western France in the Paris Basin and the south of the Tardenois, the radiometric framework, with the recent contribution of dates obtained at the Dammartin-Marpain occupations, constitutes a solid reference base (figure 3). Despite this, breaks still exist in the initial phases of the Early Mesolithic and in the Late Mesolithic. In the regions of Eastern France, the cultural framework defined based on clearly homogeneous assemblages reveals an alternation between Beuronian and Sauveterrian influences, this latter playing a much more significant role than was recently thought (Thévenin, 2008).



**Figure 3** - Chronological and cultural framework defined base of the sites of Ruffey-sur-Seille, Choisey, Dammartin-Marpain, Pont-sur-Yonne and Lhéry (Séara, © Inrap).

## 2 - Defining lithic flaking strategies

The great majority of studies of flaking techniques have concerned all of the flaking products, but with a particular focus on cores, whose features reflect only the final phases of their reduction sequence (Walczak, 1998; Souffi, 2004). The technical criteria thus identified contribute to the definition of flaking strategies, most often influenced by a more or less conscious degree of subjectivity. While this approach can be justified by the formation processes of assemblages, or the contexts of some sites, the homogeneity of the assemblages must still be evaluated before they are analyzed and the plethoric approach often taken appears to be no more than a last resort solution that masks the central question. The solutions thus reached generally emphasize the technical poverty and monotony of the flaking strategies, therefore legitimizing the secondary status accorded to this analysis domain and favoring the notion of flaking style (Rozoy, 1978). Meanwhile, this approach does take into account the recent contribution of open-air sites located in valley bottoms, at least in the northern half of France. In addition to enabling new research perspectives, these sites have shown in a surprising manner that, as for other periods, very significant lithic refittings can greatly contribute to technological studies of Mesolithic assemblages (Fagnart *et al.*, 2008).

For the Mesolithic, technological analyses accompanied by refittings were still rare in the 1990's; one of the first realized in our regions was that by Isabelle Ketterer at the site of Hangest Gravière II Nord (Ketterer, 1992, 1997; Ducrocq, 2001). This study showed that it would have been possible to obtain a high rate of associated pieces and significant groups of refittings, but the excavation of sediments moved during construction work did not enable an identification of the taphonomic conditions of the sites. While her success at finding refittings demonstrated the homogeneity and integrity of the assemblage, it is above all thanks to the motivation and will of this researcher to conduct this type of work that these results were obtained.

At the beginning of our study, we considered refittings mostly in terms of their contribution to our understanding of the formation processes and spatial organization of the occupations (Ciezsła, 1987; Séara, 2006). From this perspective, different scales were defined, sometimes very broad, such as at the site of Lhéry, where 4.7% of the 42 000 pieces recovered from a surface of nearly 1 000 m<sup>2</sup> were integrated into a group of refittings (Bostyn, Séara, 2011) (figure 4).

Specific questions linked to this same research question required analyses that took intermediate scales into account. In this manner, at Ruffey-sur-Seille one of the occupation sectors of the Early Mesolithic revealed a rather complex spatial organization (Séara, 2006) (figure 5).

The locus or unit of activities, as we defined it (Séara, 2008a), is also adapted to goal of analyzing spatial processes, while also yielding significant information on the lithic manufacturing processes. In this manner, at Pont-sur-Yonne, 26.7% of the 1 161 pieces recovered from a small, Early Mesolithic, occupation sector could be integrated into several refitting groups (figure 6).

The most efficient scale for recording the different aspects of flaking at a site is the flaking locus. These features are not common and are found in the form of compact or more or less scattered concentrations (figure 7). These different configurations do not result from specific and differential taphonomic processes since the two can coexist, such as at Dammartin-Marpain and Pont-sur-Yonne. They are more likely the consequence of sorting and collecting actions, during which the by-products left behind are scattered (Séara, 2008a). Though their number is generally small, only one at Ruffey-sur-Seille, two at Choisey, four at Pont-sur-Yonne, and five at Dammartin-Marpain, they are being found more and more often. Even though they concentrate sometimes incomplete flaking processes, the data yielded by sometimes large refitting groups have proven essential to understanding flaking strategies, whose technical complexity would not otherwise have been evident.

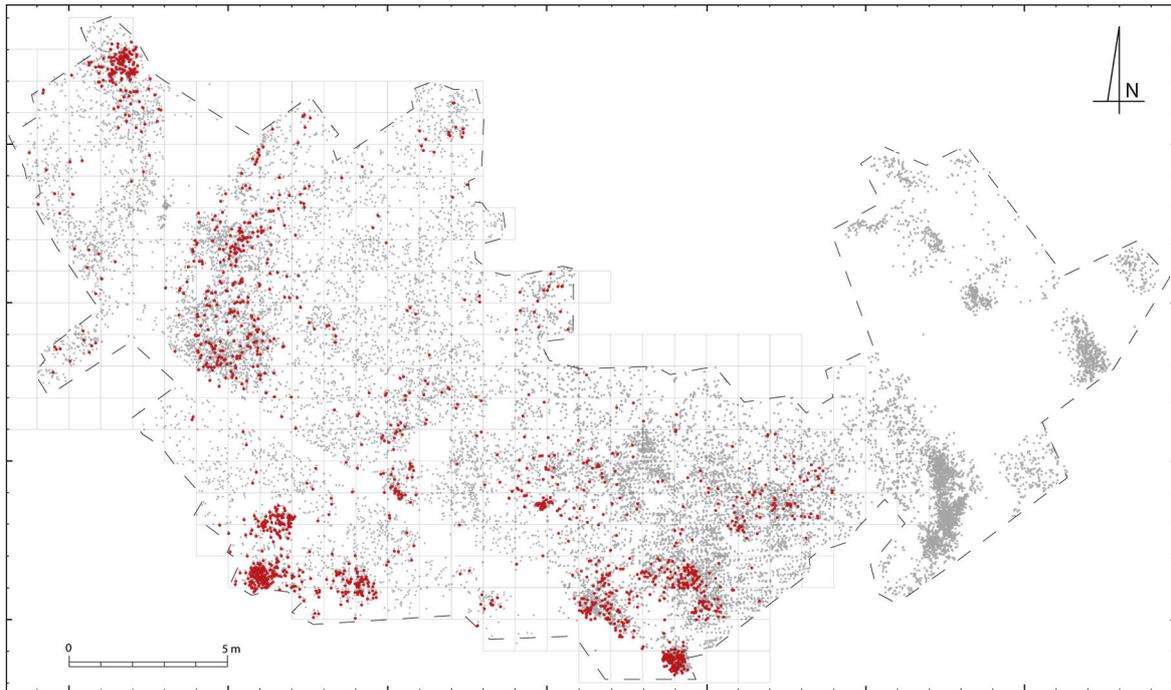


Figure 4 - Site of Lhéry, spatial distribution of the lithic pieces integrated in to a refitting group (Séara, © Inrap).

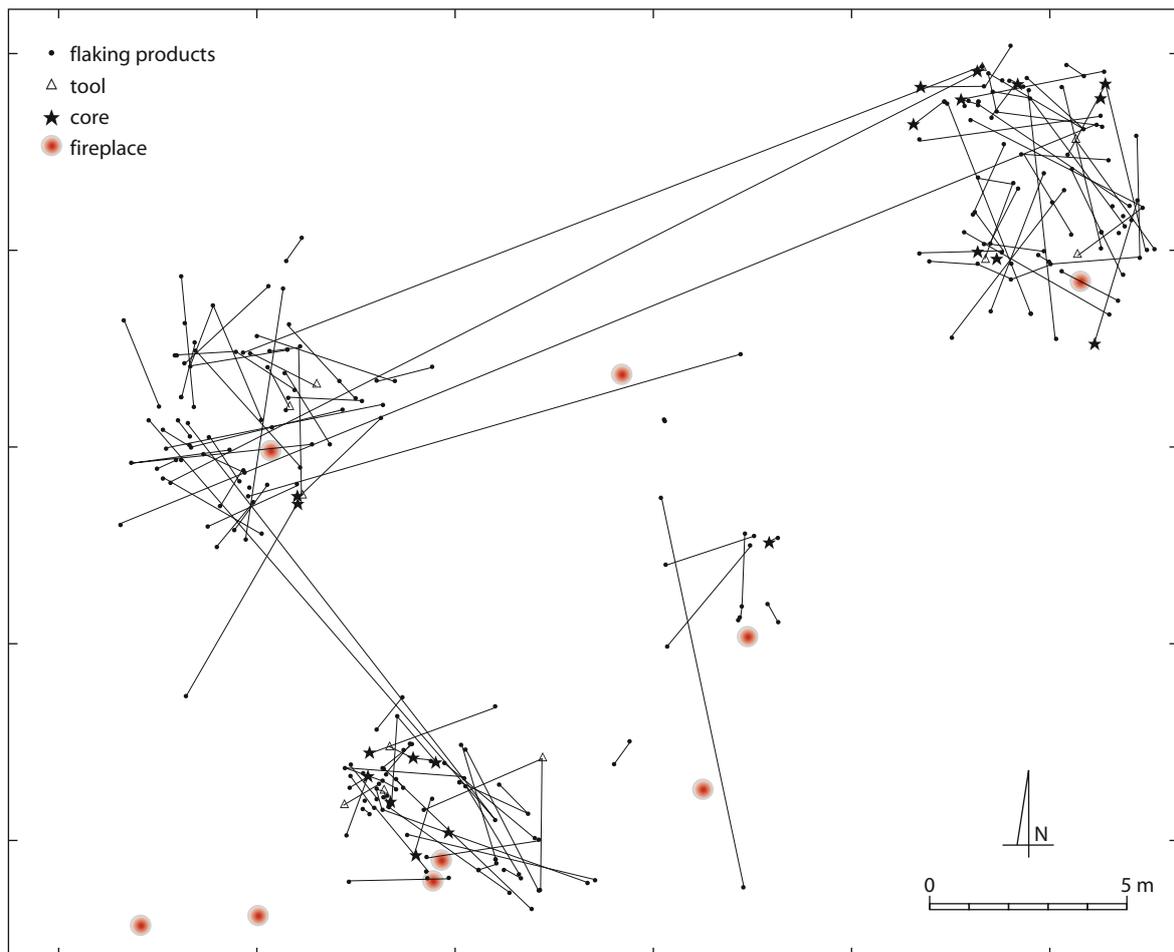
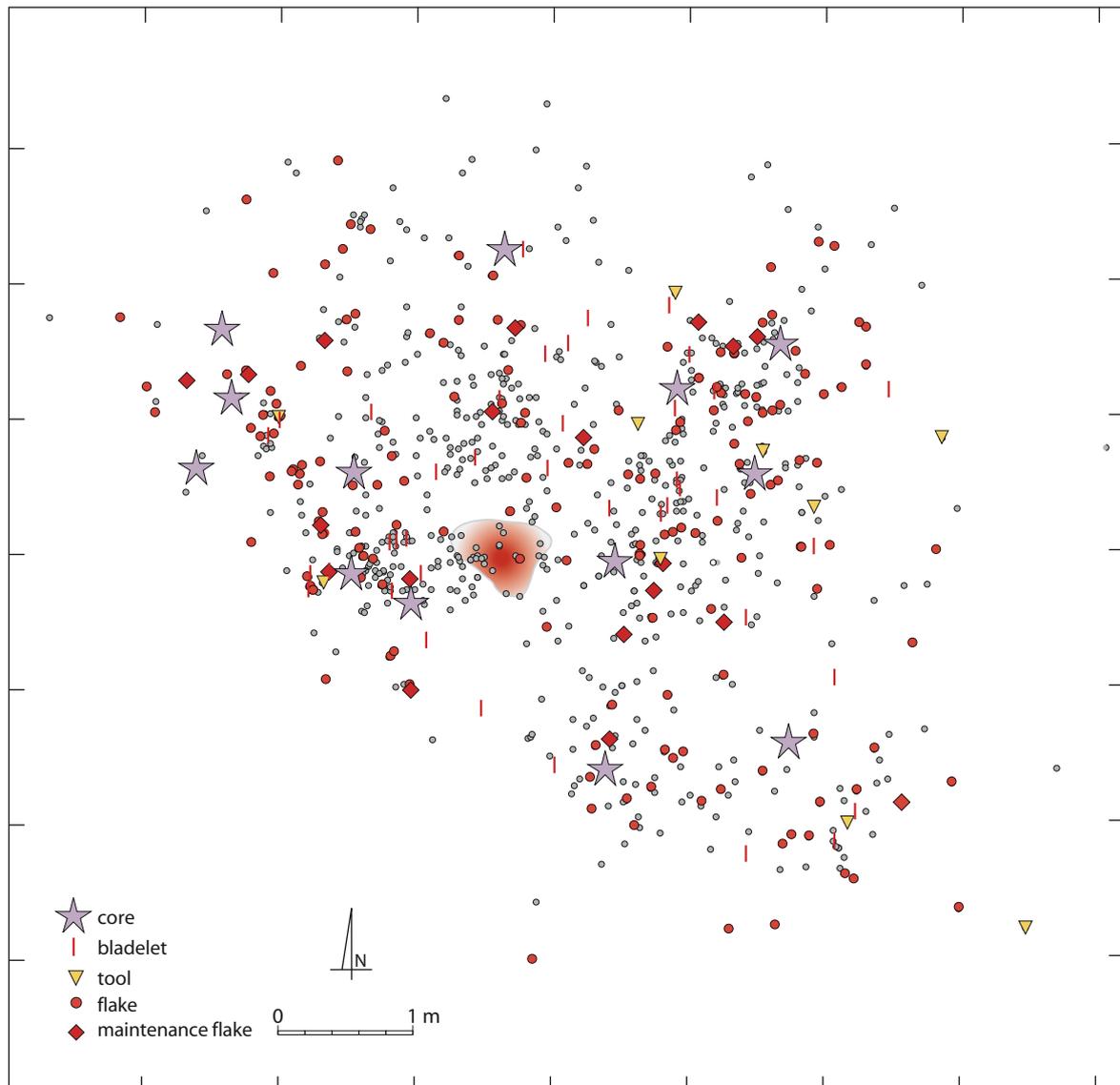


Figure 5 - Linking of three Early Mesolithic loci at Ruffey-sur-Seille through lithic refittings (Séara, © Inrap).



**Figure 6** - The distribution of lithic artefact categories within a refitting group in the Early Mesolithic at Pont-sur-Yonne (Séara, © Inrap).



A - Ruffey-sur-Seille, Early Mesolithic



B - Pont-sur-Yonne, Middle Mesolithic



C - Dammartin-Marpain, Middle Mesolithic

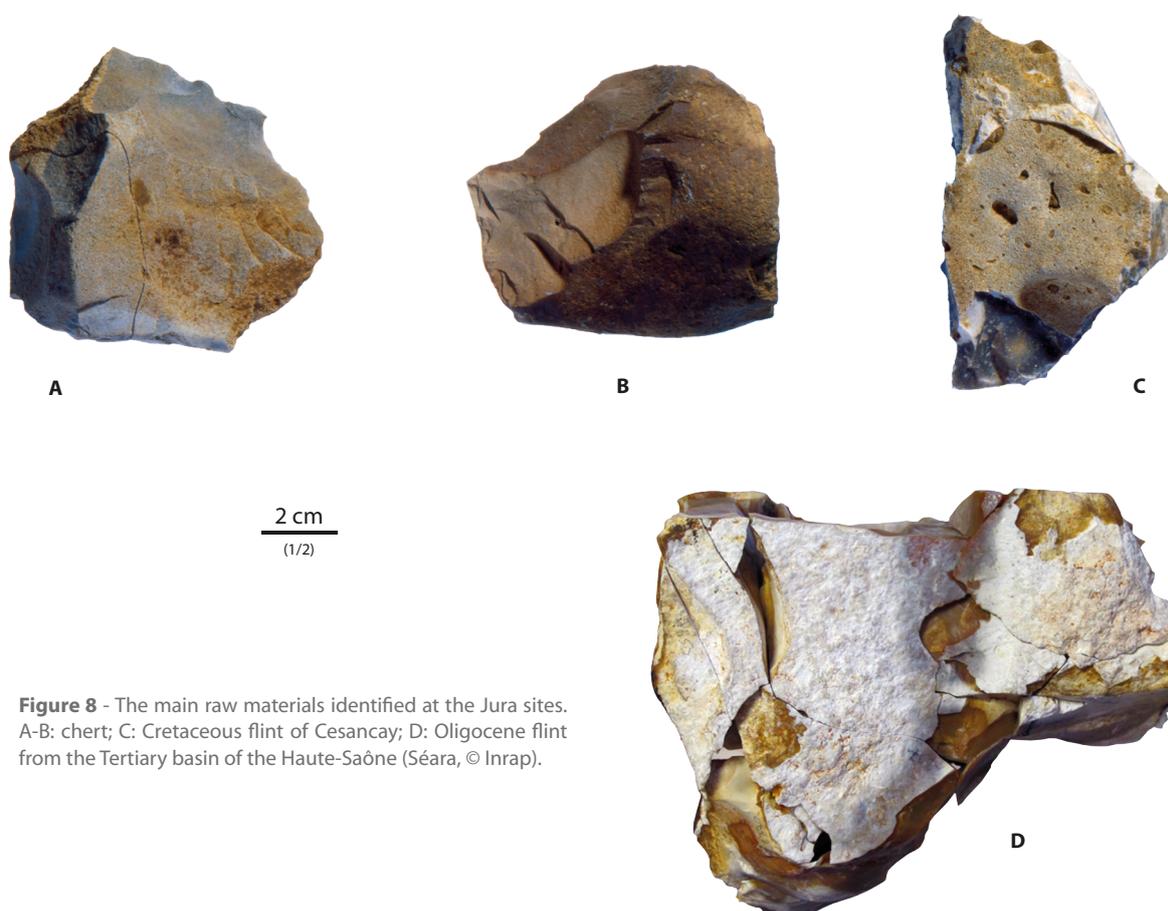


D - Lhéry, Final Mesolithic

Figure 7 - Flaking station (Séara, © Inrap).

### 3 - The role of raw materials

Before counting the different flaking strategies and evaluating their representativity, it is important to consider the variables associated with the raw materials, including the morphology of the initial block and the quality of the material. Thanks to the presence of some unworked pieces, or with just a few removals detached when the block was tested, along with some refitting groups, we have rather precise data on this question. At the Jura sites, the diverse local materials were mostly collected in the form of small blocks that were easy to flake (figure 8). These were local Bathonian, Bajocian, Callovian and Dogger cherts (Affolter, 2003; Bourgeois, 2002; Cupillard *et al.*, 1995; Cupillard, 1998). The origins of the flint used were more distant, such as that of the Upper Cretaceous Cesancey flint, originating from the southern Jura region, and the Oligocene flint from the Haute-Saône Tertiary basin. Except for this latter, the blocks selected were generally small.



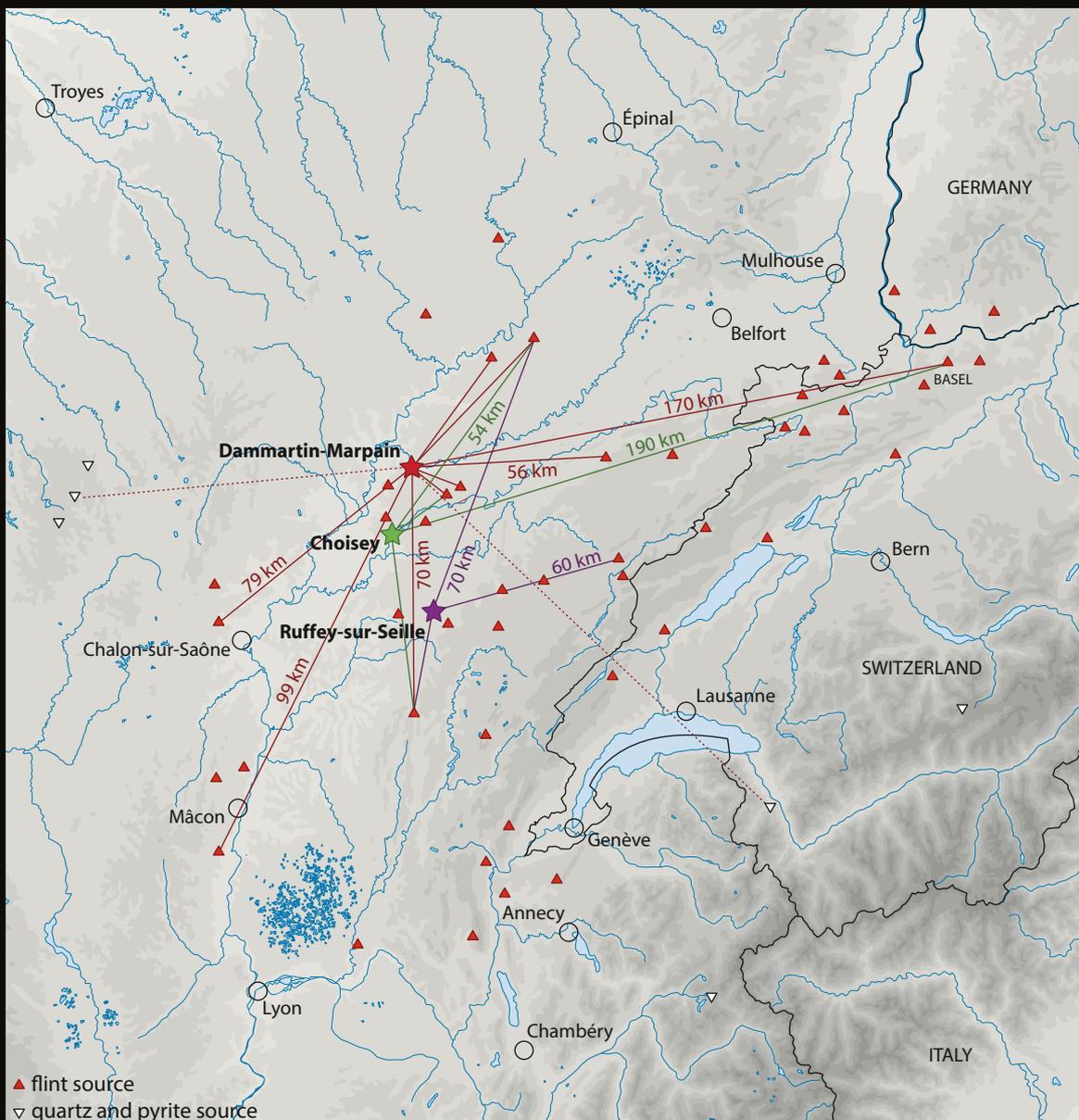
**Figure 8** - The main raw materials identified at the Jura sites. A-B: chert; C: Cretaceous flint of Cesancey; D: Oligocene flint from the Tertiary basin of the Haute-Saône (Séara, © Inrap).

Other materials with a more distant origin are present, but in small proportions. At Dammar-tin-Marpain, the most distant known origin is that of Olten in Switzerland, 170 km away (Affolter *et al.*, 2010) (figure 9). This same origin was identified at Choisey. Though we have only partial data on the form in which the distant raw materials were imported, some nearly complete refitting groups, such as that of the bladelet production in Olten flint at Choisey, indicate that small blocks were imported (figure 9). While the factor of distance could modify some flaking strategies, the small quantity of distant materials in the assemblages studied does not enable this type of observation. In general, local resources were favored.



1 cm  
(1/1)

**Figure 9** - Top: Kimmeridgian flint from Olten (Switzerland), bladelet assemblage in the process of being refitted; Bottom: map of the main known procurement sources for the sites of Ruffey-sur-Seille, Choisey and Dammartin-Marpain (Séara, © Inrap).



At Ruffey-sur-Seille and Dammartin-Marpain, evidence for the morphology of the raw material blocks and their manner of introduction into the site is remarkably preserved in the deposits of blocks with different configurations. At Ruffey-sur-Seille, a large assemblage of 22 Upper Cretaceous flint blocks, all tested, was found (Séara *et al.*, 2002), while at Dammartin-Marpain, there are smaller deposits composed of small chert blocks, this time not tested and always located in the sectors with few remains, suggesting that they were being saved for future use (figure 10).



A - Ruffey-sur-Seille, Cretaceous flint



B - Dammartin-Marpain, Bajocian chert



C - Dammartin-Marpain, Bajocian chert

Figure 10 - Block deposits (Séara, © Inrap).

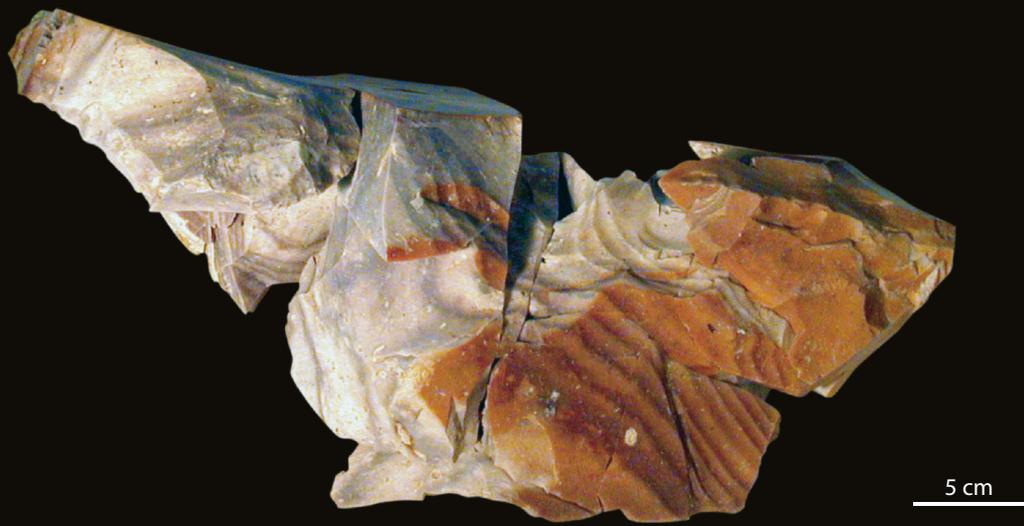
At Pont-sur-Yonne, the very different petrographic context is very different and clearly more homogeneous than this part of the Paris Basin where small, more or less regular nodules of a highly variable quality, with a rolled cortex, were selected (figure 11). These elements originate from the coarse alluvial sediments of the Yonne. Elongated pieces with a small section and chalky cortex, slightly flaked, or not at all, were also collected. The cortical surface indicates a different procurement source, probably from chalk outcrops that appear to be local (Séara, 2008a).



**Figure 11** - The morphology of flint blocks from the Early Mesolithic occupation at de Pont-sur-Yonne (Séara, © Inrap).

The site of Lhéry, near Reims, is located in a zone with the Lhéry-Romigny Tertiary flint, known for its quality. Alongside small blocks, there are rather large slabs weighing several kilograms. To enable bladelet manufacturing, these pieces were intentionally fractured using intermediary flint pieces as “wedges to split stone” (Bostyn, Séara, 2011) (figure 12).

Analysis of the raw material selection criteria seem to indicate that the main aim was to obtain volumes that would enable direct and immediate flaking with little preparation each time it was possible for the Mesolithic artisans. While in this study region, this observation is particularly true for the Early Mesolithic, in the Late Mesolithic, blocks of a better quality were used, without necessarily implying a signification of the procurement systems.



**Figure 12** - Tertiary flint block from the Lhéry sector and outcrop conditions (Séara, © Inrap).

## 4 - Flaking strategies

Even if most of the strategies identified are based on refittings, certain core types can still contribute information to this question (Séara *et al.*, 2002).

### A - Choisey (Jura)

The site of Choisey yielded an assemblage of discoid cores with radial removals on one or two surfaces (figure 13). The functional intention of the short and robust flakes obtained is difficult to determine, be it as a weapon element, or for direct use. It is also difficult to know whether this strategy is associated with an initial configured conception, or a particularly thorough reduction sequence. The small number of refittings does not allow us to answer this question, but could be the consequence of a particularly complete form of exploitation that yielded small pieces, which were thus very difficult to refitting.

Given the large number of refitting groups, the question of the diversity of flaking strategies can be best understood based on the most complete ones.

A few rather complete refittings are associated with bipolar bladelet manufacturing, such as a small group composed of 14 pieces in Cretaceous flint from the Early Mesolithic at Choisey (figure 13<sup>A</sup>). No preliminary preparation was necessary with this strategy, which yielded small, regular bladelets. This dominant strategy at Choisey shows the attention paid to selecting blocks that did not require significant preparation before the full debitage phase.

### B - Pont-sur-Yonne (Yonne)

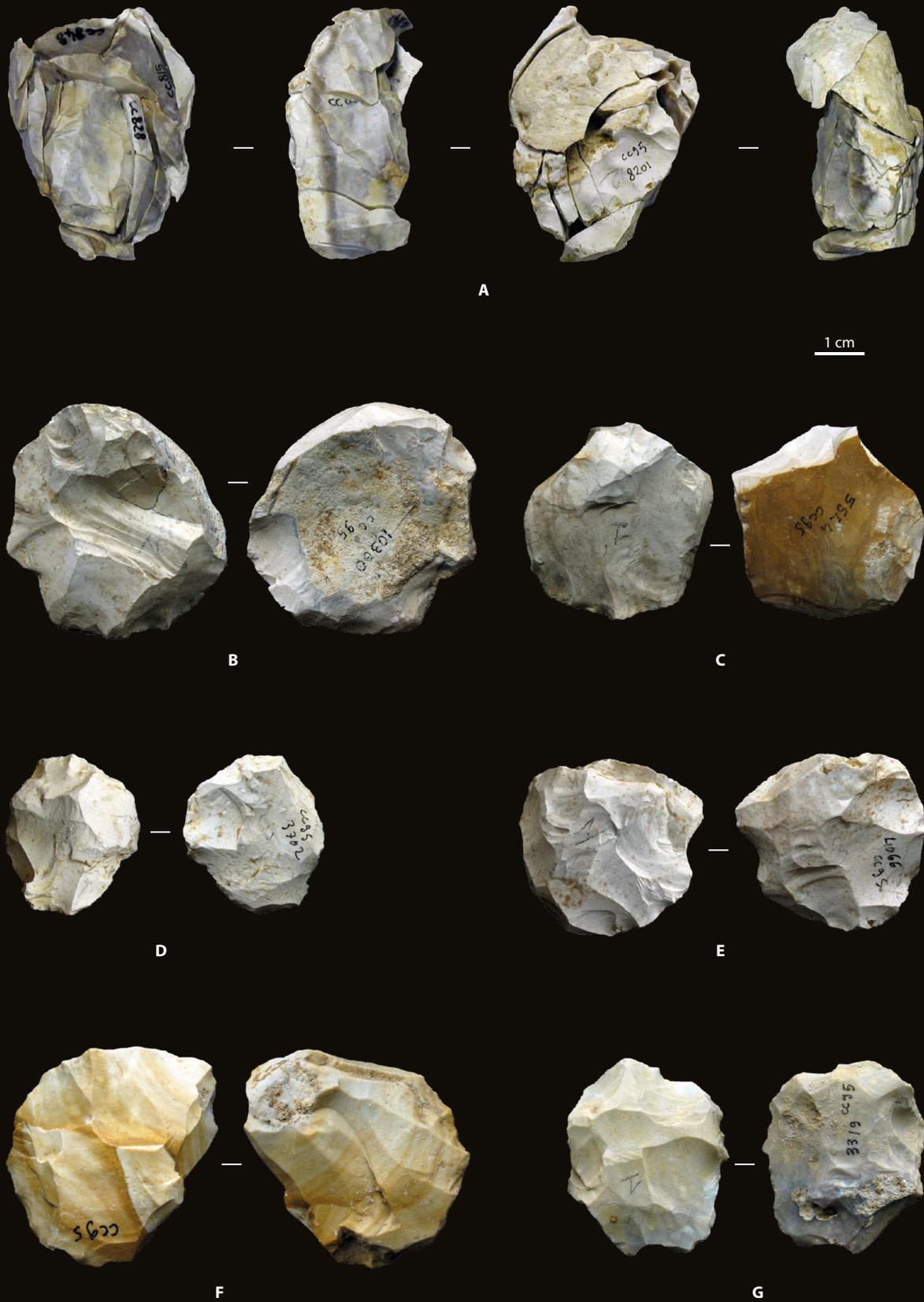
A nearly direct reduction of blocks was also observed in the Early Mesolithic assemblage of Pont-sur-Yonne. A few tubular nodules were flaked, but their low longitudinal convexity, like the example in figure 14<sup>A</sup>, required flaking that tended to be oblique, favoring on of the extremities of the piece. An attempt to rework the core from a second striking platform yielded a few flakes with hinge terminations.

Flaking was difficult in this case because the length of the core was too long relative to the section, which was the main reason this type of volume was not often employed.

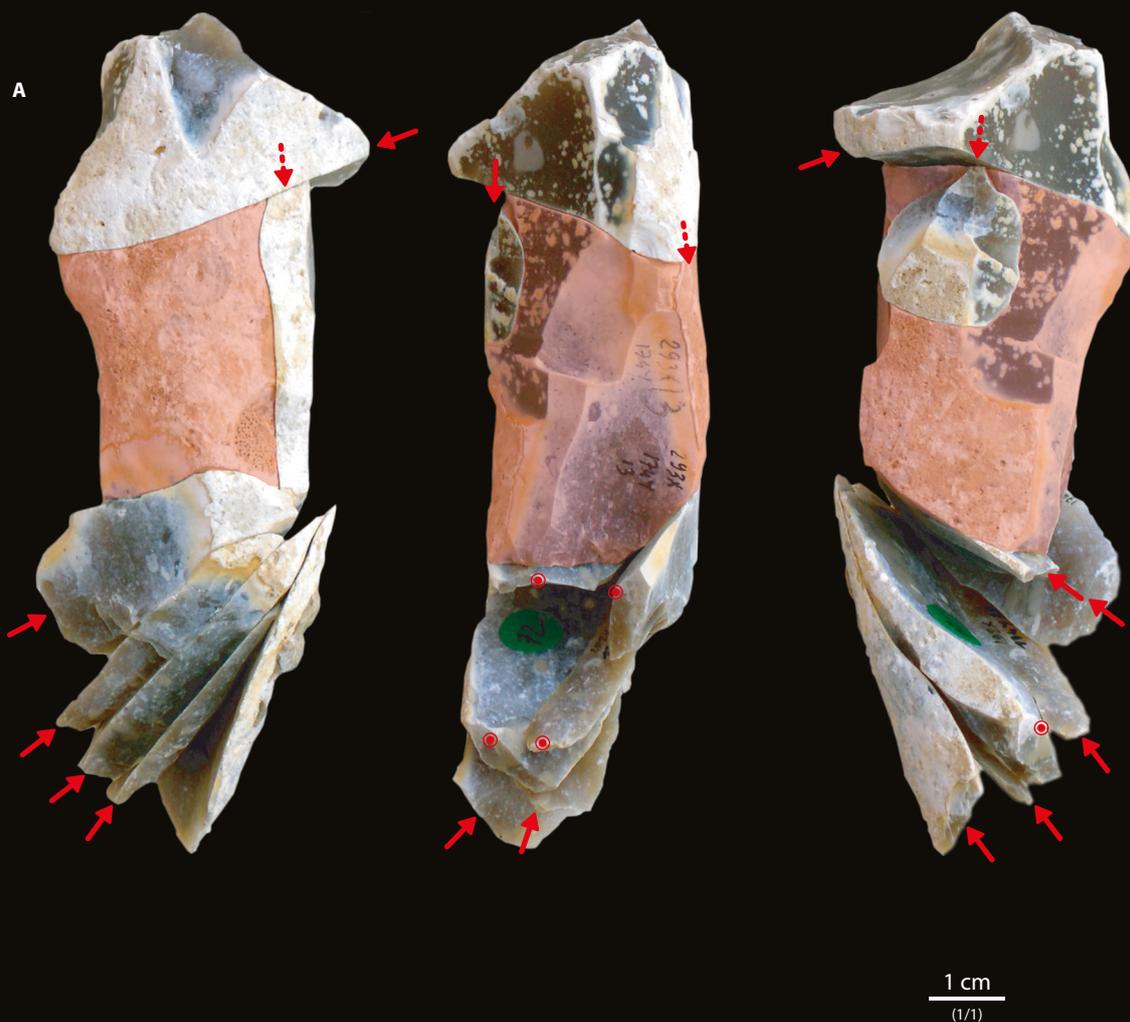
Surprisingly, flaking was much more successful and efficient with the direct flaking of much smaller nodules, which are abundantly present in the area near the site (figure 14<sup>B</sup>). Most often associated exclusively with small bladelet manufacturing, this strategy reduced to its simplest form, provides only a few blank types.

Another flaking strategy is distinguished by the initial shaping phase required by the more massive morphology of the original blocks (figure 15). This piece is a rather good illustration, indicating that after the detachment of relatively thick flakes in order to create the conditions necessary to facilitate further flaking, there was a progression toward to the detachment of bladelets or short blades. The striking platform was created in the initial phases and did not evolve afterward.

In addition to the multiple flaking directions involved in this strategy, and therefore higher skill level than that associated with the direct flaking strategies, it has the specificity of yielding a greater variety of blank types, including flakes of different sizes, most of which precede the bladelet production. The refitting group shown in figure 16 shows that the bladelet production is not represented, nor is the core, which was probably exported to be flaked elsewhere (figure 16). This is thus a good illustration of the segmentation of a reduction sequence in the context of Mesolithic occupations. One of the originalities of this sequence is that is provided the blanks for

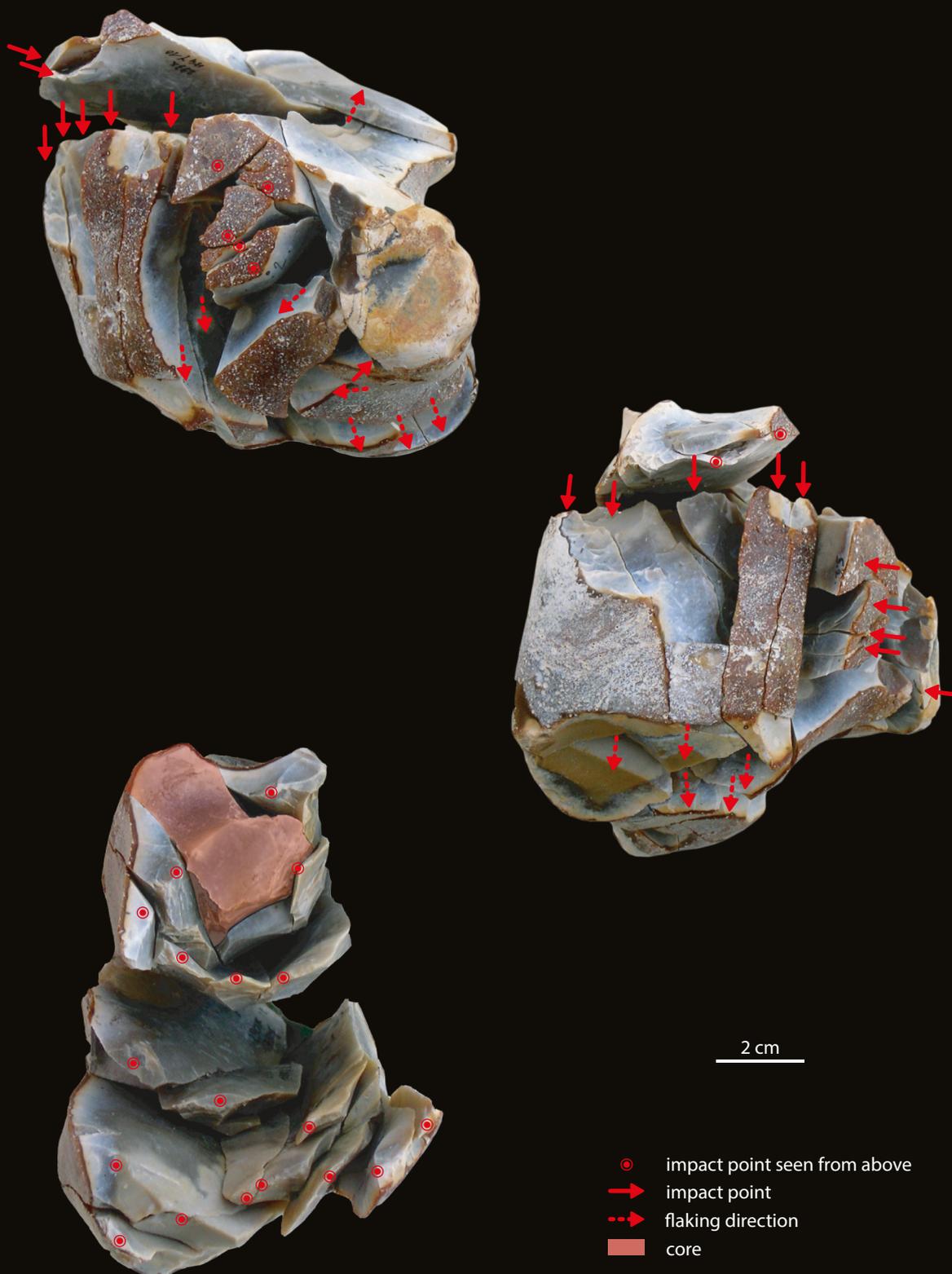


**Figure 13** - Chosey, Early Mesolithic. A: refitting group a block used for bladelet manufacturing; B-G: discoid cores (Séara, © Inrap).

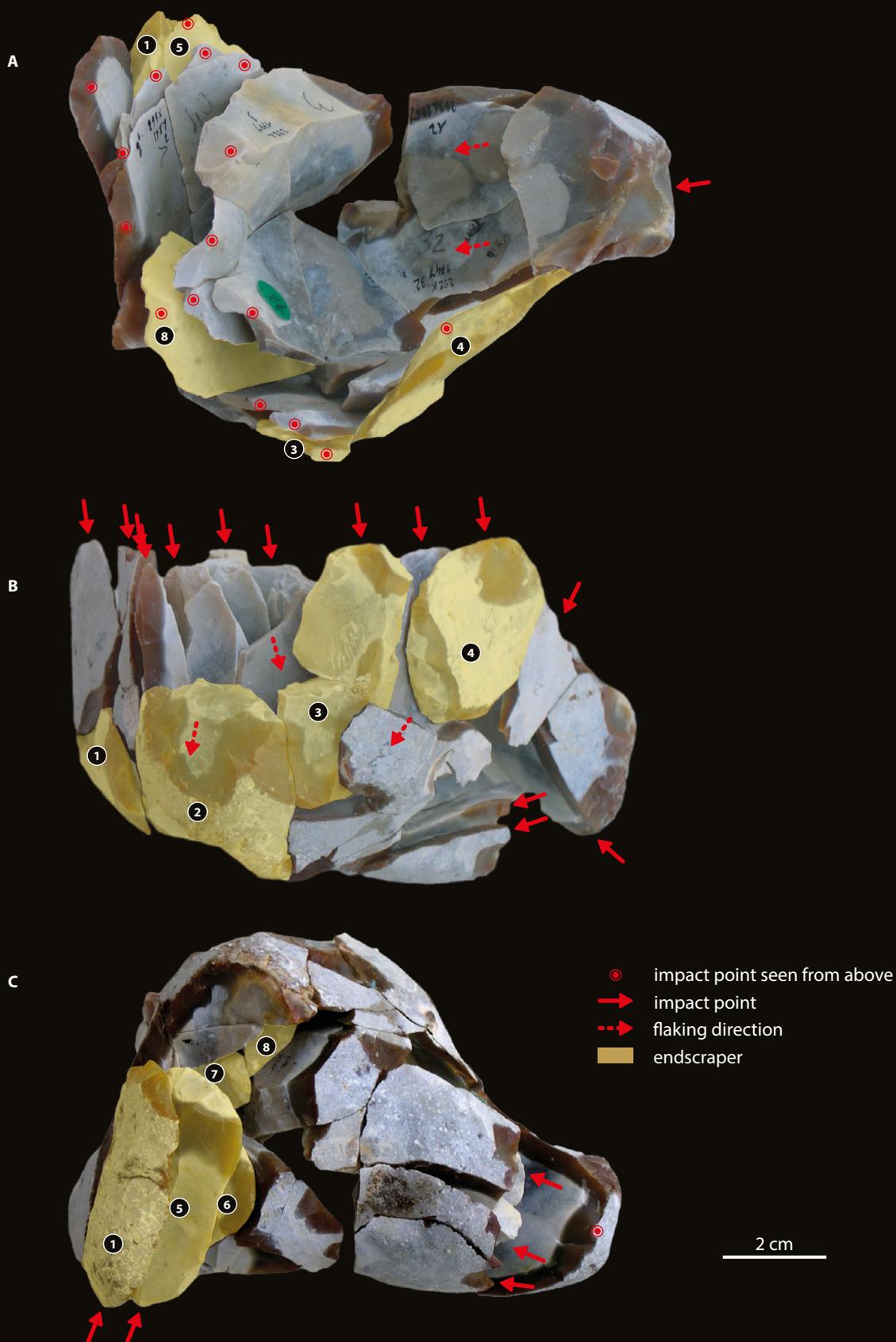


- impact point seen from above
- impact point
- .-→ flaking direction
- core

**Figure 14** - Pont-sur-Yonne, Early Mesolithic. A: refitting group of a tubular nodule used for bladelet manufacturing; B: refitting group of a small block used for bladelet manufacturing (Séara, © Inrap).



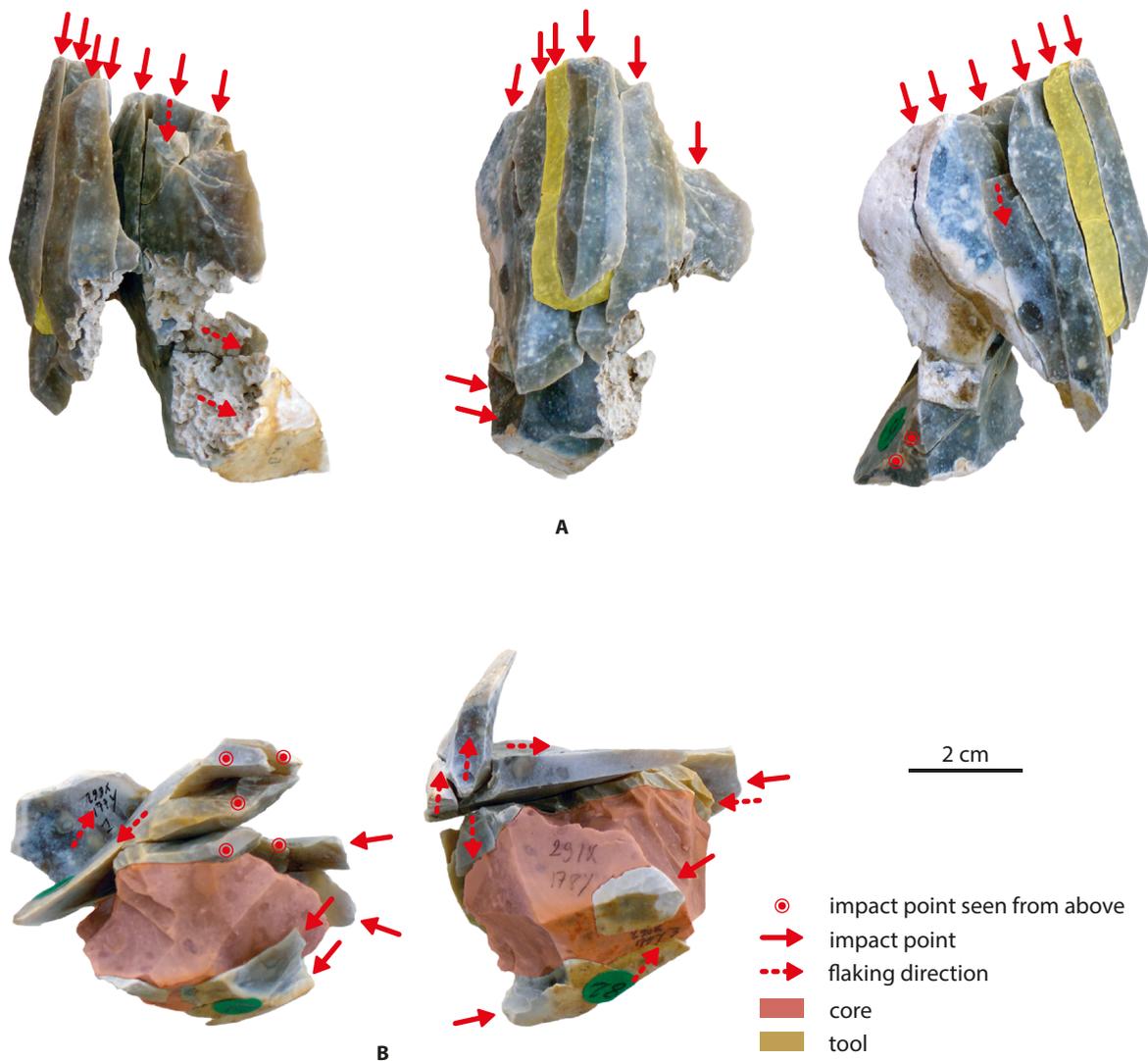
**Figure 15** - Pont-sur-Yonne, Early Mesolithic. Refitting group of a nodule used for bladelet manufacturing, attesting to an initial preparation phase (Séara, © Inrap).



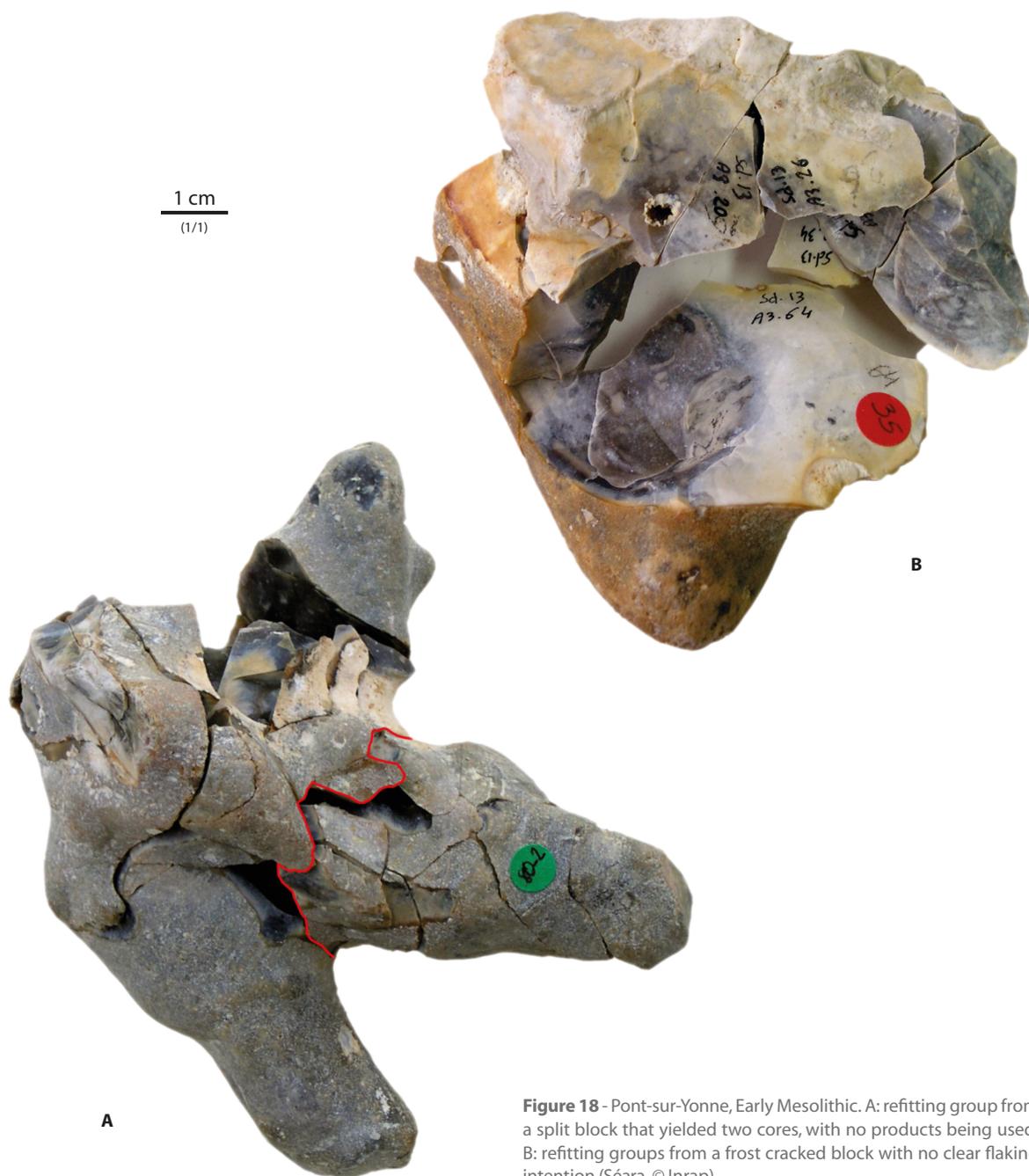
**Figure 16** - Pont-sur-Yonne, Early Mesolithic. Refitting group associated with the initial preparation phase. Eight flakes from this phase were transformed into endscrapers (Séara, © Inrap).

eight endscrapers. This flaking sequence has the advantage of integrating the manufacturing of flakes and bladelets. The care taken in the initial phases, in addition to their technical implications, also served to obtain specific blanks. The bladelets or short blades produced are relatively regular and some of them were also transformed into domestic tools, as in refitting group 1 (figure 17), including an endscraper. The domestic tools, well represented in this case, remind us of their tendency to be represented in Early Mesolithic industries (Lang, 1997; Lang, Sicard 2008; Ducrocq, 2001) (figure 17).

The last flaking strategy identified at Pont-sur-Yonne consists of a small flaking assemblage, unique at the site, and similar to the flaking strategy identified based on the discoid cores at Choisey (figure 17<sup>B</sup>). The few refitted elements are very irregular bladelets, or even flakes, whose function could not be determined by the usewear analysis realized by Jean-Paul Caspar.



**Figure 17** - Pont-sur-Yonne, Early Mesolithic. A: bladelet refitting groups with one retouched into an endscraper; B: refitting group showing discoid flaking (Séara, © Inrap).

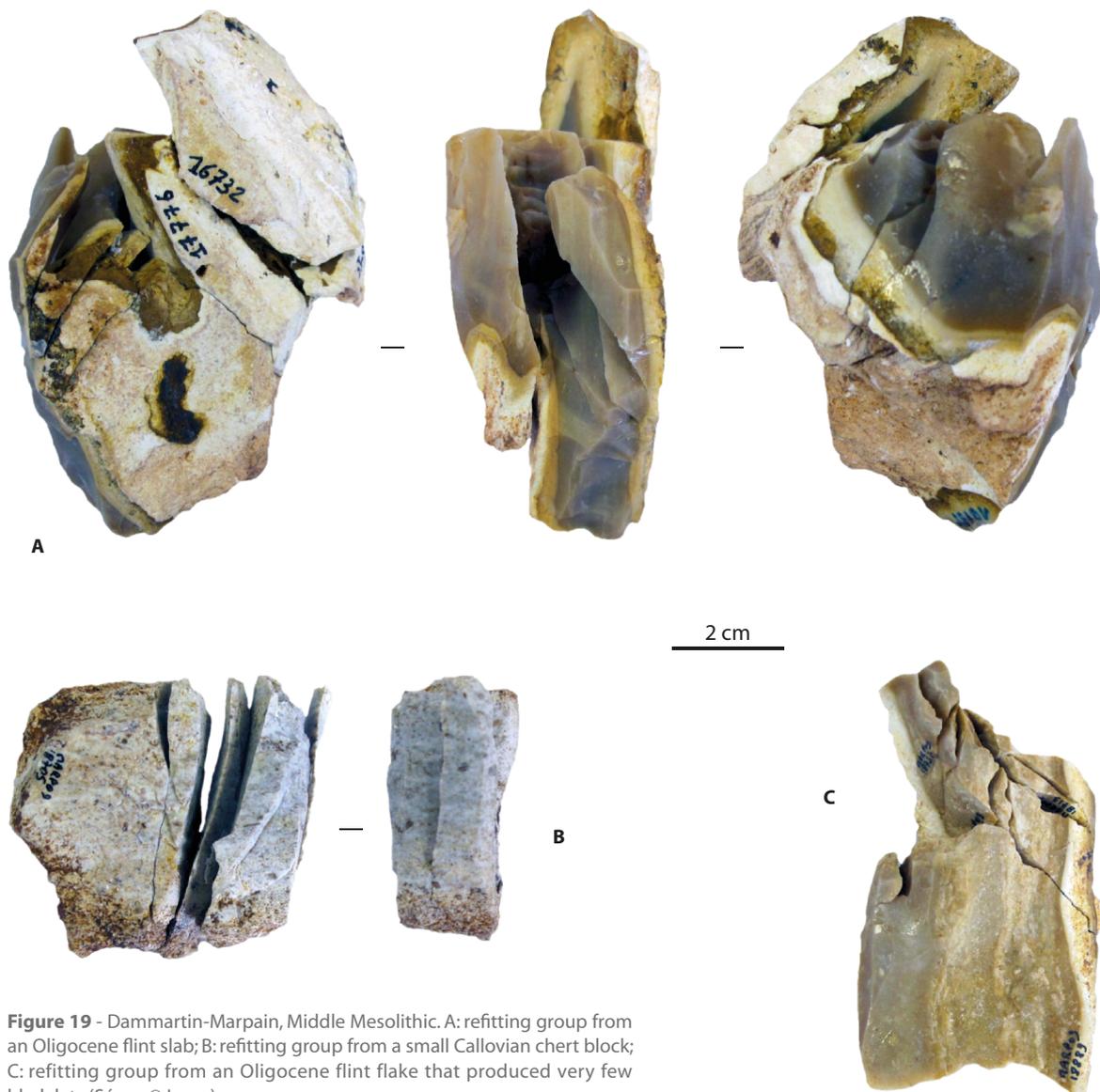


**Figure 18** - Pont-sur-Yonne, Early Mesolithic. A: refitting group from a split block that yielded two cores, with no products being used; B: refitting groups from a frost cracked block with no clear flaking intention (Séara, © Inrap).

A few refitting groups can be distinguished, not due to a specific flaking strategy, but more because of the conditions and end result of their flaking process. A split block was used for two flaking sequences that yielded thick flakes, none of which were used (figure 18<sup>A</sup>). Similar flaking scenarios have been found in association with the Middle Mesolithic occupation, as shown by the reduction of a frost cracked block that yielded only thick and irregular blanks, which were also not used (figure 18<sup>B</sup>). Though some of these specific features can themselves be the reason for these abnormal assemblages, it is also possible that they could reflect a lower skill level, or even the activities of apprentices. It is also possible that some types of activities required blanks to be obtained rapidly, therefore explaining the much more opportunistic selection of blocks.

### C - Dammartin-Marpain (Jura)

The site of Dammartin-Marpain, excavated between 2008 and 2009, has already yielded very significant refitting groups that recall the strategies previously described (Séara, Roncin, in press; Affolter *et al.*, 2010). For example, one of these refittings shows a flaking process constrained by the small width of the block (figure 19<sup>A</sup>). The full flaking phase was initiated immediately after the creation of the striking platform. Several repairs to this striking platform reduced the length of the block, which resulting meant that only a small number of bladelets could be obtained. The most frequent strategy, involving a direct initiation of flaking, is well illustrated by this example in Callovian chert. This core, which had no striking platform, yielded bladelets, but which were particularly thick (figure 19<sup>B</sup>). The striking platform of the last example, on a flake, was created by the successive detachment of transverse flakes, truncating in a way, this large support in order to rather inefficiently detach bladelets (figure 19<sup>C</sup>).



**Figure 19** - Dammartin-Marpain, Middle Mesolithic. A: refitting group from an Oligocene flint slab; B: refitting group from a small Callovian chert block; C: refitting group from an Oligocene flint flake that produced very few bladelets (Séara, © Inrap).

The realization of detailed refittings, facilitated by the existence of flaking stations, revealed a specific strategy. According to our current knowledge, it is associated only with flint slabs from the Tertiary basin of the Haute-Saône, and more precisely, with pieces that are thicker than usual. This refitting group shows the flaking of a slab of flint from the Tertiary basin, which was broken into six groups through the use of its natural cleavage. The entire group consists of 91 pieces weighing 740 g. The ensemble yielded seven cores, all of which are associated with bladelet manufacturing. All of the bladelets were collected (figure 20<sup>A</sup>).

This specific management is adapted to the morphology of the block and implies a difficult fracturation phase, dictated by the aim to manufacture bladelets. It reflects an intention to employ in the best manner possible, large and small slabs from a relatively long distance and of good quality. Once the slabs were segmented into smaller pieces, these pieces were reduced in the usual manner and their productivity was highly variable.

This same strategy is observed in another, also complete, refitting group from a locus located 40m from the preceding one. It represents the same principle of segmentation and the most of bladelets produced were also collected (figure 20<sup>B</sup>).



**Figure 20** - Dammartin-Marpain, Middle Mesolithic. A: refitting group from an Oligocene flint slab, which after it was segmented and flaked, yielded four cores; B: refitting group from an Oligocene flint slab, which after it was segmented and flaked, yielded seven cores underlined in red. No bladelets remain (Séara, © Inrap).

## D - Ruffey-sur-Seille (Jura)

The analysis of refitting groups from the site of Ruffey-sur-Seille shows the same types of strategies as those already described. The use of small blocks that did not require extensive preparation is also very frequent, as is seen in the Sauveterrian pieces 1, 2 and 3 in [figure 21](#).

For the Late Mesolithic, the data yielded by refittings are much less numerous (Deschamps, 2000). The use of indirect percussion does not appear to have an effect on the morphological criteria that dictated the selection of blocks, as seen with core 5 in [figure 21](#). The flaking strategy corresponds to blocks whose quality and form are adapted to a nearly direct exploitation. On the contrary, we observe a difference in the care taken in the maintenance of the striking platform and the base of the core, as shown by refitting group 4 in [figure 21](#).

## E - Lhéry (Marne)

A rich and informative set of data were obtained from the site of Lhéry (Marne), excavated in 2001 (Bostyn, Séara, 2011). The analysis of the cores clearly showed the use of indirect percussion, characterized by very straight and regular flake scars, with a frequent and deep distal hinge termination ([figure 22](#)). Though unidirectional flaking is dominant, different combinations of striking platforms are present: opposed, favoring flaking of the back; or perpendicular and favoring flaking of the base of the core, for example.

However, these cores, situated at the end of the *chaîne opératoire* (reduction sequence), provide only a very partial image of the flaking strategies. The very complete refitting groups were obtained enable us to understand the technical management of these cores.

The first refitting groups weighs 4 335 g and is composed of 50 pieces ([figure 23](#)). After a roughing-out phase, one of the resulting large flakes was transformed into a large bipolar flake, intermediary piece, or wedge to split the block into two groups. Each of the latter were used to manufacture bladelets, leaving behind two cores.

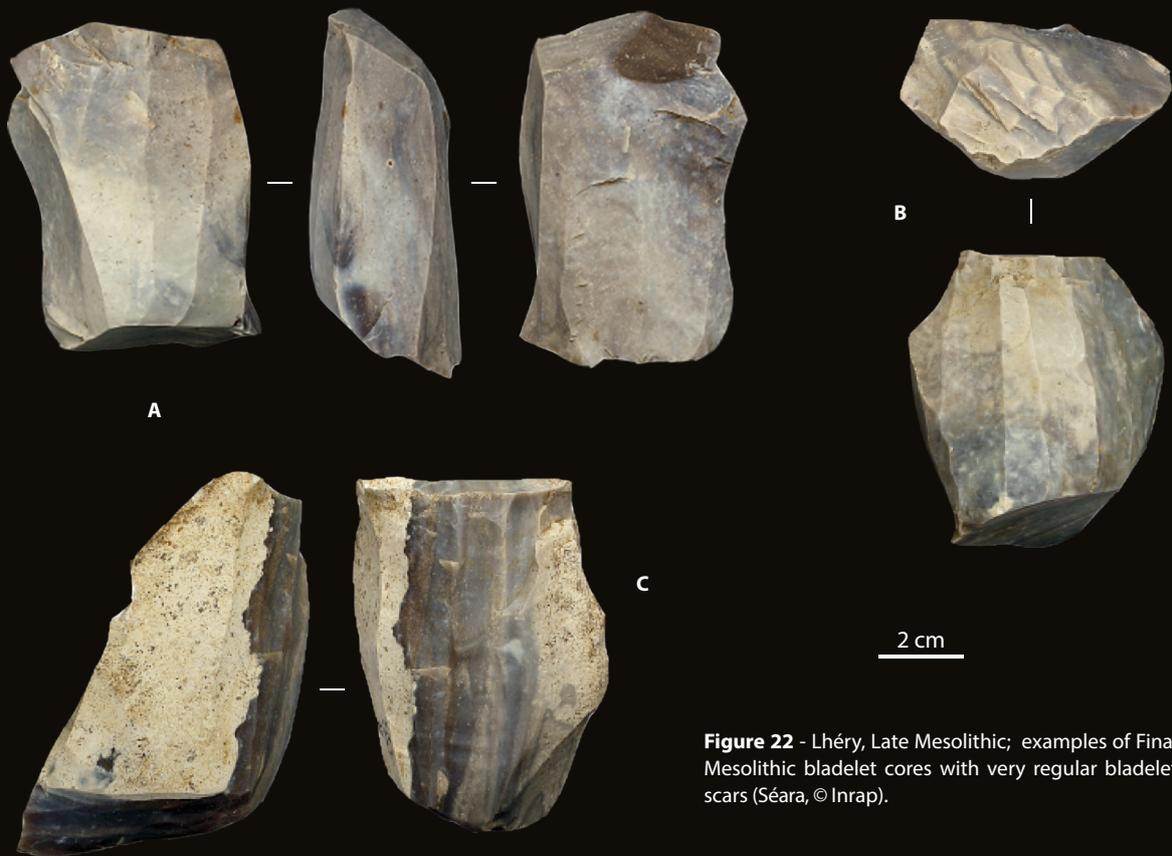
The second refitting group weighs 6 325 g and is composed of 83 pieces. It is associated with this same action of segmenting a large flint slab. The use of indirect percussion is relatively certain for group 16 B, with a core that has a smooth striking platform and deep bulb scars ([figure 24](#)).

Refitting R50 is the most complete, with 98 pieces and a weight of 9 000 g ([figure 25](#)). This block was first roughed out by the detachment of large flakes with a stone hammer. This phase led to the separation of pieces from ice cracked surfaces, two of which were used for bladelet manufacturing. The block was then broken four times, resulting in seven bladelet manufacturing groups. This block is associated with nine cores.

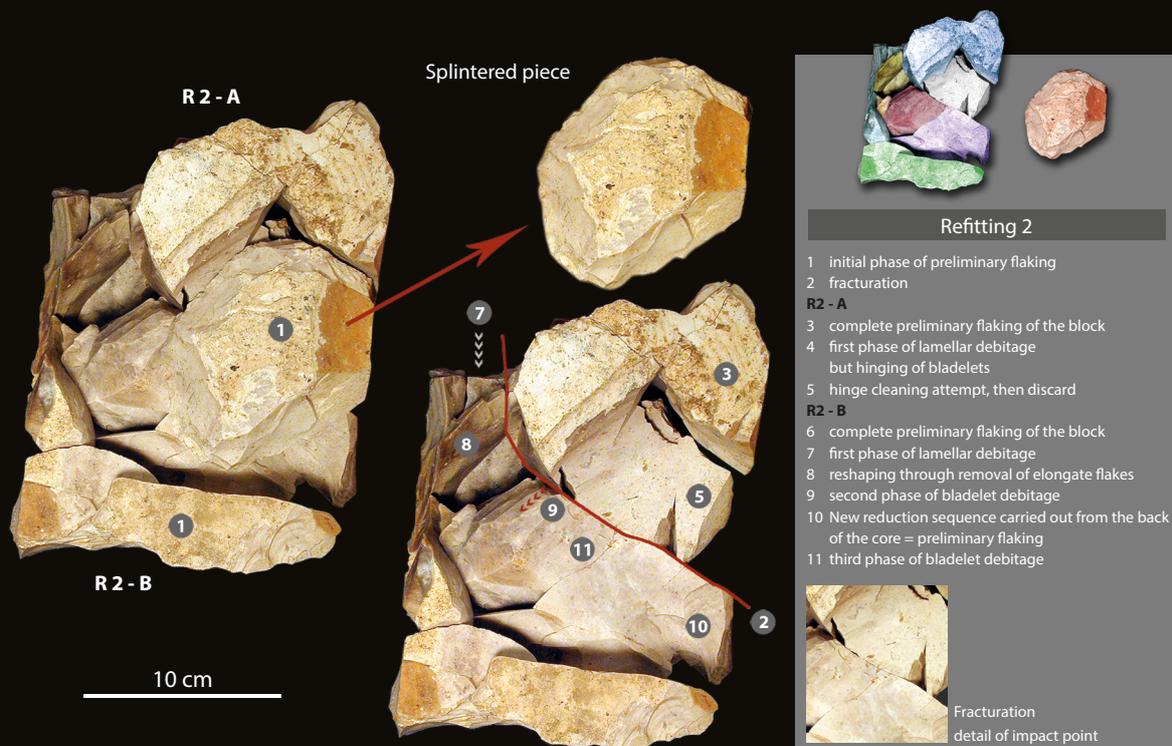
The segmentation of blocks observed at Lhéry is similar in many ways to some of the features identified at Dammartin-Marpain, in both the general conception of the flaking strategy and in the use of rather large Tertiary flint slabs. The main difference is that at Lhéry, bipolar flakes were used as intermediary pieces to fracture the blocks into segments. The data tend to show that this strategy does not have a chronological basis, but rather that its use responded to the specific constraints of this type of raw material volume for the manufacturing of bladelets.



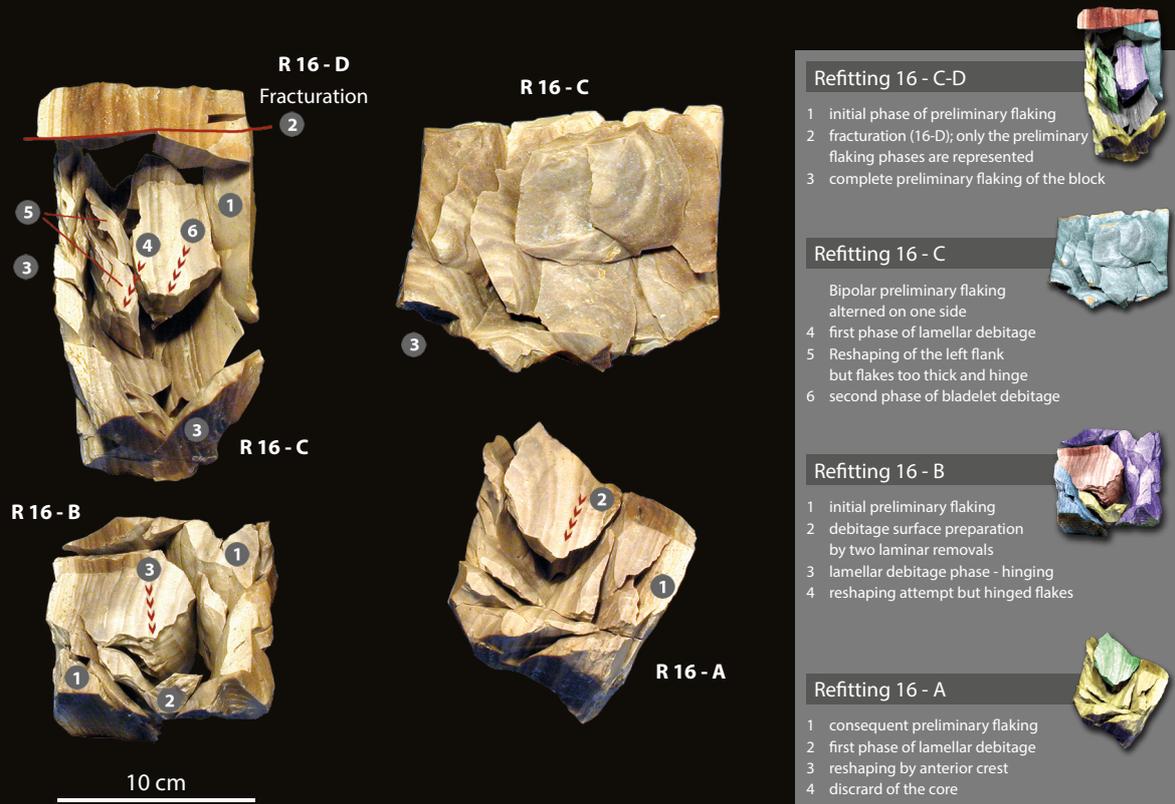
**Figure 21** - Ruffey-sur-Seille. A: refitting group of a chert bladelet core from the Middle Sauveterrian; B: refitting group of a bladelet core in Cretaceous flint from the Early Sauveterrian, C: refitting group of a bladelet core in Beuronian A flint; D: refitting group of a bladelet core from the Late Mesolithic; E: chert bladelet core from the Late Mesolithic regularly fluted (Séara, © Inrap).



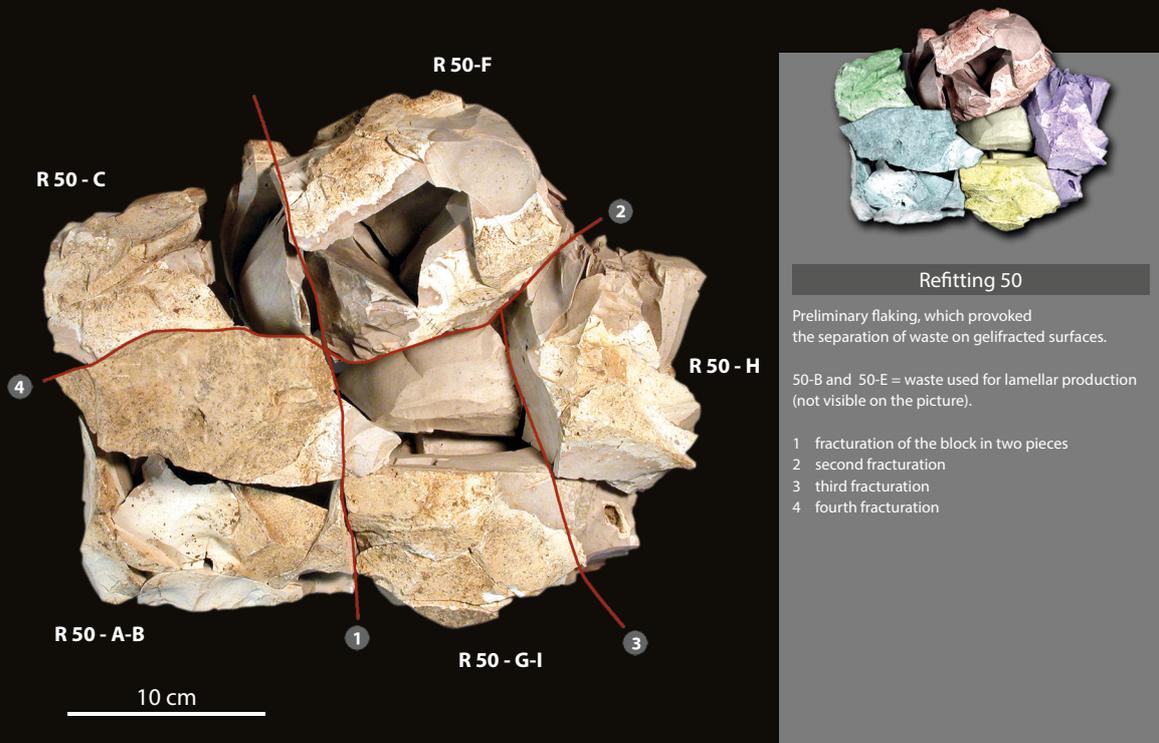
**Figure 22** - Lhéry, Late Mesolithic; examples of Final Mesolithic bladelet cores with very regular bladelet scars (Séara, © Inrap).



**Figure 23** - Lhéry, Final Mesolithic. Refitting group from a Tertiary flint slab whose breakage indicates its use as a large bipolar flake. The small blocks thus obtained were used for bladelet manufacturing by indirect percussion (Bossut, © Inrap).



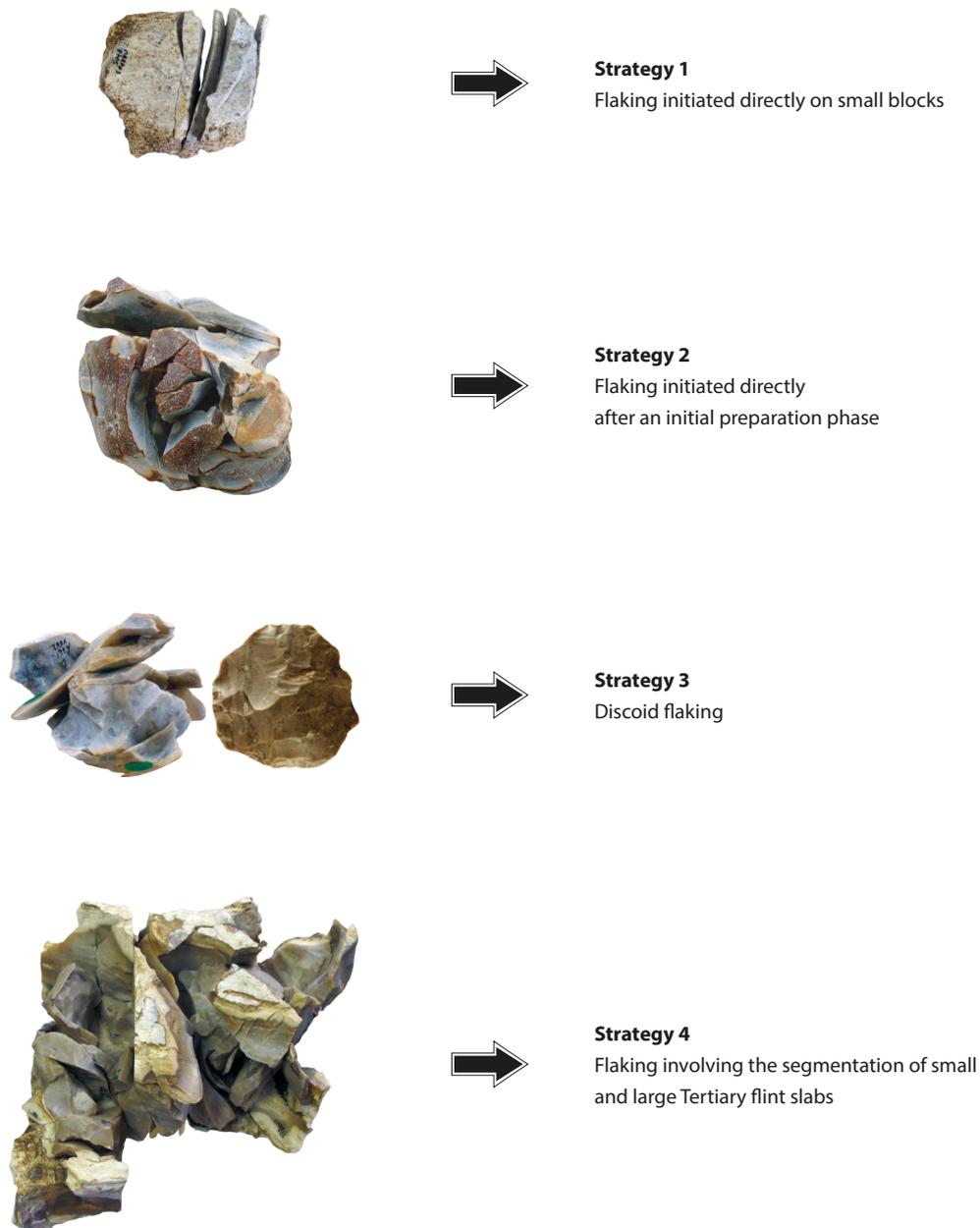
**Figure 24** - Lhéry, Final Mesolithic. Refitting group from a Tertiary flint slab show the care taken in the initial preparation phase, was well as in the full flaking phase (Bossut, © Inrap).



**Figure 25** - Lhéry, Final Mesolithic. Refitting group from a Tertiary flint slab weighing more than 9 kg, showing that the segmenting of blocks is integrated into the flaking strategy (Bossut, © Inrap).

## 5 - Low variability in the lithic flaking strategies

Despite the unequal nature of the data associated with the Early and Late Mesolithic, the numerous refitting groups from many sites, enable us to precisely and efficiently identify the lithic flaking strategies. The four broad strategies that we distinguished are accompanied by more or less numerous variants that should be taken into account before attempting any explanations (figure 26). While the variability of the flaking strategies seems certain, this work of inventory and description, across a rather large geographic area and in association with a rather broad chronological framework, made it appear much less significant than we first imagined.



**Figure 26** - Main flaking strategies identified through analysis of the assemblages from Ruffey-sur-seille, Choisey, Pont-sur-Yonne, Dammartin-Marpain and Lhéry (Séara, © Inrap).

Once we have completed this first phase of inventorying, which should be extended with the arrival of new discoveries and studies, we will be able to investigate the features, representativity and implications of these strategies (figure 27). It is difficult to make a chrono-cultural attribution since they are correlated with very different chronological and cultural contexts. Only the discoid flaking strategy, despite its low representativity, could be specifically associated with the Early Mesolithic. On the contrary, the selection criteria for blocks and the manufacturing intentions, all correlated with the nature of activities, could explain the presence, or dominance, of some flaking strategies. We will thus favor this orientation since, beyond the identification of strategies, it is their paleo-ethnographic dimension that is most interesting. No specific strategy for flake manufacturing was observed. The specific strategy that included a rather careful phase of block roughing-out and preparation, yielding flakes that served as the blanks of some tools, enabled the fulfillment of specific functional needs linked to certain activities and site functions. To then imagine that the block selection could reflect the specific function of some sites is plausible, but still not possible to assert with certainty.

	Raw material	Estimated skill-level	Flaking intentions	Final use	Representativity	Chrono-cultural implication
	Main criterion: block morphology	Medium to high	Bladelets	Direct use, weapon elements	Very high	All periods and cultures
	The criteria of morphology and quality have the same importance. Massive nature of the blocks	Good	Bladelets and flakes	Direct use, weapon elements and domestic tools	High	All periods Mostly associated with the Beuronian for the Early Mesolithic
	No clear criterion. Only flint	High	Irregular bladelets and short flakes	Undetermined. Direct use?	Low	Early Mesolithic, Beuronian
	Main criterion of the quality and flaking of large and small, thick slabs in Tertiary flint	Very high	Bladelets	Direct use, weapon elements, a few domestic tools	Medium	Early and Late Mesolithic

Figure 27 - Evaluation of the factors, the representativity and the implications of the different strategies (Séara, © Inrap).

Many questions have been raised, uncertain observations have been made, and future directions have been drawn. The numerous refittings realized, some of which are quite remarkable, have provided significant information on lithic flaking strategies during the Mesolithic. Thanks to this, a practice has been rehabilitated, one that was too rapidly discarded, often out of convenience, from the analysis procedures applied to Mesolithic assemblages. It is clear that we must consider the lessons learned from recent experiences in this domain, which underline the necessity to perform a preliminary evaluation of the homogeneity of an assemblage. These latter will determine the capacity to which refittings can provide information and the degree to which we can draw upon them in our interpretations. Of course the need to augment the relative data incite us to include refitting analysis, but the level of investment must be adjusted to clearly defined research questions. Though this practice is sometimes unrewarding, we should the very significant results obtained in a short amount of time, without which the existence of some flaking strategies would have totally escaped us.

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## VARIABILITY IN THE MANUFACTURING OF TRIANGULAR GEOMETRIC MICROLITHS DURING THE EARLY MESOLITHIC:

Toward a Simplification of Barb Manufacturing?  
A Comparative Techno-functional Analysis  
of Microlithic Assemblages from Saint-Lizier  
at Creysse (24) and La Grande Rivoire at Sassenage (38)

Lorène CHESNAUX

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### Abstract

*The aim of this short article is to present the heuristic potential of a detailed analysis of microliths. The analysis of the manufacturing methods and of the use-wear traces of microliths from two Early Mesolithic assemblages show a certain variability which can be interpreted as a simplification of operating procedures.*

### Keywords

*Early Mesolithic, microliths, techno-functional analysis.*

## 1 - The study

Geometric and non-geometric microliths are very numerous in the Early Mesolithic (Costa, Marchand, 2006). Most studies of them consist of descriptions of their morphological features and dimensions, rather than technological reconstructions. In the context of my doctoral research (Chesnaux, 2014), I developed a new classification of microliths through a detailed analysis of the morpho-technical features associated with weapon elements. It is based on the identification of the active or hafted parts, such as the point, edge, back, or base, which reflect the functional intentions of their makers and users. In conjunction with this analysis, I conducted several experiments (trampling, manufacturing and projection), which enabled me to interpret the damage observed on the microliths (Chesnaux, 2013, 2014).

This analysis method revealed a significant difference in the manufacturing of triangles – identified as barbs – in two homogeneous assemblages attributed to the Sauveterrian Early Mesolithic: Saint-Lizier à Creysse and La Grande Rivoire à Sassenage. After briefly describing these assemblages, triangle manufacturing in each one is compared and discussed in relation to other similar assemblages from this period.

## 2 - The triangles at Saint-Lizier, Creysse

The site of Saint-Lizier à Creysse (Tallet, 2013), located 200 m from the current banks of the Dordogne River, contained three concentrations. Concentrations 1 and 3, first attributed to the Mesolithic and then dated, were retained for study. Micro-charcoals (*Acer* or *Prunus*, identification realized by I. Théry-Parisot) found in the surrounding sediments were dated by AMS. The calculated ages are  $10\,040 \pm 40$  BP and  $9\,900 \pm 40$  BP, and respectively 9810-9380 cal BC and 9440-9280 cal BC after laboratory calibration (Beta analytic). These dates are particularly high and compare with the date of the earliest level at Fontfaurès-en-Quercy (9350/8600 cal BC; Barbaza, Valdeyron, 1991; Valdeyron *et al.*, 2008).

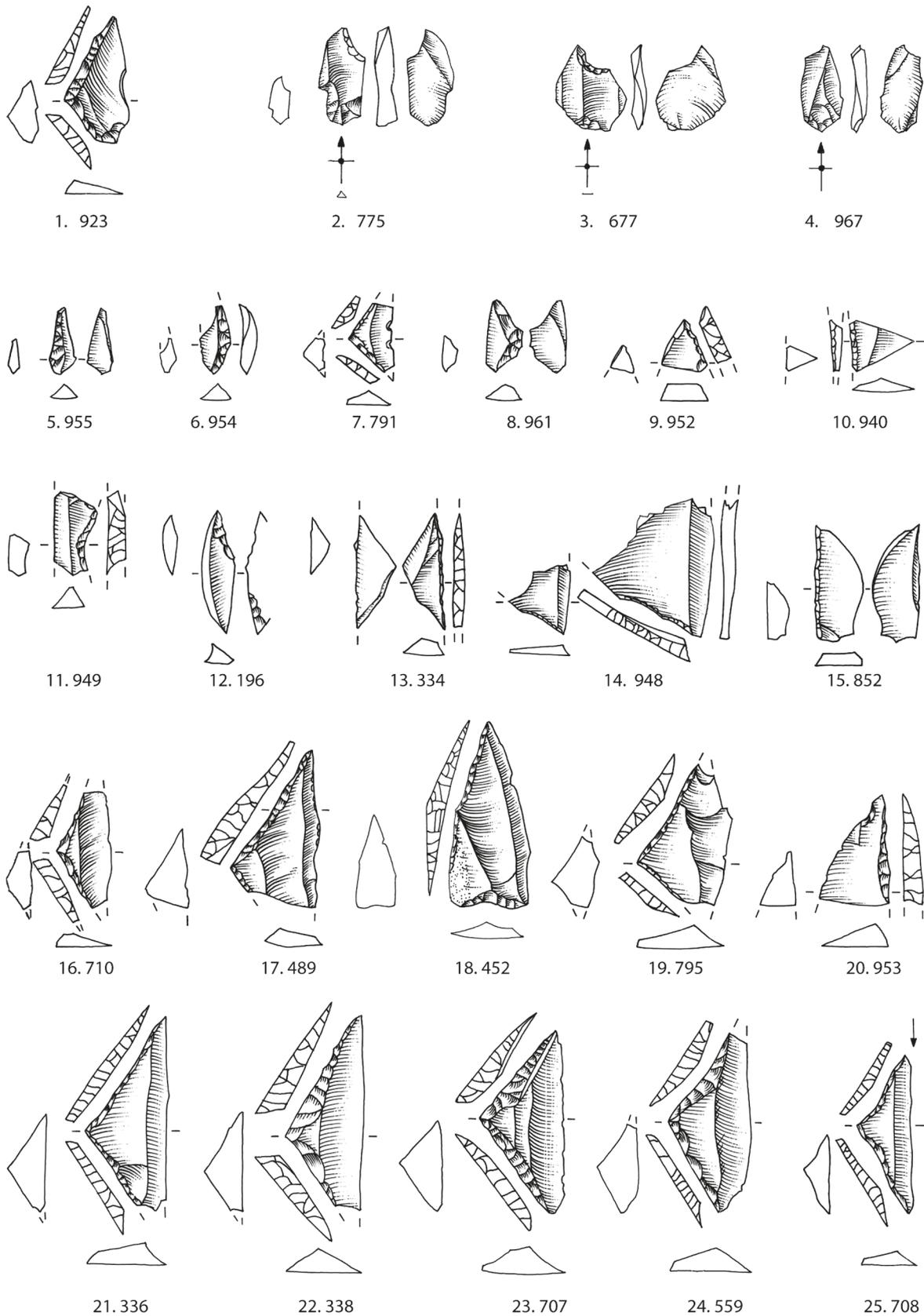
The geoarchaeological analysis realized by M. Rué (in Tallet, 2013) showed that concentrations 1 and 3 correspond to the second filling phase of a paleo-channel of the Dordogne, which was then stabilized. The taphonomic analysis (spatial distribution, object orientations, refitted and matched pieces, artifact surface features, and granulometry) showed that the two concentrations were displaced along the same south-east axis, but that this movement resulted in only a slight redistribution of the artifacts. The analysis by P. Fernandes (in Tallet, 2013) revealed that nearly the entire assemblage is composed of flint initially collected in the form of pebbles from the terrace itself. The techno-functional analysis of the assemblage (Chesnaux in Tallet, 2013) also argues in favor of its homogeneity, with around 50 refittings realized in each concentration.

Meticulous sorting of the water-sieved materials from concentrations 1 and 3 was realized using a binocular magnifier. Numerous significant pieces were thus found, including 10 microliths and hyper-microliths, 4 microliths broken during manufacturing, 9 Krukowski pseudo-microburins, and 29 microburins.

22 microliths were found in concentrations 1 and 3. Among the types identified, most (14 are isosceles triangles (figure 1). There are also two oblique truncated points with retouched bases. The remaining microliths are too damaged to be attributed to a type. It is likely that they are pieces in the beginning stages of manufacturing (these fragments have no damage diagnostic of impact and display fractures of the Krukowski pseudo-microburin type, Chesnaux in Tallet, 2013).

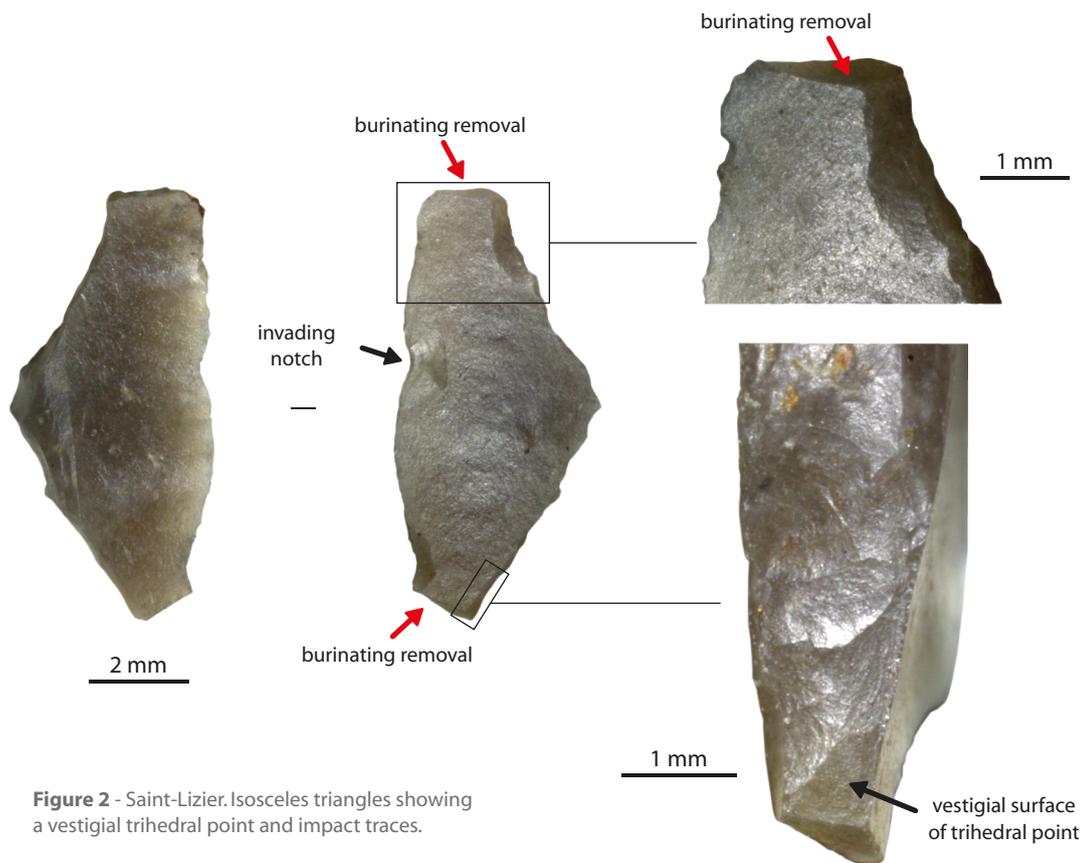
The 14 isosceles triangles were all manufactured in the same manner. They were made on the mesial part of a blade or bladelet – as is shown by the longitudinal ridge(s) on the upper face – with a double truncation that is straight or sometimes slightly concave. This enabled the formation of two pointed symmetric extremities on each end of the transverse axis of the piece. In my morpho-technical classification of active parts (Chesnaux, 2013, 2014), these are designated as double-points. A few trihedral points, not completely obliterated by retouch, are still visible on one of the extremities of some triangles (figure 2). It should be noted that the number of microburins (59) is nearly three times that of microliths (22).

Two isosceles triangles (figure 2) have discrete burinating fractures starting from a point and following the length of a truncation or edge. The experimental reference base indicates that these triangular weapon elements were broken upon impact and according to my interpretive model (Chesnaux, 2013, 2014), they were probably hafted laterally along the shaft of the arrow, thus as barbs. The other damaged microliths (12) display clear transverse fractures that are not diagnostic of impact. These fractures could result from trampling, manufacturing or impact.



**Figure 1** - Saint-Lizier. Microlithic assemblage from C1 and C3. Isosceles triangles: 1, 7, 16, 17, 19, 21-25; point with oblique truncation and retouched base: 18; undetermined microlith fragments: 6, 8-10, 14, 20; microburins: 2-4; Failed microburin: 11; Krukowskis: 5, 8, 12, 13, 15 (drawings: R. Picavet, after Tallet, 2013).

1 cm  
(1/1)



**Figure 2** - Saint-Lizier. Isosceles triangles showing a vestigial trihedral point and impact traces.

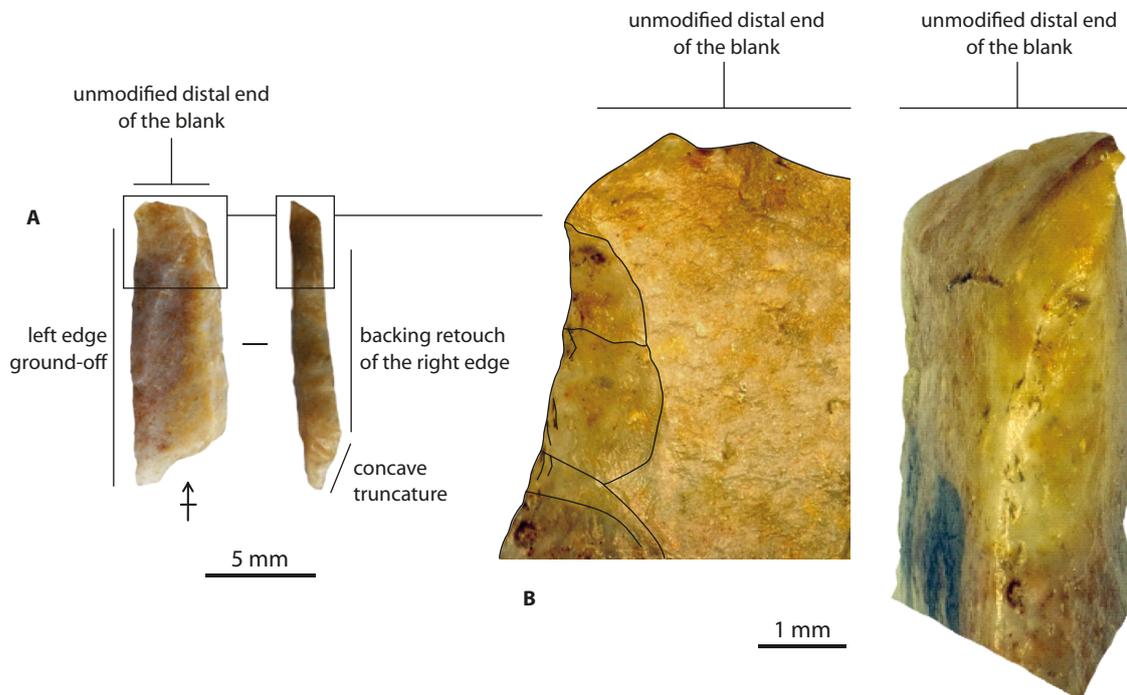
### 3 - The triangles at La Grande Rivoire, Sassenage

The site of La Grande Rivoire (Sassenage, Isère) is a rock shelter (Senonian limestone with flint) located at 580 m altitude in the northern foothills of the Vercors mountains, and 70m above the current bed of the Furon River.

The first operations were rescue excavations that began in 1986 under the direction of R. Picavet. Five sessions took place from 1986 to 1994, revealing a long stratigraphy extending from the Sauveterrian to the Gallo Roman period (Picavet, 1991, 1999). The Mesolithic Sauveterrian and Castelnovian deposits were explored through a deep sondage. Given the exceptional nature of this stratigraphy, more than five meters deep, the excavations were continued by P.-Y. Nicod in 2000 (e.g. Nicod *et al.*, 2006; Nicod, Picavet, 2009, 2011). Most of the flint originated from the wall of the site itself, from which some blocks were collected, and from the Val de Lans (Senonian) 15km away, and Vassieux (Barrémo-Bédoulian) around 20 km away (Bressy, 2002). It is nonetheless difficult to extrapolate these results to the microliths, whose surface is sometimes too small to identify the features of each raw material.

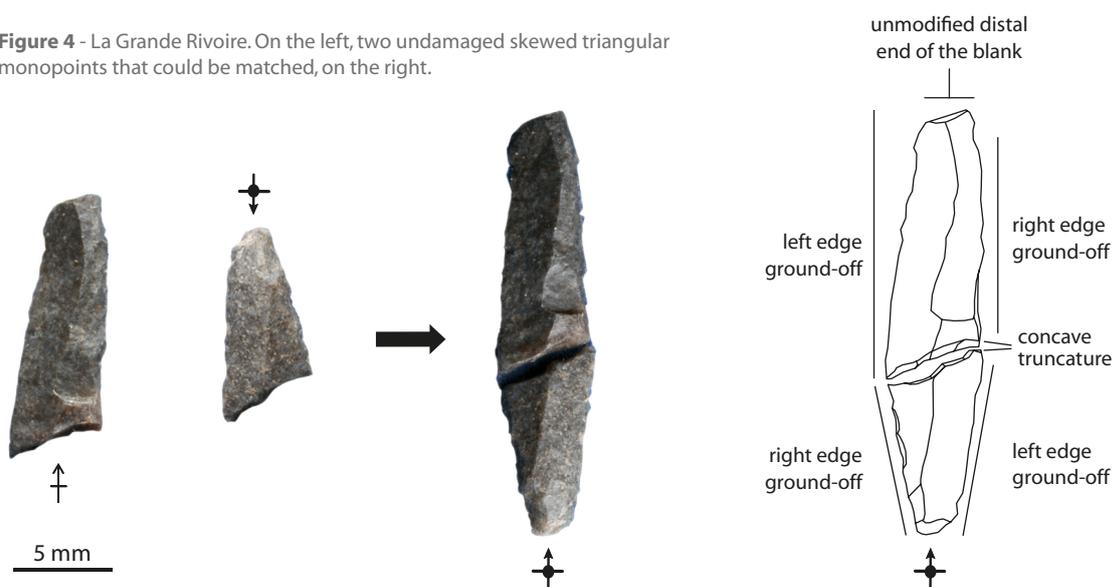
Horizons D and C of the sondage by R. Picavet during the 1980's, correlated in 2006 with the stratigraphic horizons of S36 and S39, were respectively dated to 8540-8280 BC. (Drucker *et al.*, 2008) and 7790-7570 BC (Picavet, 1999), which permits an attribution of the entire group to the Early Mesolithic Sauveterrian. I was able to analyze the microliths yielded by the planimetric excavation in 2010 in sectors SU12-15 (spits d18-22) and SU16-22 (spits d39-42 and d44), marking the end of the Sauveterrian sequence and broadly corresponding to level C in the sondage by R. Picavet.

I identified 162 microliths, including 103 scalene triangles, 25 Sauveterrian points and pointed backed bladelets, one backed bladelet, and 33 undetermined microliths. The main focus of this article is the triangular weapon elements. As with the Saint-Lizier assemblage, these are dominant in this assemblage. Though all of them have a scalene shape, they were not all made in the same manner, and I distinguished two manufacturing methods. 69 scalene triangles have only one modified point, the small point (GEEM, 1969). This point is skewed relative to the longitudinal axis of the piece and formed by a concave or straight-oblique truncation. These are designated as skewed monopoints (Chesnaux, 2013, 2014). The large point was therefore not modified. It corresponds either to the proximal end of the blank (presence of the butt) or the unmodified distal end of the blank (figure 3). Among the 69 scalene triangles / skewed monopoints, 38 were made on the proximal end of the blank and 31 on the distal end. Surprisingly, two probable matches were identified between two skewed monopoints (figure 4). These matches indicate rather regular blanks, with an ogival shape (possibly broken in two by bending, though we have no factual evidence of the bladelet fracturing method), permitting the creation of two microliths, each with a small, skewed point. This shows a particularly significant simplification in triangular microlith manufacturing techniques. We should note that while skewed monopoints modified on their distal end are often designated in typological classifications as scalene triangles whose large point is broken, skewed monopoints modified on their proximal end are often designated as scalene bladelets (Bintz, Pelletier, 1999). This is a type that is often found in assemblages attributed to the later phases of the Sauveterrian, as at the site of Blachettes, Sinaré (Pelletier *et al.*, 2004), for example.



**Figure 3** - La Grande Rivoire. Scalene triangle/skewed monopoint modified at the distal end of the blank. A: It may look as the large point is broken; B: However, stereomicroscopic observation of the distal end reveals that the backing retouch runs through the distal end of the blank. A single small point is intended. On the left: detail of the ground-off left edge and of the distal end (front view). On the right: detail of the ground-off left edge and of the unmodified distal end (lateral view).

**Figure 4** - La Grande Rivoire. On the left, two undamaged skewed triangular monopoints that could be matched, on the right.



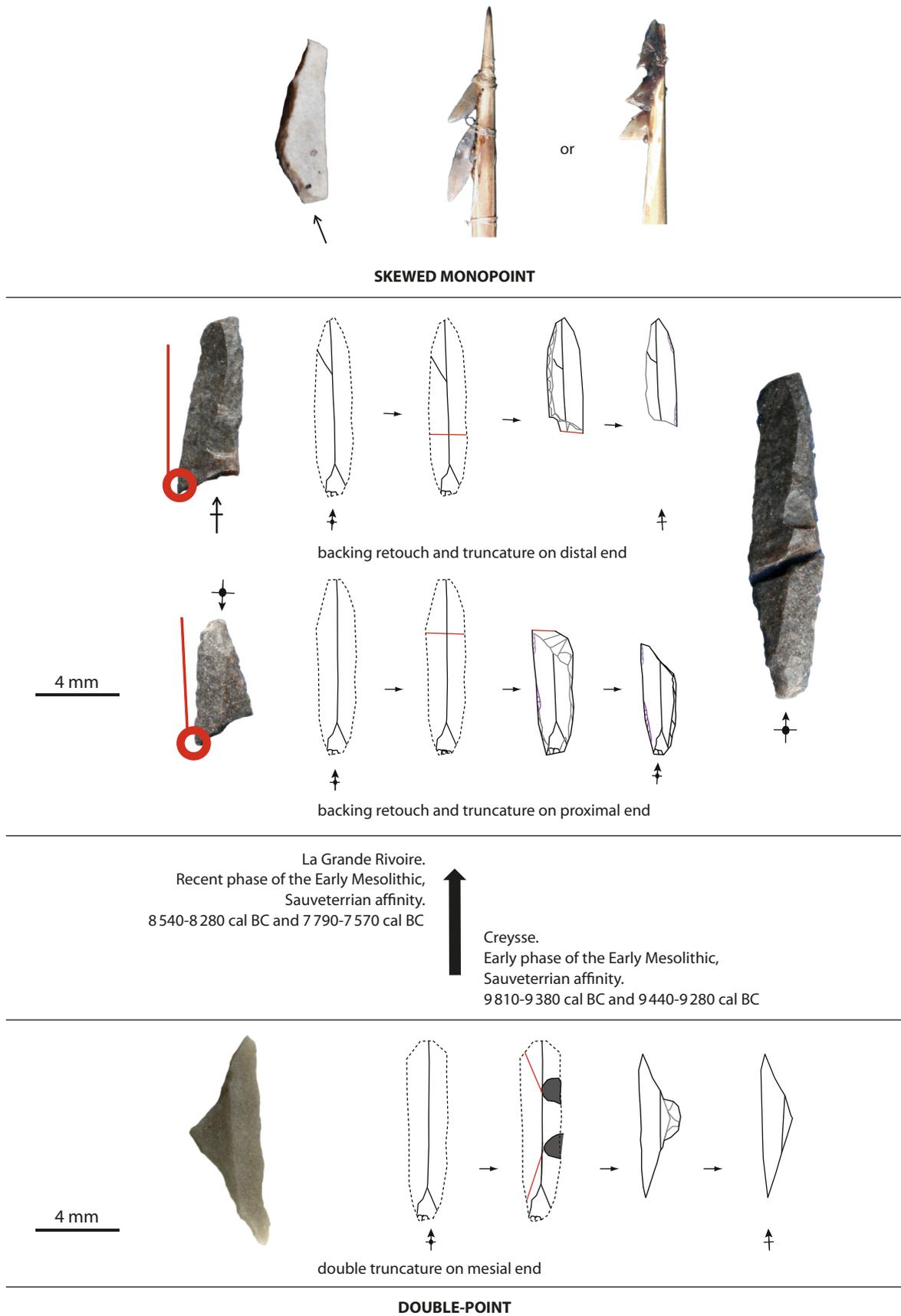
The second manufacturing technique is represented by 13 scalene triangles with two points made on the mesial part of the blank and opposite each other in the transverse axis of the piece. Backing and two truncations form one point oriented in the longitudinal axis of the piece and another that is skewed relative to this same axis. Like the triangles at Saint-Lizier, these are double-points (Chesnaux, 2013). However, in contrast to the triangles at Saint-Lizier, these are all scalene triangles which were probably not made using the microburin technique since only 3 microburins were found in these levels. Furthermore, there is a large number of Krukowski pseudo-microburins (flaking accidents) clearly showing that microburins were made at the site.

21 triangular microliths (13%), due to the transverse fragmentation that removed their distal or proximal end, can be attributed to either the first or second manufacturing technique. Even if double-points constituted the majority of this group of undetermined pieces, skewed monopoints would remain dominant in the complete assemblage.

Finally, since the six fractures diagnostic of impact observed on these triangles (double-points and skewed monopoints) are all burinating fractures (in contrast to the experimental axial points; Chesnaux, 2013), it appears that, like the triangles at Saint-Lizier, they were hafted as barbs on an arrow shaft.

#### 4 - Toward a simplification of barb manufacturing

This study of Early Sauveterrian assemblages from Creysse and Late Sauveterrian assemblages from La Grande Rivoire revealed a remarkable difference in the manufacturing techniques of scalene triangles, all of which served as barbs. While in the Early Sauveterrian at Saint-Lizier, double-points were made through two truncations (obtained by one or two fractures made by the microburin technique), in the Late Sauveterrian at La Grande Rivoire, the creation of large points, useless in the functioning of barbs, was abandoned and two lateral weapon elements were made from a single blank (figure 5).



**Figure 5** - Evolutionary scenario of barb manufacturing from the Early Sauveterrian (Saint-Lizier) to the Late Sauveterrian (Grande Rivoire).

This variability, even if between two geographically distant assemblages, could indicate an evolution in the manufacturing of barbs during the Early Mesolithic tending toward a simplification of techniques and an optimized use of blanks. It is of course necessary to analyze more triangular weapon element assemblages in well-dated southern contexts to confirm this variability.

We should first note that this scenario already mirrors the evolutionary model concerning Sauveterrian triangles from Fontfaurès-en-Quercy in south-western France, described by N. Valdeyron (Barbaza, Valdeyron, 1991; Valdeyron, 1994) who observed a trend toward elongation during this period. In this case, the Early Sauveterrian triangles realized with the microburin technique are made on the mesial part of the blank. The angle between the large base and the small base is thus very open. In contrast, the Late Sauveterrian triangles are no longer made on the mesial part of the blank. Here the entire length of the blank was used and the angle between the large base and small base thus becomes smaller. The elongation of triangles (and notably the change from isosceles to scalene triangles) during the Sauveterrian would thus correlate with changes in their manufacturing techniques.

Furthermore, in a study of three microlith assemblages in south-western France, R. Guilbert (2001, 2003) showed an evolution in the manufacturing of geometrics by fragmentation using the microburin technique at the beginning of the Early Sauveterrian, which completely disappears at the end of the Sauveterrian.

## 5 - First functional explanations

The manner in which composite arrows with lateral armatures, requiring a large number of barbs (the barbs are often detached when the arrow penetrates the animal), as was shown in our experiments (Chesnaux, 2013, 2014), could have itself incited Mesolithic hunters to simplify their microlith manufacturing techniques and to improve their production investment by abandoning the microburin technique (associated with many flaking accidents), and by sometimes even producing two microliths from one bladelet blank. It is of course necessary to verify the existence of this latter practice on other assemblages since, for the moment, it has been identified only at La Grande Rivoire.

Meanwhile, these results have opened new perspectives in our understanding and palethnological explanation of the evolution of microlith assemblages during the Early Mesolithic.

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## FUEL USE AND MANAGEMENT DURING THE MESOLITHIC:

### Recent Approaches in Archaeobotany

Auréade HENRY, Isabelle THÉRY-PARISOT

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## FUEL USE AND MANAGEMENT DURING THE MESOLITHIC:

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#### Abstract

*In order to propose working models for the Mesolithic period, this paper presents recent developments in archaeobotany orientated towards the question of fuel management systems and how ethnographic studies and experimentation can enhance our understanding of past phenomena.*

*The importance of fire and its systematic use during the Mesolithic can be assessed through direct evidence, i.e. the recovery of burned materials with wood, stone, bone and plant remains being the most commonly encountered. The diversity of activities related to fire is also suggested by indirect testimonies, such as the presence of materials (or their processing traces on artefacts) for the production of which a thermic treatment is needed, such as birch tar, animal hides, etc. In accordance with these observations, fuel management practices of Mesolithic societies were undoubtedly complex and culturally significant. However, they remain difficult to approach archaeologically: What kind of fuel was collected and for which purposes? What is the relationship between environment, fuel selection, hearth and site functions?*

#### Keywords

*Mesolithic hearths, fuel use, charcoal analysis, phytoliths, experimentation, ethnoarchaeology.*

## Introduction

It is now widely recognized that the wood charcoal found in archaeological sites reflects accurately the vegetation present in the firewood procurement area (Chabal, 1982, 1991, 1997; Chabal *et al.*, 1999; Asouti, Austin, 2005). However, because the function linking the anthracological spectrum with its source-vegetation is unknown, anthracologists have begun to address the successive filters built up between the ligneous vegetation and the anthracological diagram (Théry-Parisot *et al.*, 2010a-b). Studies integrating not only the firewood management strategies of past societies, but also the effects of combustion and depositional or post-depositional processes on wood charcoal allow us to evaluate the diachronic transformations of the material “wood” and then the charcoal assemblages, and to thus refine our perception of the ligneous environment and its exploitation by humans. These “classic” anthracological questions are now joined by studies aimed at identifying other fuels and their properties (Théry-Parisot, 2001; Théry-Parisot, Costamagno 2005; Delhon *et al.*, 2008; Braadbart *et al.*, 2012). Therefore, the study of fuel management in reality consists of an integrated approach that involves several tools (morphometry, experimentation, modelling) and /or research disciplines (ethnography, zooarchaeology, phytolith analysis, physic-chemical analyses, etc.; [figure 1](#)).

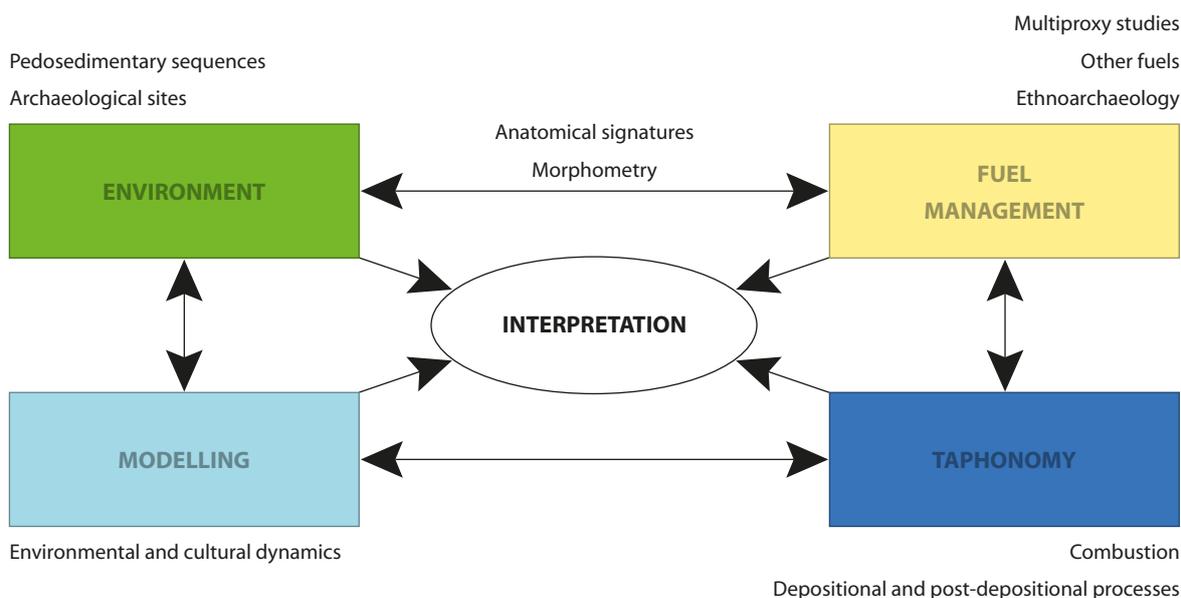


Figure 1 - Research domain : fuel management.

In the framework of a doctoral thesis on the Mesolithic of south-western France, we addressed the relationships between the environment and fuel management, while beginning to explore the manners in which social practices can be brought to light through charcoal studies (Henry, 2011). A brief evaluation of research progress for the period in question shows that paleoenvironmental studies are relatively numerous, but unevenly distributed across France (taphonomic conditions, research context, etc.), while data on the use of fuels are rare and scattered. To cite just one example, the range of fuels potentially used by Mesolithic groups has not been studied in-depth: due to the increased biomass since the end of the Pleistocene and the good preservation of wood charcoal in numerous archaeological sites, researchers have rarely inquired into the use of other fuel sources during this period. Meanwhile, understanding the choice of a fuel in terms of available vs. used resources used is crucial to obtaining a better knowledge of the social, as well as paleoenvironmental, context of a human group.

From this perspective, a priority in our work has been to construct a theoretical and methodological framework for the study of fuel management (Henry, 2011). In other words, “*an approach to phenomena that are unique in particular, but similar in general*” (Bentley, 2003: 9) enabling a consideration of both the cultural and environmental diversity encountered throughout the period, and the particular features associated with each archaeological site. This systemic approach follows the current orientations in research on fuels, with the interpretation of archaeological data being largely based on the creation of experimental and ethnoarchaeological reference datasets.

## 1 - Theoretical framework: a systemic approach

To develop a methodology adapted to our research subject, a fundamental step is to identify the parameters that operate in (and have an influence on) the processes involved in producing and using fire, starting from the environment from which the fuel was collected until the fire is abandoned (Théry-Parisot, 2001). In doing this, we quickly realize that “simple” behaviors or actions, such as wood collecting, are part of a system of complex relations (figure 2).

The framework of our research is thus situated at the interface between the socio-ecological context (Mesolithic groups interacting with their environment) and the fuel resources used, and resulting from, these interactions. The environmental conditions (climate, topography, pedological and geological facies, vegetation, etc.) probably always had a determining influence on fuel management strategies. The environment evidently imposes limitations, but does not alone determine the modalities or frequencies of its exploitation (Friedman, 1974; Ingold, 1980). This is probably also true in the domain of ideology, which likely defines a framework for the exploitation of fuel resources, but does not determine it alone.

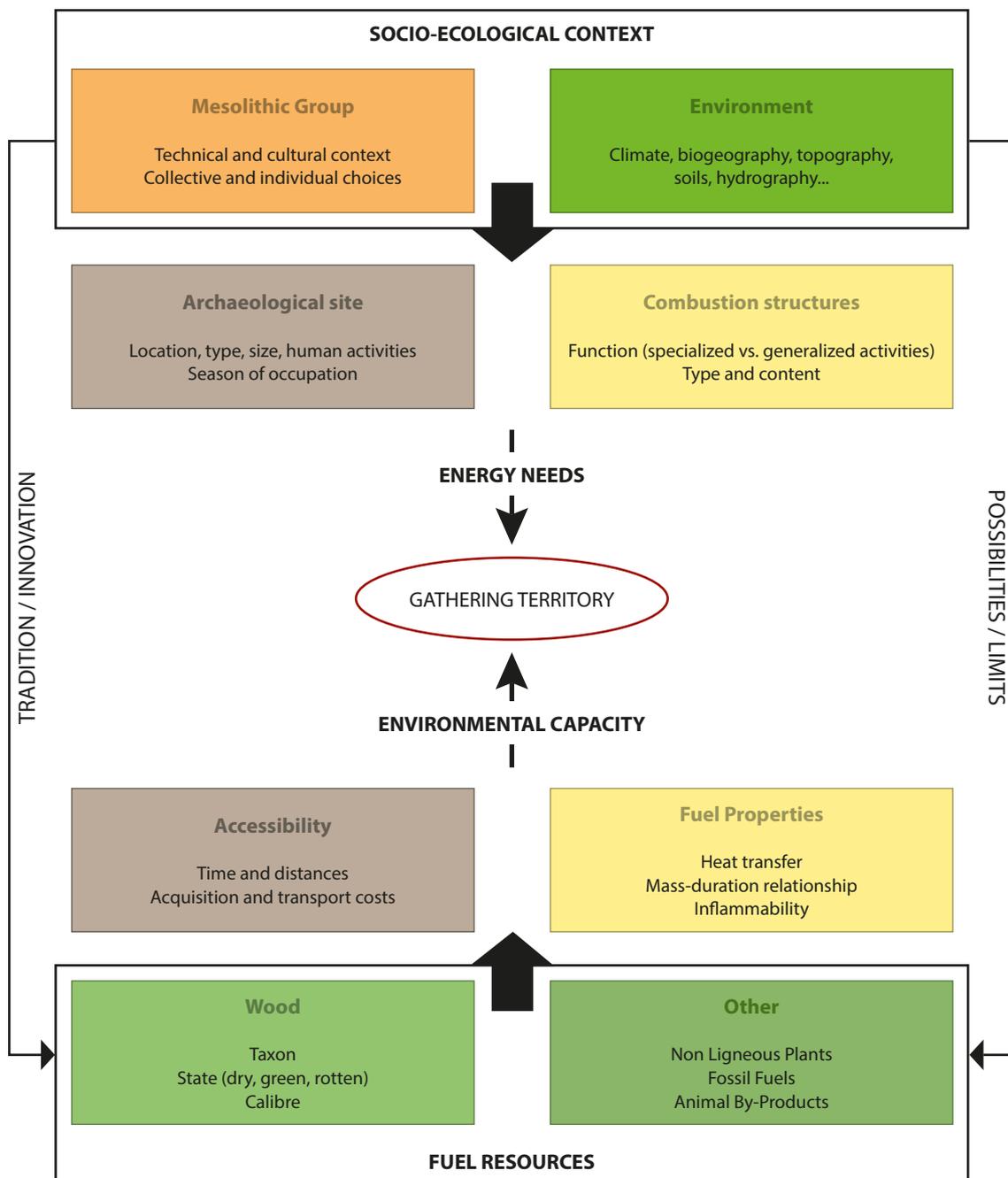


Figure 2 - Fuel management system (after Théry-Parisot, 2001, Henry *et al.*, 2009, modified).

The parameters related to the organization of groups, such as their size and by extension the size of sites, as well as their function and their occupation duration, influence the nature and intensity of activities linked to fire (Théry-Parisot, 2001). These latter have an impact on the consumption of fuels. The satisfaction of the fuel needs of groups (in terms of modalities or capacities) is an expression of the socio-ecological context: the social organization (division of labor, procurement frequency), collection techniques (collection tools, knowledge of the location and properties of different fuels), and ideological factors (perception of the environment, habits, interdictions / preferences, etc.) intervene at all stages of fuel collection and use. The satisfaction of energy (fuel) needs occurs within a given time frame, but also space; it is thus linked to both the occupation duration and the environmental and/or seasonal conditions that influence the nature of the needs, while also determining the productivity of the environment, meaning the exploitable biomass over a given surface area, which in turn contributes to the delimitation of the territory covered by the group for procurement. To summarize, fuel management represents “*the expression of the relationship between the energy needs of groups and their capacity to satisfy them*” (Théry-Parisot, 2001: 148).

Of course, these relationships and their nature are not all unilateral and participate in continuous and multidirectional exchanges between the different parameters if only the scale and/or observation angle is modified. Therefore, in the more or less long term, the use of wood does or does not have an influence on the environment, the productivity of the location, the methods of exploitation, or all of the parameters together. Variations in consumption can also influence the social organization (and vice-versa), or the productivity of a location, which in turn can also influence consumption, etc.

The nature of certain parameters indicates that it is impossible to determine, in archaeological terms, all of the complexity of different situations. Nonetheless, just taking this into account enables us to develop a better-adapted approach, forcibly involving the integration of results from other paleoenvironmental disciplines, along with archaeological data (Théry-Parisot, 2001; Hather, Mason, 2002). As a result, cultural facies, occupation types, procurement territories, site functions, all of which provide direct or indirect evidence of activities linked to fire (burned materials, tools, activities requiring the use of fire, etc.), are all factors that must be considered when attempting to understand the particular nature of firewood management by past human groups.

## 2 - Which fuels for which uses?

The fuel residues found in archaeological sites provide direct evidence of the importance of fire to the economy of societies. The persistence of the fireplace as a central element in the activities of human groups since at least the beginning of the Upper Paleolithic enables us approach Mesolithic groups from a paleo-ethnographic perspective (Gallay, 1999). The archaeological data suggest that fire intervened in a broad range of activities, which nonetheless remain difficult to identify, and it is generally believed that prehistoric fires had several had several simultaneous and/or successive functions (Perlès, 1977; Taborin, 1989). These functions can be divided into two broad groups of activities: (i) activities that we designate here as “domestic”, which are associated with the daily production of fire for drying, lighting, heating, protection, food preparation, the elimination of waste, etc. Their non-specialized nature distinguishes them from activities in which fire plays a role in the operational sequences of processing and/or transforming materials. Within this latter category, the demonstrated or suspected uses of fire during the Mesolithic are highly varied.

## A - A few uses of fire in the Mesolithic

Different thermic treatments (roasting, drying and smoking) can be used to preserve perishable foods for their deferred consumption at a different site and/or during a season different from that during which they were acquired (e.g. Zapata *et al.*, 2002). It is also likely that fire played a role in the tanning/smoking of certain hides, as has been observed nowadays in many traditional groups (Beyries, 2008). The fabrication of adhesives, such as birch tar, which residues are mainly found on stone artifacts such as arrowheads, requires a heating phase (Pollard, Heron, 1996; Regert, 2004). The thermic treatment of stones in the context of different activities (fracturing, ochre preparation) has been observed (Guilbert, 2001; Brochier, Livache, 2003; Rozoy, 1995; Marchand, this volume). The use of fire as a tool for shaping and hardening wood has also been observed (Mordant, Mordant, 1987). More hypothetically, it is also possible that during this period fire was used away from the habitat site in controlled burn practices associated with subsistence activities (Mason, 2000; Ryan, Blackford, 2010). Finally, though it is difficult to observe, it is plausible that fire played an important symbolic role in Mesolithic belief systems, as is indicated by the funerary practice of cremation (Schulting, 1998; Verjux, 2007).

The skillful use of fire in the context of diverse activities requires a complex management of fuels, especially since fire-related activities must have varied in time and space depending on the cultural and technical traditions of groups, as well as seasonal and/or circumstantial needs.

To summarize, the lifeways of a group have a determining influence on their manner of managing fuels. Therefore, a better understanding of fuel-related practices should contribute to our knowledge of Mesolithic lifeways. The following question is thus raised: to what extent can the study of fuel residues found in archaeological sites enable us to characterize social practices?

## B - Fuel economy in the Mesolithic

### a - Potential alternative fuels

To our knowledge, only two zooarchaeological studies have addressed the question of the use of bone and cervid antler as fuel (respectively Thibeau, 2008; Bridault *et al.*, 2009), even though bone use is widely known for the Paleolithic (Cain, 2005; Théry *et al.*, 2005; Costamagno *et al.*, 2009). Based on the negative results of these studies, it appears difficult to generalize or conclude that the use of bone as a fuel is specific to the Paleolithic.

In the same manner, we could hypothesize that the use of lignite, occasionally observed in the Paleolithic / Epipalaeolithic (Théry *et al.*, 1995), becomes obsolete in the Mesolithic. This material is not always easy to identify, however, and only two anthracological studies of Mesolithic sites have addressed this question (Théry *et al.*, 1996; Henry, 2011).

For the Mesolithic, there is no information on the possible use of peat or non-ligneous vegetal materials (herbaceous plants, leaves) as fuel. We believe that the development of a methodology adapted to the identification of these elements in archaeological contexts is one of the research priorities in this domain.

Finally, excrements, especially those of ruminants, may have been employed, given their use by many modern pastoralist societies for their specific combustible properties (Johannessen, Hastorf 1990; Zapata Peña, 2003). Starting in the Neolithic, the floors of sheepfolds, regularly cleaned by fire, provide evidence for livestock penning through the identification of fossil "manure" (Brochier, 1983, 1996; Delhon *et al.*, 2008). The ability to identify these materials archaeologically (Gur-Arieh *et al.*, 2014) raises the question of their use as fuel during Mesolithic, but also Neolithic times, not yet demonstrated.

## **b - Firewood**

An archeo-anthracological deposit is a reflection of both the original ligneous vegetation and its use as a fuel. However, though an anthracological study conducted under good conditions provides a coherent image of the locally available ligneous vegetation, without complementary data (palynology, carpology, other paleoenvironmental data), it does not permit a full evaluation of the criteria for selecting ligneous fuel materials. Given the good paleoecological representativeness of charcoal remains, should we consider Mesolithic behaviors as opportunistic (e.g., Piqué, 1999)? In other words, an absence of selection in the procurement of firewood would give only a slightly biased image of the ligneous vegetation in the procurement zone. It would also imply that one of the main factors determining fuel management systems in the Mesolithic would be a limited collection effort (Delhon, Thiébault, 2009). This hypothesis nonetheless remains to be validated, since we know almost nothing about the firewood collection strategies: were they driven by a taxonomic choice or a set of criteria (Théry-Parisot, 1998, 2001, 2002)? Parameters such as the size and/or state of the wood modify not only the behavior of taxa when burned, but also their combustion properties. For example, combustion will always be more rapid with smaller pieces, regardless of the species, since the fireplace is more oxygenated. It can be slowed down if the wood is green or moist, and accelerated if it is decayed (e.g. the “flash” combustion of wood that has lost most of its combustible properties). The calorific value represents the total quantity of heat released per unit weight of fuel (Chabal, *op. cit.*). Being dependent on the chemical composition of the species, it is greater for taxa rich in extracts (resins, tannins) and lignins than for taxa with a higher cellulose or ash content. That being, the differences in the calorific value of different species are relatively small, while they increase considerably depending on the state of the wood (*ibid.*). Green wood, for example, has a very low calorific value. We thus understand how the “species” criterion can become secondary in the collection of firewood, without necessarily adopting a deterministic conception. To summarize, serious inquiry into the burning qualities of the species used and, by extension, the potential functions of fireplaces, is possible only with knowledge of the sizes and/or states of the wood before combustion (Théry-Parisot, 1998, 2001). Finally, the state of the wood (green, dead, rotten) and its size are also related to the strategies for procuring it (felling/ collection, kindling, etc.). It is thus imperative to reach beyond the “classic” anthracological information to identify the state and/or size of the wood used in fireplaces, in order to reconstruct fuel selection strategies.

### **3 - What tools can we use to shed light on the practices of Mesolithic societies?**

Research progress in this domain thus depends on the existence of solid modern reference bases, which are still under development. These latter are based on the acquisition of analogical data that can be compared and ultimately transposed to archaeological materials.

#### **A - Observing modern fuel management systems**

To test the hypothesis that human behaviors played a perceptible role in the nature and the composition of anthracological assemblages, ethnoarchaeology is a pertinent research tool (Ntinou *et al.*, 1999; Ntinou, 2002). It enables us to obtain a global understanding of each fuel management system since all of the interacting parameters are observable or even measurable (Henry *et al.*, 2009). For each recorded context, we can thus evaluate the influence of the human

filter on anthracological deposits *before* the intervention of post-depositional processes, which also bias our perception of past phenomena and must consequently be dissociated from human processes through other types of research (e.g. taphonomic analyses of wood charcoal by Théry-Parisot, 2001; Chrzavzez, 2013; Chrzavzez *et al.*, 2014).

The ethnoarchaeological approach must enable us to replace our research question into a well-known reference context, which the archaeologist, in any case draws upon in his/her interpretations, in the same way that the reproducibility of observations must be evaluated in conjunction with a search for explanatory mechanisms (Gardin, 1979; Gallay, 1980, 1986). This procedure permits us to expose the complexity of behaviors and situations in response to models that are sometimes too simplistic (Asouti, Austin, 2005).

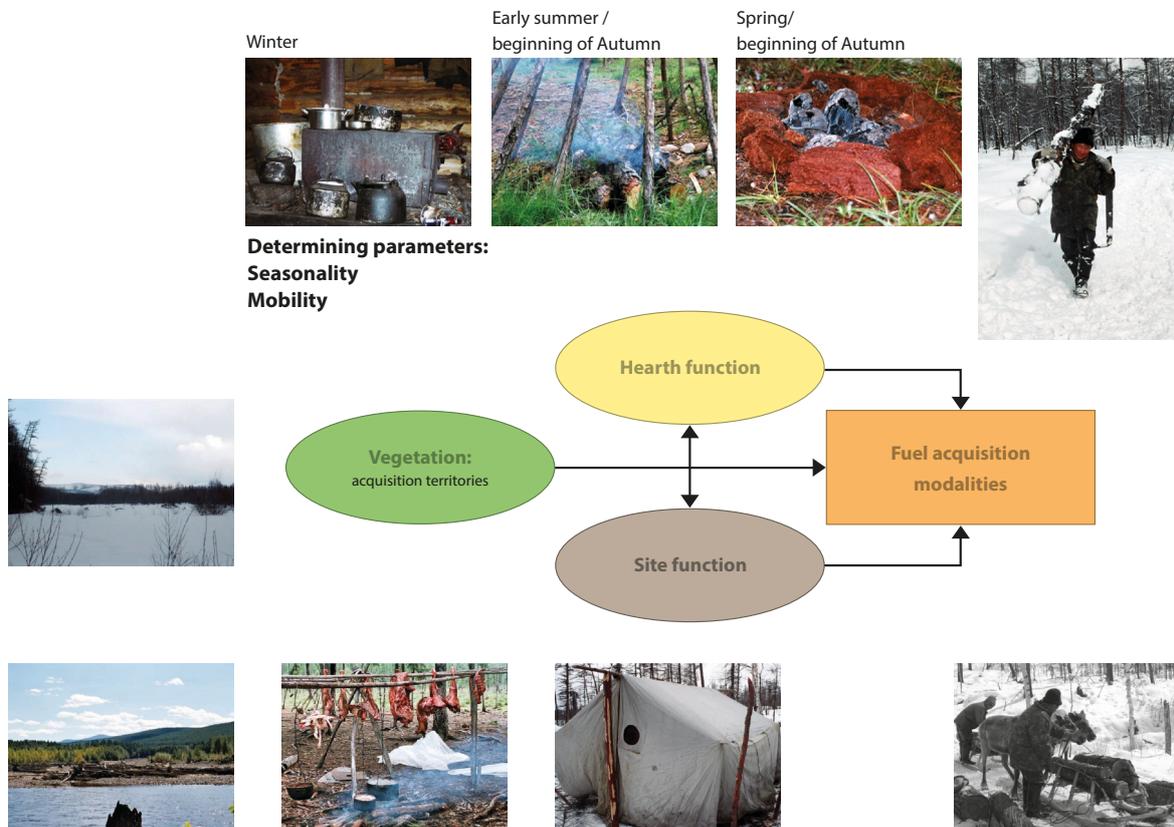
Ethnoarchaeological observations obviously cannot be directly applied to archaeological contexts, but provide us with a basis for reflection through observations of the relationships between human practices and charcoal deposits in well-defined situations. The ultimate goal of such an approach is to feed our archaeological models with elements relating to both the paleoecological representativeness of wood charcoal and criteria for selecting fuel materials.

The ethno-anthracological research literature on fuel management has been greatly enriched over the last decade. It consists mainly of observations of sedentary / sedentarized societies (Johannessen, Hastorf 1990; Ntinou, 2002; Zapata-Peña *et al.*, 2003; Alix, Brewster, 2004; Moutarde, 2006; Dufraisse, 2007; Brandisauskas 2007; Joly *et al.*, 2009; Llorenç Picornell *et al.*, 2011; [figure 3](#)).



**Figure 3** - Locations of the ethno-anthracological references cited in the text.

In the context of mobility and the strong influence of seasonality that is characteristic of Mesolithic societies, it was important to investigate the relationship between societies and the forest and the influence of these lifeways on fuel management strategies. Following this perspective, a first ethno archaeological study was realized in the taiga with the Evenks of the Amur region in eastern Siberia (Henry *et al.*, 2009; figure 4). Working with nomadic Evenk groups living in one of the southernmost boreal forests in the northern hemisphere provided the basis for very relevant reflections on life in a forest environment. While these reindeer herders in the taiga clearly practice an economy that is specialized and focused on animals (Ingold, 1980), it is traditionally much more diversified than that of their homologues in the extreme north of Siberia (*ibid.*). In addition, the biomass (as well as the taxa encountered) is similar to that which was available to the first Mesolithic groups living in European mountain areas and/or northern Europe. Ethnoarchaeological studies have moreover already been realized with Evenk groups in the context of research on the Mesolithic in northern Europe (Grøn, Kuznetsov, 2004).



**Figure 4** - Diagram of the management of firewood by an Evenk group in eastern Siberia (photos: A. Henry, ACI Système Renne).

Our results indicate that the study model for fuel management is well adapted to recording the practices of modern groups in all their complexity (Henry, 2011). Some observations arising from this boreal context can be retained as working archaeological hypotheses:

- i. Specialized fireplaces have a strong cultural significance and their contents are often different from those of non-specialized fireplaces.
- ii. The addition of non-ligneous vegetal materials is not forcibly due to a lack of wood; it corresponds to a specific function of the fireplaces and can be highly diagnostic of seasonality.

- iii. The number and nature of activities linked to fire depend on the season; these activities participate in the definition of the function of the site.
- iv. Fuel selection is an active process which does not forcibly contrast with the good ecological representativeness of the fuel residues; this is notably because:
- v. The selection of the state of the wood (green / seasoned- healthy / degraded) is sufficient to satisfy all hearth functions. It is at least as important as the wood species.

The confirmation, through ethnography, of the importance of a group of features that define an appropriate fuel – size, physiological and phonological state of the wood, species, etc. – must induce archeobotanists to question the nature of the choices made *before* any attempt to interpret a fireplace based only on the wood species.

For this reason, to advance in the characterization of fuels, it is essential to constitute experimental reference datasets.

## **B - Constituting experimental reference bases**

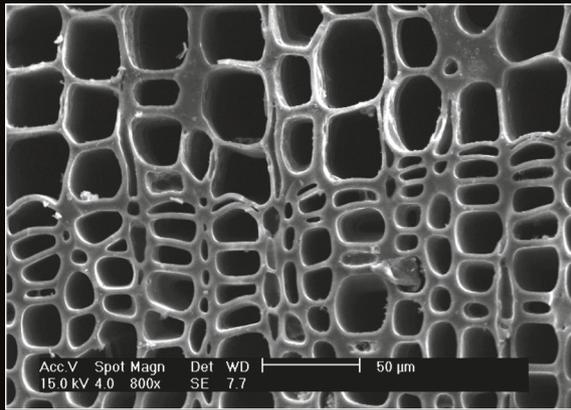
The constitution of reference bases that enable the identification of anatomical markers on wood charcoals, dedicated to the interpretation of practices (fuels used, collection strategies, selection of wood size and / or state) is a long-term process that requires the production of a large number of replicas under laboratory conditions. After this phase of validating the cause and effect relationships between a material in a given form or state and the appearance of specific *post* combustion features, a second important step in experimentation is to transpose these modern observations to archaeological contexts. Below is a brief inventory of a few studies in progress.

### **a - The soundness of the wood**

It is possible to identify the soundness of the wood (i.e., healthy, dead, degraded) by identifying and quantifying the action of microscopic fungal decay features. This action results in alterations to the cellular structure of the wood that are sometimes visible on the anthracological remains (figure 5), serving as markers for the identification of dead or decayed wood (Théry-Parisot, 2001; Moskal-del Hoyo *et al.*, 2010). To interpret archeological charcoal remains in terms of the soundness of the wood used in fireplaces, a tool for the identification of healthy, dead and decayed conifer wood was developed (Henry, 2011). The anthracological study of an Evenk fireplace specialized for hide smoking and fed with decayed wood enabled the identification of a relationship between certain visible modifications of the microstructure of the charcoals and the combustion of degraded wood. A series of experiments with open fireplaces involving the observation of more than 1 500 conifer wood charcoals confirmed this observation and enabled the creation of an index of the sanitary state of the wood *ante* combustion, applicable to archaeological wood charcoals (Henry, Théry-Parisot, 2014). Other groups of taxa remain to be tested.

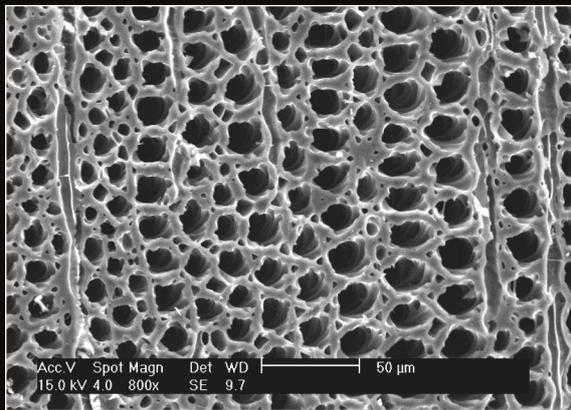
### **b - The moisture content of wood**

Hypotheses concerning the identification of green wood (as opposed to seasoned wood) based on charcoal remains are based in part on the presence of radial cracks and vitrification (Marguerie, Hunot, 2007). The conditions for the appearance of the latter phenomenon are poorly understood. We can nonetheless eliminate the combustion of green wood (Henry, 2011) and high temperatures (Mc Parland *et al.*, 2010; Henry, 2011) as possibilities. Recent studies show that the potentially relevant variables are probably related to the state of decay of the wood used and/or charring in a reductive atmosphere (Henry, 2011).

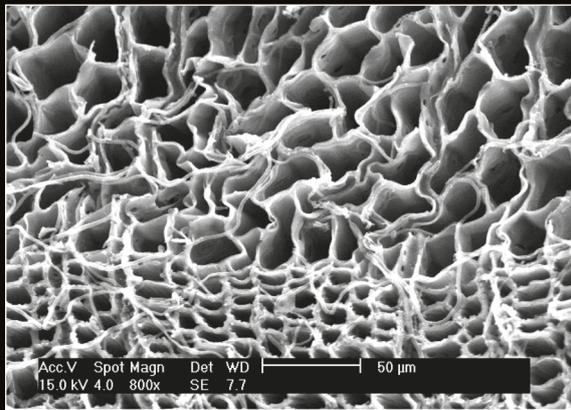


**Transversal section, charcoals of coniferous wood:**

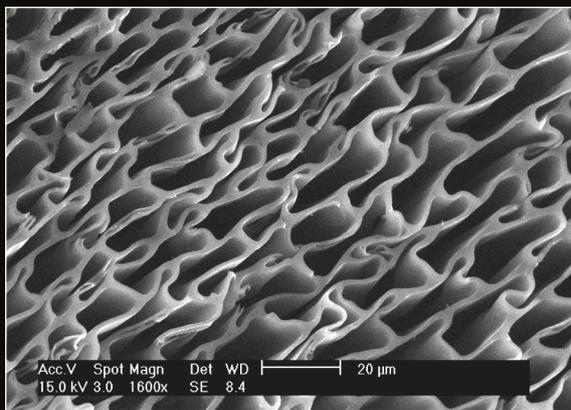
**A** - Showing no fungal degradations



**B** - At an incipient stage of degradation:  
formation of cavities in secondary walls



**C** - Progressive erosion of the cell walls,  
which appear fragile and porous

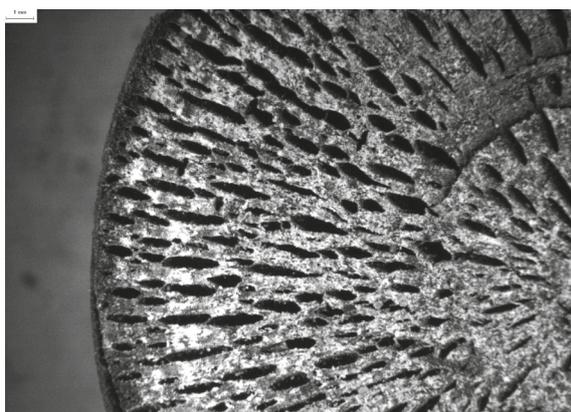


**D** - Degraded and collapsed cell walls

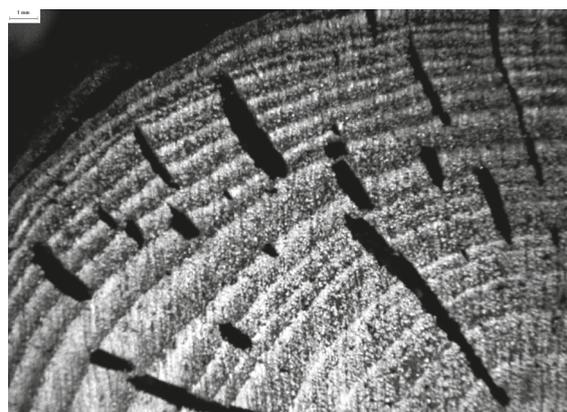
**Figure 5** - Main features of the degradation of conifer wood by decay fungi (photos : M. Repoux, CEMEF, Sophia Antipolis).

The simple presence of radial cracks on wood charcoals does not necessarily indicate the use of green wood in a fireplace (Théry-Parisot, 2001). On the other hand, the combustion of green wood results in an increase in the number of cracks per mm<sup>2</sup>; these cracks are also morphologically shorter and wider than those observed on seasoned wood (Théry-Parisot, Henry, 2012; figure 6). These results have been confirmed by a similar experimental study with species from the Patagonian region in Argentina (Caruso Fermé, 2012). The modalities for transposing these observations to archaeological contexts nonetheless remain to be determined.

#### Transversal sections, experimentally produced charcoals:



**A** - Resulting from the combustion of green wood (*Pinus sylvestris*)



**B** - Resulting from the combustion of seasoned wood (*Pinus sylvestris*)

**Figure 6** - Morphology of radial cracks on experimental samples charred under laboratory conditions – muffle furnace (photos: I. Théry-Parisot).

### c - Wood diameter

The description of wood sizes (diameters) in anthracological remains is a relatively ancient approach (Marguerie, 1992), still recently applied to the Mesolithic site of Pont-Glas (Marcoux, 2009). Measuring methods have since been improved (Chrzavzez, 2006; Paradis-Grenouillet *et al.*, 2010). Research on the potentials and limitations of this analysis tool have also advanced significantly (Chrzavzez *et al.*, 2011; Théry-Parisot *et al.*, 2011; García, Dufraisse, 2012), in the framework of the “Dendrac” ANR project (dir. by A. Dufraisse), for example, whose results will soon be published.

### d - Other fuels

Finally, growing numbers of experimental analyses of other combustible materials, many involving the constitution of reference datasets, enable investigations into the motivations for their use; these materials include lignite (Théry-Parisot, 2001; Henry, 2011) and bone (Théry-Parisot, *ibid.*; Théry-Parisot, Costamagno, 2005; Mentzer, 2009). Physico-chemical and phytolith analyses with the objective of identifying the use of dung and/or manure are also being conducted (Delhon *et al.*, 2008; Braadabart *et al.*, 2012; Shahack-Gross, 2011; Lancelotti, Madella, 2012; Gur-Arieh *et al.*, 2014).

## Conclusion

Anthracology currently provides answers to a certain number of questions, but only a true interdisciplinary approach can enable the development of fuel management models for the Mesolithic that are open to other technical sub-systems, and which thus contribute to our knowledge of the function of these occupations, the main question in current research. The analysis methods and tools discussed here all have their own potentials and limitations. Their complementarity enables a more global consideration of the complexity of fuel management systems and contributes to our understating of human-environment interactions during the Mesolithic.

The increase of archeobotanical studies is an important step in this process, contributing to clarify the environmental context of Mesolithic occupations, with a growing number of data showing that Mesolithic groups were highly adapted and anchored to their local context. To interpret charcoal remains from a perspective broader than that of paleoecology, it is imperative that we continue to develop experimental and ethnoarchaeological reference bases.

Ethnoarchaeology enables us to think generally about the fuel management models applicable to the Mesolithic, and to consider more specifically the variability of techniques and practices and regional or individual particularities, and the manner in which these parameters participate in the definition of lifeways. This approach is closely linked to the experimental approach; it enables us to compare the evidence from modern contexts to samples produced in laboratories in order to constitute solid reference data that are then transposable to archaeological remains. The identification of the palette of fuels and firewood collecting practices through the study of archaeological remains is based on the long-term process of experimentation.

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## THE MESOLITHIC, A GREEN REVOLUTION IN THE HEART OF FORESTED EUROPE?

First Reflections on this Question

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## THE MESOLITHIC, A GREEN REVOLUTION IN THE HEART OF FORESTED EUROPE?

### First Reflections on this Question

Nicolas VALDEYRON

#### Abstract

*As an introduction, this short article raises the question of the role of vegetal resources in the dietary economy of the Mesolithic. For many years, this role was seen as a given even if there was no significant archaeological evidence to support it. Meanwhile, during the last decade, reliable observations have led to new discussions and the recording in Western Europe of intensive nuts (mostly hazelnuts) gathering, along with practices associated with storage and differential consumption.*

#### Keywords

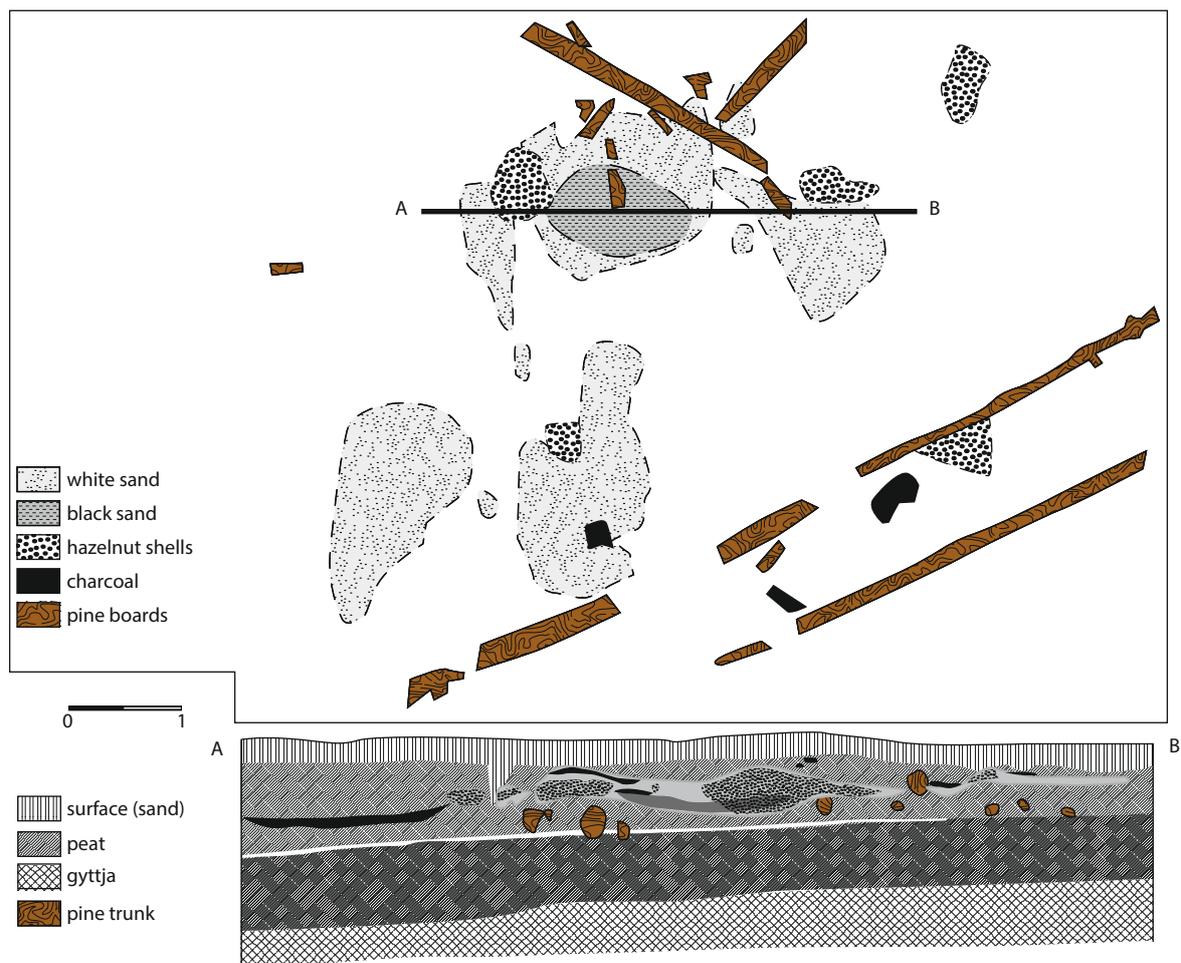
*Mesolithic, diet, vegetal resources, hazelnuts, storage.*

The Mesolithic covers only a short period of European Prehistory, the first five or six thousand years of the Holocene. It is thus wedged between the Late Paleolithic, a much longer period correlated with the arrival in Europe of Anatomically Modern Humans, the supposed creators of the first art forms, and the Neolithic, a slightly shorter period nonetheless tied to, with the beginning of agricultural economies, the irreversible acceleration of the complexification of human societies. Lacking, *a priori*, an attribute bestowing it with such a clear identity, the Mesolithic can by comparison appear dull, with no specific interest or consistency. And yet, the challenges involved in its study, related to the dialectic of a completely new Human-Environment relationship, are at least as important as those underlying the originality and reputation of the two periods between which it is framed: the Mesolithic is the moment during which post-glacial Europe was reconquered by vegetation, with the gradual development of a large, continental primary forest, little by little dominated by oak. Those who occupied and travelled across these territories, likely forgetting even the memory itself of the vast Paleolithic spaces and being unaware of the agricultural revolution to come, invented new ways of life founded on a predation and storage economy in which the intensive gathering and collecting of vegetal resources undoubtedly played an economic, as well as social, role that was both new and emblematic.

This innovative contribution of plants to the Mesolithic diet was considered long ago, and more recently, as a given (Clarke, 1976), or at least a high probability (Barbaza, 1999; Ghesquière, 2012). This position is fully justified by both the environmental context, of course potentially and eminently favorable to its development, and by the ethnographic examples of populations evolving in forested spaces more or less similar to what must have been the great primary forest of Europe. However, until recently, convincing archaeological evidence for food collection and storage was inexistent and the reality of this contribution thus remained (almost) purely speculative because

it was archaeologically (almost) silent. Indeed, though charred edible vegetal remains are common at European Mesolithic sites, including the most southern ones (Antolín *et al.*, 2013), direct evidence of the anthropogenic origin of their presence, preparation, and / or consumption, differential or not, by humans seemed impossible to find. This is no longer entirely true and a few recently published examples highlight the reality of this double practice (i.e. intensive collection and storage) in which it is now tempting to see an element that is specifically and authentically Mesolithic.

One piece of evidence is provided by the site of Staosnaig, located on the Scottish island of Colonsay (Mithen *et al.*, 2001). Occupied at around 6 500 cal BC, it yielded six structures piled with the remains of charred hazelnuts: one large pit, 5 m in diameter, alone yielded 16 kg of shells corresponding to 30 to 40 000 hazelnuts! The authors demonstrated that this pit was the discard zone for the overly grilled contents of an oven, which could have processed between 120 and 330 000 hazelnuts, equaling the accumulated production of several thousands of trees. Another example is provided by the 7 500 hazelnut shells extracted from a sedimentary sample of only 250 liters, at the Irish site of Derragh Island (Bunce, 2011). An analysis of them showed that they were subject to a slight, homogeneous charring similar to that reproduced during torrefaction.



**Figure 1** - Duvensee (Germany), WP6. Close-up of the excavated zone, with grilling hearths, pine boards, charcoal, and hazelnut shell concentrations (CAD: N. Valdeyron, after D. Holst, 2011).

Even more convincing are the “roasting structures” of locations 8 and 6 of Duvensee in northern Germany (Holst, 2010, 2011), at short-term occupation sites specialized in the hazelnut processing and occupied during the early and middle phases of the Mesolithic. Constructed in an artificial sand level forming a sort of screed and itself resting on a layer of pine and birch bark, these complex structures (figure 1), measuring 6 to 0.2 m<sup>2</sup>, were organized in a group and the largest ones were protected by wooden cases. They attest to what must have been a frequent and intensive practice of hazelnut grilling, phenomenal quantities (several tens of thousands) of which were found.

In France, no find of this type has been clearly identified or described for the Mesolithic, except for some pits at the site of Auneau interpreted as shelled fruit storage features (Verjux, 2000, 2004, 2006). The sites of Escabasses (Thémines) and Cuzoul de Gramat in the Lot Department could nonetheless represent the same types of behaviors as those described above, involving the collection and processing of large quantities of hazelnuts (Valdeyron, 2013). At Escabasses, a hearth feature (US 14) dated to the 8<sup>th</sup> millennium cal BC the strongly resembles a “roasting pit” in its morphology (deep, oblong pit with partially rubified walls) and contents (a very large quantity of wood charcoal). As for Cuzoul de Gramat, intact concentrations of several dozens of hazelnut shells contained within an ashy mass were observed (figure 2) in a level attributed to the first half of the 6<sup>th</sup> millennium cal BC: the aim of ongoing research at this site is to explain this unusual configuration by testing the hypothesis of a functional link between the ash accumulations and hazelnut processing for storage.



**Figure 2** - Le Cuzoul de Gramat (Lot, France). Close-up of an ash concentration in the process of excavation in a level from the end of the Mesolithic, containing whole or almost whole hazelnut shells (photo: M. Miesch).

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## THE COMPLEX EVOLUTION OF THE MESOLITHIC IN PICARDIE

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## THE COMPLEX EVOLUTION OF THE MESOLITHIC IN PICARDIE

Thierry DUCROCQ

### Abstract

Numerous absolute dates enable the construction of a detailed chronology of the Mesolithic in Picardie. Here, phases of typological stability are separated by clear breaks. A rapid analysis of diverse elements reveals changes that were more significant than simple modifications of projectile points.

### Keywords

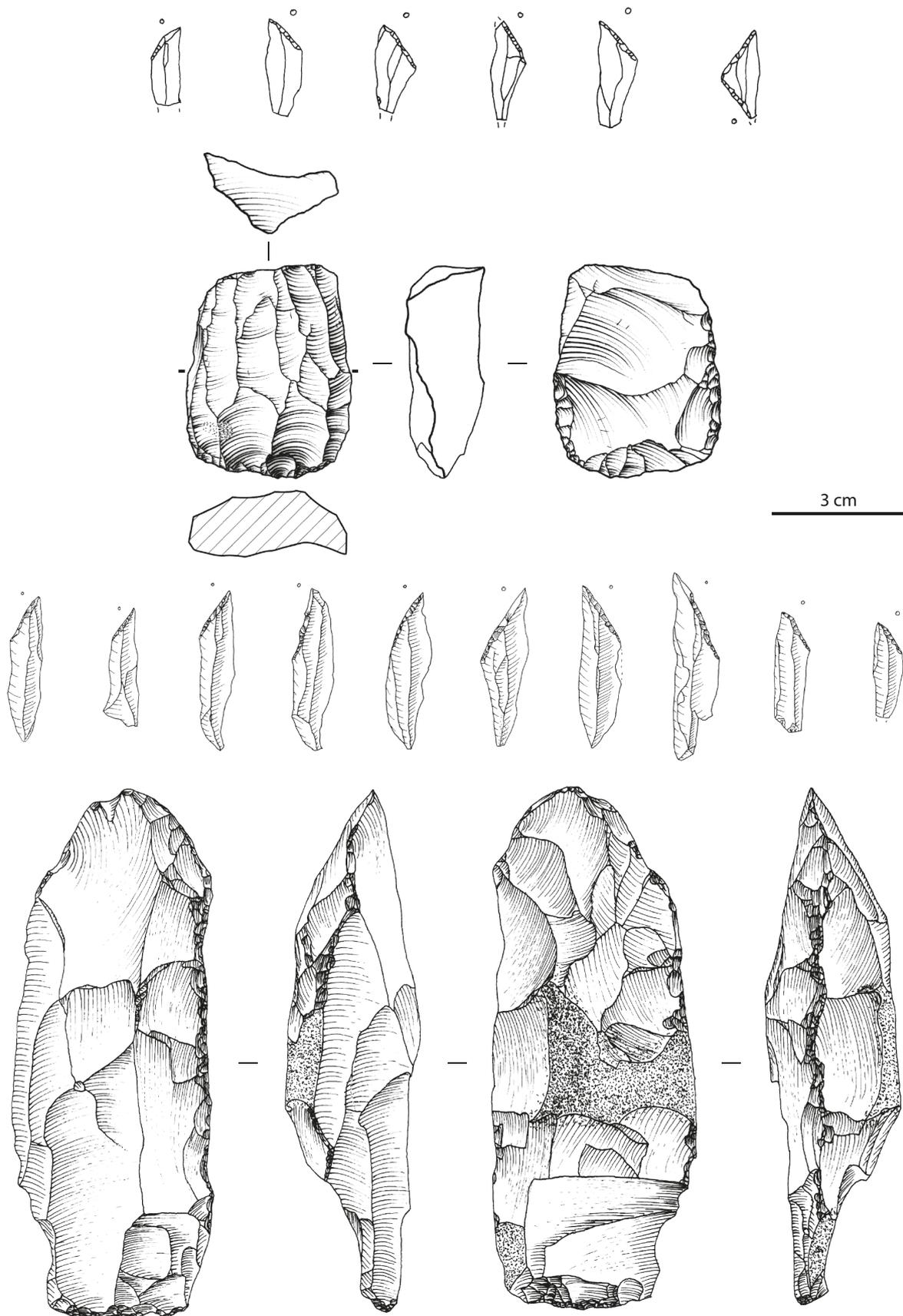
Mesolithic, Picardie, chronology, break, continuity.

The dating of Mesolithic artifacts in the peaty valleys of the Picardie region enabled the construction of a detailed chronology of Mesolithic assemblages. The very beginning of the Mesolithic (or Initial Mesolithic) occurred at around 9 800 BP<sup>1</sup> according to several dated concentrations at Warluis (Coutard *et al.*, 2010; Ducrocq *et al.*, 2008; Ducrocq, 2009). Then, at around 9 400 BP, some sites in Warluis and Hangest-sur-Somme yield microlithic assemblages composed only of points with an unretouched base, which are thus similar to Early Maglemosian assemblages (Brinch Petersen, 2009; Coutard *et al.*, 2010; Ducrocq *et al.*, 2008; Ducrocq, 2001, 2009, submitted). Other assemblages contain typical points with a retouched base that enable their attribution to the Beuronian in the broad sense (Ducrocq, 2009). The phase with segments, between 9 100 and 8 700 BP, is the best represented (Fagnart *et al.*, 2008; Ducrocq, 2013). The following microlithic assemblages, between 8 200 and at least 7 700 BP, are characterized by mistletoe points and backed bladelets. They are generally attributed to the RMS A (Gob, 1985). The Mesolithic with trapezes is represented in Picardie by several microlithic associations that seem to succeed each other: first, small trapezes, then rather large *trapèzes à bases décalées*, and finally, asymmetric trapezes and derived triangular forms with flat inverse retouch. The latter group corresponds to the last regional Mesolithic industry. This is thus the Terminal Mesolithic (Ducrocq, 2001, 2009).

Disregarding palimpsests enables us to observe periods of typological stability over four centuries, separated by breaks. Some of these breaks could correspond to a simple transformation of the technical system due to intrinsic factors, outside influences or responses to climatic and environmental fluctuations (Robinson *et al.*, 2013). Others result from deep societal changes, or even immigration. It is still impossible to answer these questions due to a lack of data for each phase. The aim of this brief note is nonetheless to present an inventory of the differences observed between these different periods of the Mesolithic.

The study of lithic productions enables us to distinguish between blade manufacturing by direct percussion with a soft stone from the manufacturing of regularized pieces by indirect percussion in the most recent assemblages with trapezes and blades with Montbani retouch (Rozoy, 1968,

1. All absolute dates are given in BP non cal.



**Figure 1** - Initial Mesolithic weapon elements and cores from Warluis IIIb (above), Early Maglemosian weapon elements from Warluis V (middle), and axe from Hangest II3 (drawings: T. Ducrocq except for the core, drawn by S. Lancelot).

Coincy and then Montbani styles). During the full debitage phase, rather large pieces were detached, along with some smaller ones that might be qualified as bladelets according to morphometric criteria. There is no evidence yet for two distinct production sequences (*chaînes opératoires*) for the blades and possible bladelets. For the moment, in Picardie, technological analyses are not more precise than weapon element typology for chronological attributions (Paris *et al.*, 2012), except for the Initial Mesolithic (work in progress).

Much less frequent artifacts, such as “axes” are always present in the “Early Maglemosian”, as well as at La Chaussée-Tirancourt at the end of the local Beuronian and in the RMS A. They are absent in the Beuronian with segments, in which we find a few grooved sandstone pieces, and probably some prismatic tools of the Montmorencien type (Ducrocq *et al.*, 2014).

The bone and antler tools include points and bevels, though perforated antler sheaths are found only in the later phases, represented by an object in the upper level at La Chaussée-Tirancourt (contact peat / silt, between 7 500 et 6 900 BP, Ducrocq, 2001: 193), and isolated pieces with dotted decorations (Fagnart, 1991).

Other than a few red deer teeth, the personal ornaments consist mostly of perforated Tertiary fossil shells (*Ampullina* in the Beuronian with segments at Warluis II and especially *Bayana* in the Late Beuronian at La Chaussée-Tirancourt). These objects are similar to those attributed to the Ahrensbourgian at Remouchamps (Lejeune, 1984), but they are still absent from the Initial Mesolithic and the “Early Maglemosian”. During the RMS A, a change appears to have occurred with the use of perforated Holocene cardiums (Pit 2 at La Chaussée-Tirancourt).

Charred hazelnut shells are present in highly variable proportions in most of the sites. Their absence from the oldest sites can be linked to their chronological position before the rise of *Corylus* within the deciduous woodland.

The animal species most consumed are wild boar, red deer, roe deer and aurochs (Bridault, 1997). We observe a specificity with the Beuronians with segments whose predation was focused on wild boar (Ducrocq, 2013).

There is no clear evidence for fishing before the end of the Beuronian and during the RMS A, as shown by pike remains at La Chaussée-Tirancourt (Ducrocq, 2001).

The Mesolithic sites of all periods are located in the same places, either on the alluvial plains, on the edges of plateaus, or on sandy mounds (Ducrocq, 2001).

The filling of valley bottoms by peat gradually reduced the dry surfaces near streams and rivers, which were the preferred living spaces. The number of sites in the valleys thus decreased depending on their age. There was generally a much greater density of the most recent sites due to multiple diachronic returns to the same, much more restricted, locations. The high density and rather diverse toolkits of RMS A and Mesolithic with trapeze sites could therefore be the result of taphonomic factors. On the other hand, the abundance of endscrapers and burins in the Initial Mesolithic and “Early Maglemosian” contrasts greatly with the Beuronian with segments, in which the tools consist mostly of unretouched blanks. These latter sites are the most numerous (slightly less than 50% of the sites), but their abundance in the peaty valleys, such as Le Thérain (Coutard *et al.*, 2010) or La Selle (Fagnart *et al.*, 2008), could be due to sedimentation processes that favored the development and preservation of shallow levels. However, the greater representation of this phase is not limited to the peaty zones. It also exists in the Oise Valley (Paris *et al.*, 2012), and on the sandy mounds and plateau edges (Ducrocq, 2001). This is probably due to an increased mobility and a resulting multiplication of campsites. In Flandre, the abundance of sites contemporary with this period is interpreted as the result of a high mobility that contrasts with that of the later Mesolithic populations (Crombé *et al.*, 2011).



**Figure 2** - Weapon elements and perforated shells from the Beuronian with segments at Warluis II (above), and the RMS A at Hangest-sur-Somme III (mistletoe points) and pit 2 at La Chaussée-Tirancourt (Cardiums) (below) (photos: S. Lancelot).

Finally, the zones of distribution of the “Early Maglemosian”, the Beuronian and the RMS A are very different (Ducrocq, submitted). This could be linked to major the paleo-geographic modifications associated with the transgression (Sturt *et al.*, 2013), which could explain the movements of populations, the modifications of resources and / or the establishment of new exchange networks.

This brief inventory shows that the phasing that is gradually becoming apparent is based not only on typological data, but on a set of factors indicating a complex evolution of the Mesolithic in northern France.

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# REFLECTIONS ON THE MOBILITY PATTERNS OF MESOLITHIC POPULATIONS IN SOUTH-WESTERN FRANCE: the Example of the Brive and Quercy Regions

Magali REVERSAT

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## REFLECTIONS ON THE MOBILITY PATTERNS OF MESOLITHIC POPULATIONS IN SOUTH-WESTERN FRANCE: the Example of the Brive and Quercy Regions

Magali REVERSAT

### Abstract

*How was the mobility of Mesolithic groups organized in the Quercy and Brive Basins? Were open-air sites and caves and rock shelter sites complementary? What is the contribution of these different site types to questions concerning mobility patterns? Though it is probably not feasible to apply a single model to these Mesolithic hunter-gatherer societies, it is possible to address some questions through analysis of the material evidence, such as lithic industries, faunal remains, and even vegetal remains. In theory, the variable proportions of these elements reflect specialized site functions, seasonality strategies and the economic organization of these societies and their territories. However, is the variation of these elements linked to socio-cultural and environmental factors, or the function of a specific site-type (open-air, cave or rock shelter)? In the regions considered here, it is difficult to distinguish between these factors due to the variable nature of the bibliographic sources related to the sites, the taphonomic condition of the assemblages, and the great number of open-air sites known only through survey operations. This study has nonetheless enabled us to inventory the available documentation, as well as revealing differences and similarities in the economic strategies of these populations.*

### Keywords

*Sauveterrian, South-western France, mobility, resources, chronology.*

## Introduction

The organization of Mesolithic populations is represented by different site-types, which vary according to several factors: the type of mobility, the activities practiced in place, the resources sought, the role of the site in the cycle of resource procurement and, depending on the period, the duration and recurrence of occupations (Fontana, 2011). These different site-types are created by the diverse activities performed at them (table 1), which are determined by the “technical traditions” of each group, usually in relationship to their economic strategies.

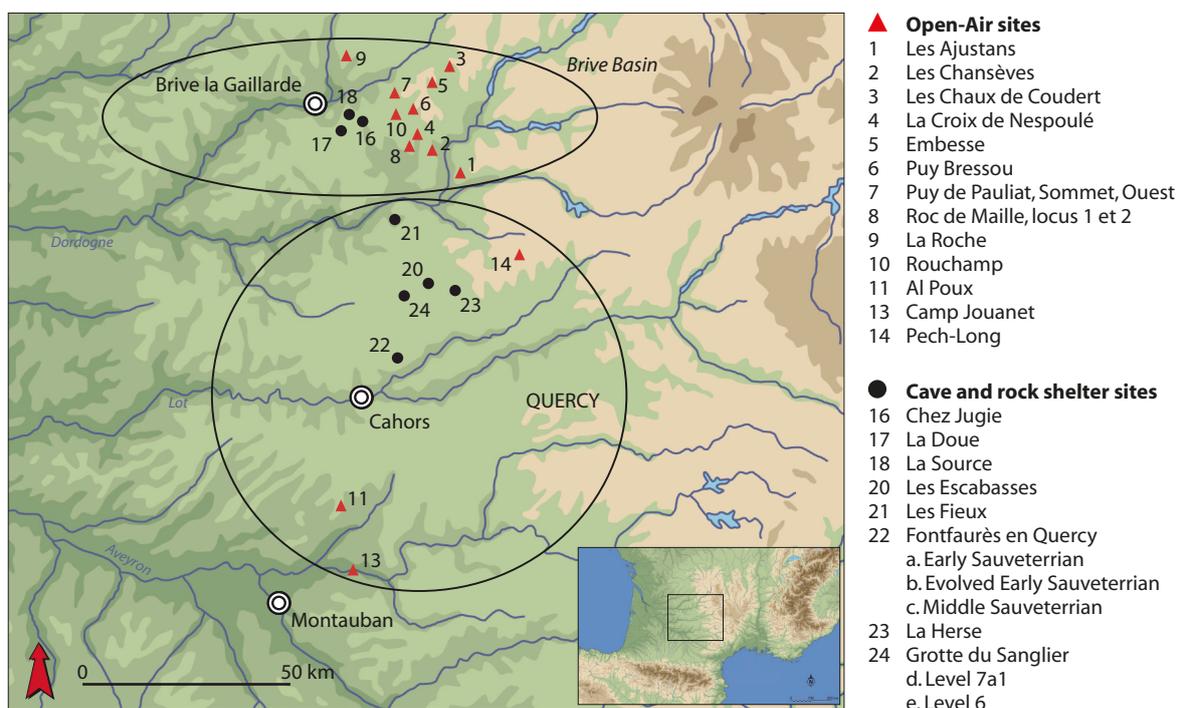
They can also be linked to other factors, such as the types of animals processed, the climatic conditions and the use of the goods obtained, in relation to the occupation duration and site functions (Beyries, 1997). The sites therefore contain different artifact types in variable proportions, even if they were occupied by the same groups. Mobility is an essential element of the socio-economic system of each group, and the main difficulty is to reconstruct these human behaviors based on very fragmentary evidence (Bonnemaison, 1981).

	Activities linked to animal resources	Halieutic activities	Activities linked to raw material use
Activity types	Scraping and cutting of dry hide	Resource exploitation	Raw material extraction
	Butchery (cutting of meat, carcass, fresh meat material, fresh hide, and scraping and sawing of fresh bone)		Flaking workshop
	Osseous material working (dry bone and antler)		
Site types	"Field camps" Temporary operational center, occupied by specialized groups		"Locations" Procurement or transformation of the raw material. Short duration, often containing a small number of tools
	"Stations" Location used by specialized groups to observe the territory and collect information on animal movements. This site type is rarely occupied at night and can include hunting camps.		
Mobility types	Logistical mobility of "Collectors" ("Stations" "Field camps")		Residential mobility of "Foragers"
			Logistical mobility of "Collectors"

**Table 1** - Site types and activities that could be generated by the different mobility types (after Reversat, 2012).

To accurately define these mobility patterns, it is necessary to determine the nature of artifact associations, which can be understood only from economic factors, themselves understood through analysis of the artifacts found at sites: stone (analyzed from three different perspectives: raw material procurement, typo-technology and usewear of lithic industries) as well as animal and plant resources.

This study, conducted as part of a Master 2 program at the University Toulouse 2 (Reversat, 2012), is based on the bibliographic information available for the Mesolithic in the Quercy and Brive Basin regions (figure 1). The great variety of exploitable biotopes in these contiguous regions are linked to the diverse activities practiced there. This context is thus well adapted to an investigation of the nature of Mesolithic mobility strategies within this space. It also raises the question of whether these two territories were unified to a certain degree during the Mesolithic. Are there functional differences and/or similarities between the sites in these two regions that could suggest they were complimentary?



**Figure 1** - Site locations (after Reversat, 2012).

## 1 - Data

Among the 24 sites in this study (annex 1), attributed to the Sauveterrian culture, 13 are located in the Brive region and 11 in the Quercy region. The average altitude of the 15 open-air sites is 472 m, and that of the 9 cave and rock shelter sites is 312 m. The majority of these sites (14) were identified through surface surveys or test pits, and the remaining ones (10) were excavated.

According to Pierre-Yves Demars (Demars, 2007), there was an increase in occupation of the Correze plateau during the Mesolithic. Most of the sites are located on a high point: a summit (Puy de Pauliat Sommet), a plateau (Puy de Pauliat Ouest), a crest (La Croix de Nespoulé, Roc de Maille), or on a cliff edge overlooking a gorge (La Roche d'Allasac, Les Ajustans), and generally open onto a vast panorama. This exposure to weather conditions indicates that the sites were occupied during the more favorable seasons (Demars, 2007). The cave and rock shelter sites (3) are located in the Brive Basin. The sites of Chez Jugie and La Source are very near each other and located in a small, 30 m high, sandstone cliff face next to the small stream of Enval. The nearby site of La Doue is located in a stone cirque (Demars, 2011).

In the Quercy region, the cave and rock shelter sites (6) are more numerous than in the Brive region, while the open-air sites (5) are less numerous. Only two open-air sites, Al Poux and Camp Jouanet, are located in the Bas-Quercy (Lower Quercy region). The other sites are located in the Haut-Quercy (High Quercy region), all within a low altitude limestone environment, between 200 m and 400 m (Barbaza *et al.*, 1991), except for the site of Pech Long at 618 m altitude. None of the sites show a clear topographic preference that would have influenced the choice of their location.

## A - Chronology

For this study, it is necessary to establish a chronology in order to determine whether the observations and comparisons made are valid (Gallay, 1986). Among the 24 sites considered, seven have available radiocarbon dates (figure 2). These are Chez Jugie and La Doue for the Brive Basin and Fontfaurès-en-Quercy, Les Escabasses, Les Fieux, La Grotte du Sanglier and Le Cuzoul de Gramat for the Quercy region. Together these sites compose a set of 27 dates clearly divided between the Early Sauveterrian and the Middle Sauveterrian. There is a clear hiatus between 7 600 and 6 400 cal BC. This period does not appear to correspond to climatic variations or calibration

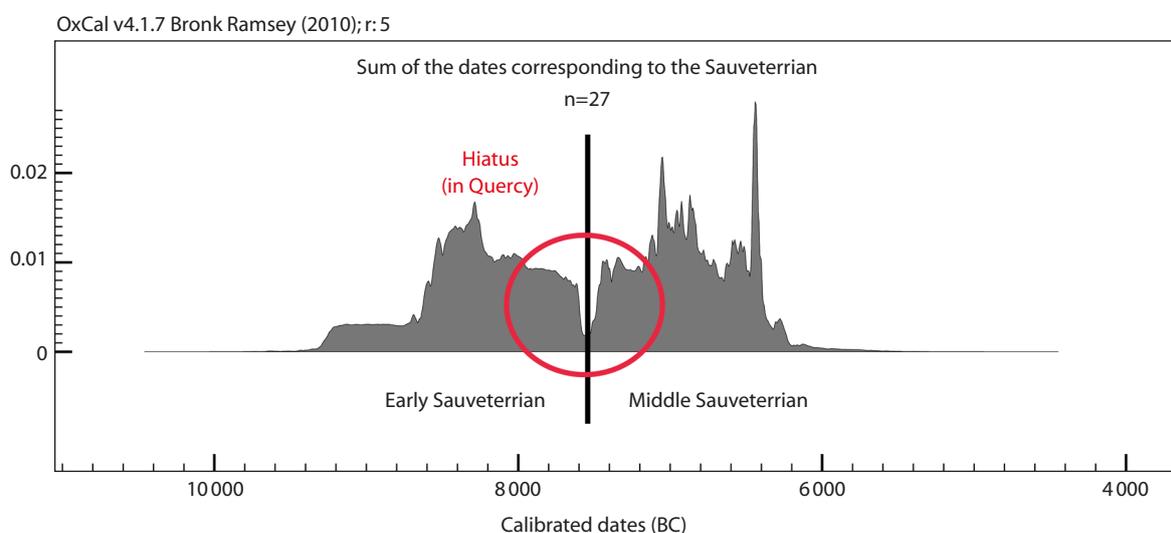


Figure 2 - Radiocarbon dates (for Quercy only, after Reversat, 2012).

curve variations. While the hypothesis of a regional phenomenon cannot be eliminated, this hiatus could also be linked to a lack of data for this period. Though it is not possible to demonstrate a strict contemporaneity between these sites, which would enable the identification of possible complementary relationships between them, they do show some chronological unity.

## **B - Study limitations**

Despite the large number of sites considered in this study, this corpus has certain limitations that are detrimental to determining the nature of a site: insufficient data (functional analyses, lithic industry analyses, radiocarbon dates), partial or unpublished data, taphonomic problems (palimpsests, surface collections), poor representativity of some elements (e.g. deficit of weapon elements at surface collection sites). Some types of artifacts also vary from one site to another, such as faunal remains and organic remains, which are scarce or absent in the Brive region due to the acidity of the sediments (sandstone environment), resulting in a significant loss of data. All of these problems, limitations and missing elements are a great disadvantage in the study of these sites. Nonetheless, it is possible to extract several interesting features from the studies made of some sites.

## **C - Vegetal resources**

Vegetal resources were studied only at the site of Al Poux in the Quercy region, where a total of 17 carpo-remains were recovered. The study by Laurent Bouby (Bouby, 2002) evidenced only three species and showed a dominance of hazelnut shells, with Galium and common dogwood (*Cornus sanguinea*). Based on these results, showing that hazelnuts were probably intentionally brought to the site, the hypothesis of a collection in autumn and preservation for winter was proposed, while the presence of the two other species appears to be accidental. The hazelnut species is advantageous due to its nutritional value, ease of collection and good preservation. In general, these three species bear fruit in autumn and most often colonize relatively clear forests and forest edges.

## **D - Animal resources**

The available data on animal resources originates from only a few occupation sites in the Quercy region. The site of La Herse was studied by H el ene Martin (Martin, 1991), who proposed that bone materials were processed and used there, represented by three fragments with saw marks, striations and shaping marks. The site of Fontfaur es-en-Quercy, also studied by H el ene Martin (Martin, 1991), is interpreted as a kill zone with an exportation of the meatiest pieces. In addition, a study of fish vertebrae (Lignon, 1991) indicates that the site was occupied during the warm season. The study of the site of Escabasses, realized by Julie Riv ere (Riv ere, 2006), shows that it was occupied in the context of red deer hunting during the bellowing season, with a complementary collection of antlers from spring to fall. At La Grotte du Sanglier, Jean Dufau (Dufau, 2001) used cementochronology to show that the site was occupied from May to November. He considered hunting during the Mesolithic to be opportunistic due to the abundance of red deer, which he described as dependent on the forest. H el ene Martin and Olivier Le Gall (Martin, Le Gall, 1987, 1989) interpreted the site of La Doue as a specialized occupation devoted to the processing of hunted carcasses to be exported to another relatively close site where they would be preserved for winter. Finally, Al Poux, studied by Isabelle Carr ere (Carr ere, 2002) could not be interpreted due to its relatively small (21 pieces), and therefore possibly non-representative, assemblage.

The faunal assemblages of cave and rock shelter sites are generally dominated by red deer, while the only open-air site studied (Al Poux) yielded an assemblage dominated by bovinds, including aurochs. The latter are very heavy animals that provide a large quantity of meat. The large surface area of this site (Amiel, Lelouvier *et al.*, 2002), and the large quantity of meat present there, indicate that it was occupied by a large group. Questions concerning the environmental context and the distribution of animal resources must be considered. Nonetheless, since these resources were available in all environments, they appear to show a clear selection in their consumption. According to their authors, these studies revealed seasonal occupations, most often via cementochronological and carpological analyses. We must nonetheless remember that these types of analyses indicate only the time of the animal kill, and not the time of consumption. Only an exact identification of the bones present at these sites could give a precise indication of the seasonality and the nature of the occupation.

### E - Usewear analysis

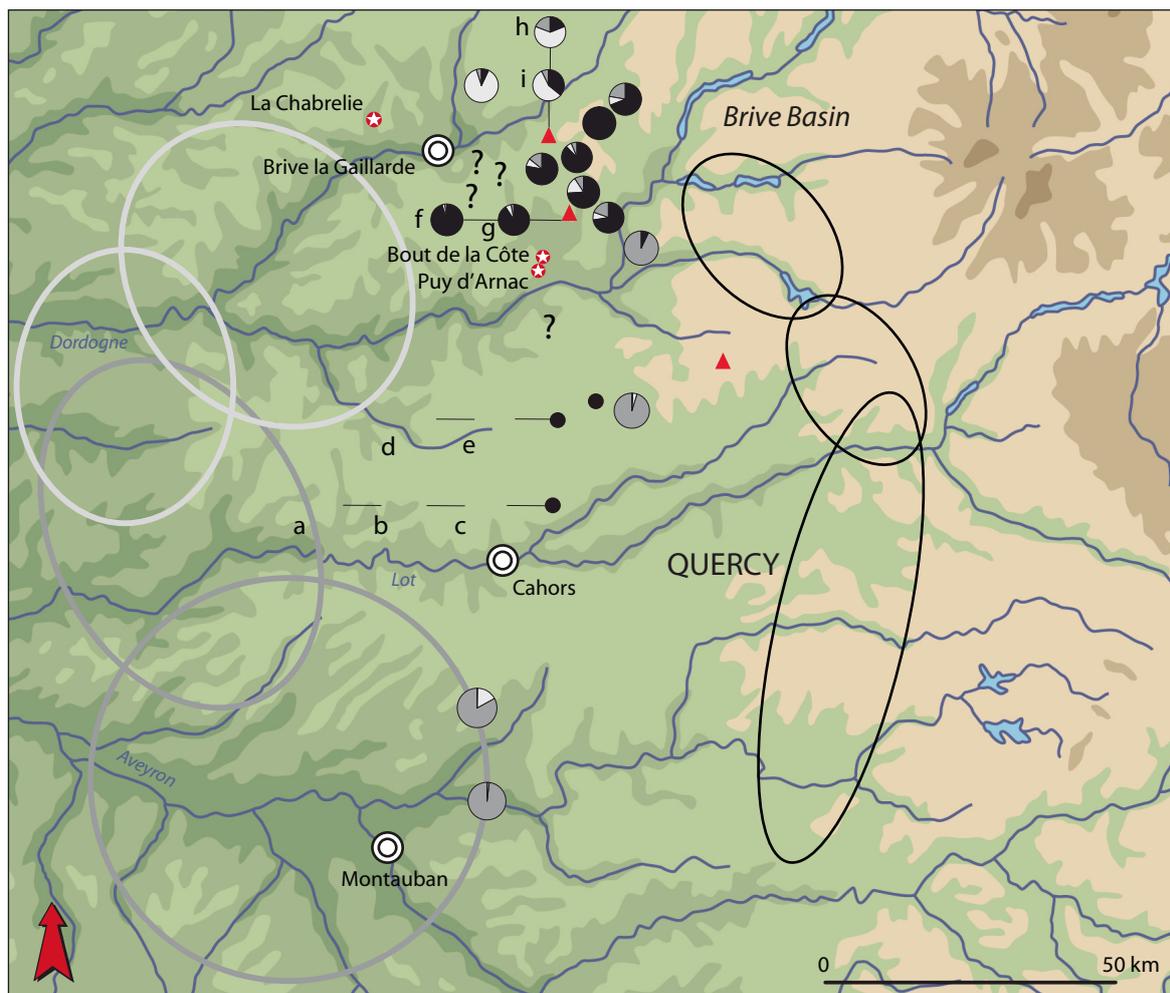
Among all the sites considered, a usewear analysis was realized for only one. This study was conducted by Sylvie Philibert on the site of Fontfaurès-en-Quercy (Philibert, 2002). It concerns three archaeological horizons: the early phase of the Early Sauveterrian, the evolved phase of the Early Sauveterrian and the Early Montclusian. Despite the small number of pieces with usewear (10% of the tool assemblage), often poorly preserved due to modifications by fire and patina, the analysis revealed that butchery activities were realized in this rock shelter during the warm season, and that it could therefore be considered as a hunting camp. This site would thus be part of a larger network of sites occupied during the movements of a small group of hunters that could come from the Haut-Agenais, the Perigord or the Massif Central, based on some flint types whose sources are in these regions. Nonetheless, there is no proof of this distant origin since the hunters could have acquired these flints at least partially through exchange.

### F - Stone resources

Three main raw materials, common in the Quercy and Brive regions, were considered in this study (figure 3). These are Tertiary flint, dominant in Quercy, Jasperoid flints, dominant in Brive, and Senonian flint (table 2).

Raw materials		Quercy	Brive Basin	Total
Jasperoid flint	Cave or rock shelter	2.00	-	<b>2.00</b>
	Open-Air	0,50	61	<b>30.75</b>
<b>Total</b>		<b>1.25</b>	<b>61</b>	
Senonian flint	Cave or rock shelter	14.00	-	<b>14.00</b>
	Open-Air	7.00	22	<b>14.50</b>
<b>Total</b>		<b>10.50</b>	<b>22</b>	
Tertiary flint	Cave or rock shelter	57.00	-	<b>57.00</b>
	Open-Air	76.00	16	<b>46.00</b>
<b>Total</b>		<b>66.50</b>	<b>16</b>	

**Table 2** - Percentage of the most prominent raw materials for each site type and region (provisional percentages).



**Figure 3** - Raw material locations (the most present and their proportions) and their primary sources (after Reversat, 2012).

The choice to consider only these three raw materials was made with the aim of having a sample with one material that is present in both regions, one that is local in each one of them, and one that can be considered as non-local. The latter could more or less determine a flexible limit of the territory. Senonian flint is available at a distance of around 30 km from both the Brive and Quercy regions (except at the sites of Camp Jouanet and Al Poux). Long distance flints (more than 100 km), such as Fumelois or Bergeracois, are absent in both regions.

The Jasperoid flint of the Infralias (beginning of the Lower Jurassic) is found south of the Corrèze at the Bout de la Côte, Puy d'Arnac and Chabrelie sources. It has also been relatively well localized all around the northern edge of the Massif Central (Demars, 1995), around Figeac, and up to Capdenac (Turq, 2000). The Tertiary lacustrine flint (Cenozoic) is abundant in the south, in the Lot-et-Garonne department (Demars, 1995). The primary sources are located on the periphery of the limestone plateaus (Cantal Basin and Aveyron to the east, the Lower Quercy to the south, and the silicifications in Périgord to the west) and contribute pebbles to the alluvial deposits and terraces of the Lot, the Célé and the Dordogne rivers, thus constituting secondary sources.

In the Brive region, Senonian flint is present in small quantities at sites other than La Roche d'Allasac, at Puy de Pauliat. Concerning the latter site, Pierre-Yves Demars (Demars, 2000) believes that this phenomenon is due to its earlier chronological attribution and believes that Jasperoid flint became "widely dominant" (Demars, 2007: 51) starting in the Middle Sauveterrian, replacing Senonian flint. For the site of La Roche d'Allasac, Demars identifies a "different province" (Demars, 2007: 51) for the procurement of raw materials. At some sites, it seems that the quality of the flint played an important role in tool manufacturing. The site of Chez Jugie, for which only one petrographic analysis of the tools has been realized (Chelotti, 2010), has a majority of Senonian flint, though it is closer to the Bout de la Côte and Puy d'Arnac sources. Other factors, such as flaking quality, determined the selection of the raw materials used to manufacture weapon elements. Two hypotheses can thus be proposed: one, this phenomenon is a result of exchanges and / or displacements; two, it is a result of a selection of good quality flints.

In the Quercy region, the range of materials used at Fontfaurès-en-Quercy, Les Escabasses and Les Fieux remains nearly the same in several occupation levels, spanning the Sauveterrian sequence. This suggests continuity in the occupation of a territory and knowledge of the resources of this geographic zone by the Mesolithic populations, as well as a transmission of this knowledge through time (Briand, 2005).

The study of the raw materials therefore reveals two aspects: a raw material economy with an intentional selection of flints from nearby sources, and the selection of different raw materials in the two regions.

## G - Lithic industry

Because the total number of pieces in the lithic industries of each site is not indicated, the percentages (table 3) were calculated based on the number of tools (domestic tools and weapon elements), cores, microburins, and non-retouched pieces (flakes, bladelets and blades).

Among the non-retouched pieces, flakes are dominant in both regions, except at Chez Jugie. Bladelets are present at cave and rock shelter sites, except at Camp Jouanet (Chalard *et al.*, 2002), and blades are generally scarce relative to the other artifact types, and even absent at Puy Bressou, Rouchamp, and in the Middle Sauveterrian level (C6) at the Grotte du Sanglier (Séronie-Vivien [dir.], 2001). Two hypotheses could explain the high proportion of flakes in both regions. First, since weapon elements are most often made from bladelets, this blank type is more frequently employed than others and they are therefore less numerous at the sites. This first hypothesis is supported by the site of Camp Jouanet where, if we take into account the retouched pieces, the percentage of flakes in the total assemblage increases from 54% to 55%, and that of bladelets from 26% to 32%. The spread between the two percentages is thus reduced, showing the high percentage of tools made on bladelets. According to the second hypothesis, flakes would have been the desired blanks and were used as expedient tools, minimizing the costs of obtaining, transporting and maintaining them. The hypothesis could be supported at Pech Long (Reversat, 2011), where it appears that

Sites	Level	Raw blanks			Cores	Domestic tools	Weapon elements	Microburins
		Flakes	Bladelets	Blades				
Puy Bressou		90.5	3	-	6.0	-	0.2	0,7
Roc de Maille locus 2		88	2	0.4	9.0	-	0,4	0.6
Rouchamp		86	3	-	7.0	3.0	-	1.0
Pech Long		74	8	0.3	14.0	3.0	0.3	0.2
Al Poux		80	7	4.0	2.0	3.0	2.0	0.1
Camp Jouanet		55	26	4.0	3.0	2.5	7.0	1.0
Chez Jugie	Disturbed	20	24	12.0	6.0	13.0	17.0	8.5
La Source		58	28	0.3	1.2	5.0	4.5	3.0
Fontfaurès-en-Quercy	C6	70	13	1.0	1.0	7.5	4.0	3.0
	C5 d, c, b	80	11	0.5	0.3	2.0	5.5	0.02
	C5 a / C4 b	79	14	0.2	0.5	2.0	4.5	-
Les Escabasses		71	14	1.6	0.2	1.6	12.0	0.1
La Grotte de Sanglier	C 7 a 1	51	10	0.2	4.0	13.0	21.5	0.5
	C 6	53	11	-	8.0	14.0	14.0	-

Table 3 - Percentages of raw products, tools, cores and microburins for each site type and region (provisional percentages).

flaking was clearly oriented toward flake manufacturing, based on their abundance in the assemblage (51% flakes, 6% bladelets), the number of tools on flakes (17 on flakes, 12 on bladelets), and the percentage of flake cores (79% flake cores, 10% bladelet cores).

The percentage of cores found at the sites can reflect the blank types produced in place if it is high, or a segmentation of the *chaîne opératoire* (production sequence), if it is low, as is also true for an absence of cortical flakes (Dachy, 2010). The proportion of cores at the cave and rock shelter sites is usually lower (3%) than that at the open-air sites (7%). At many sites, the cores still have some cortex (non-quantified information), suggesting a superficial preparation at sites such as Camp Jouanet (Amiel, 2002), Pech Long (Reversat, 2011), Les Ajustans, Les Chaux de Coudert and La Roche d'Allasac (Demars, 2011).

Two open-air sites were interpreted as flaking workshops (annex 2). These are Rouchamp (Demars, 2007) and Camp Jouanet (Valdeyron, 2002), where all phases of one or several *chaînes opératoires* are represented. Pech Long also appears to have all the features of a flaking workshop. On the contrary, this is not true for the cave and rock shelter sites, which have fragmentary *chaînes opératoires* and low core proportions, even if the latter were exported. The sites of Les Fieux (Marcus, 2000: imprecise, non-quantified information), Les Escabasses (Guilbault, 2009: 14%) and Al Poux (Chalard *et al.*, 2002: 11 %) have a low percentage of cortical pieces, indicating that the first flaking phase could have been realized elsewhere. Similarly, at Les Fieux, there are no cores in Senonian or Jasperoid flint, showing that these pieces were imported or acquired through exchange (Briand, 2004). Finally, at Camp Jouanet, cortical flakes represent 40% of all the flakes, and 21% of the whole assemblage, compared to cores at 3%. This abundance could correspond to the quantity of blocks (70) found at the site (Amiel, 2002), or to an importation of cores that could still be used, considering the number of non-exhausted cores.

In terms of typology, weapon elements are rare at all of the open-air sites except two, Puy de Pauliat Ouest (Demars, 2007) and Camp Jouanet (Amiel, Lelouvier *et al.*, 2002). At the cave and rock shelter sites of Les Escabasses, Fontfaurès-en-Quercy (evolved Early Sauveterrian level: C 5 d, c, b; and Middle Sauveterrian level C 5 et C 4 b), and La Grotte du Sanglier (C 7 a 1) the percentage of weapon elements is high relative to the low percentage of microburins. This argues in favor of a total or nearly total importation of weapon elements to these sites. In reality, only the sites of Chez Jugie, La Source and Fontfaurès-en-Quercy (Early Sauveterrian level (C 6), have a similar percentage of weapon elements and microburins. Finally, at Fontfaurès-en-Quercy, classic domestic tools, such as endscrapers, perforators and burins, are present, but in small quantities. This deficit does not exist in the Early Sauveterrian (Barbaza *et al.*, 1991). Ochred endscrapers were found at La Herse and at Fontfaurès-en-Quercy (Philibert, 2002). Ochre is often associated with dry or tanned hide working due to its qualities as a fine abrasive (Philibert, 1995).

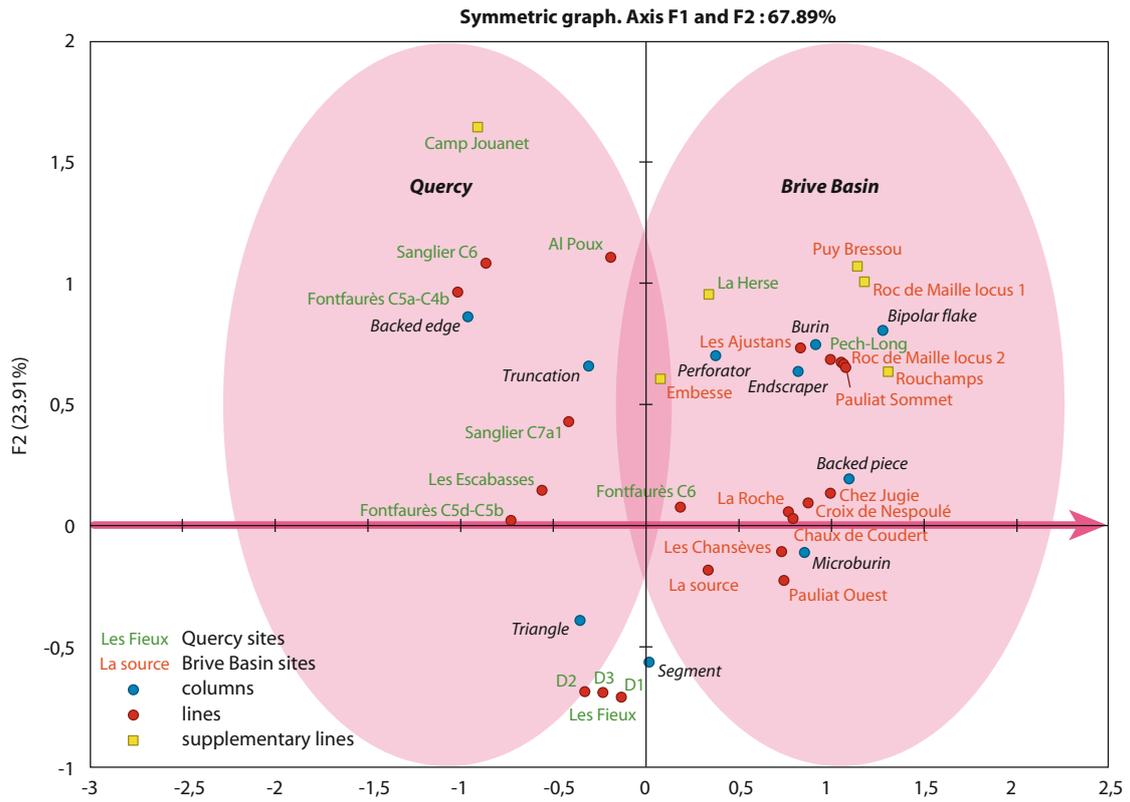
In general, the open-air sites have higher proportions of flakes and cores and very few weapon elements, while the cave and rock shelter sites have high proportions of flakes, bladelets and weapon elements, and very few cores and microburins.

## 2 - Interpretation

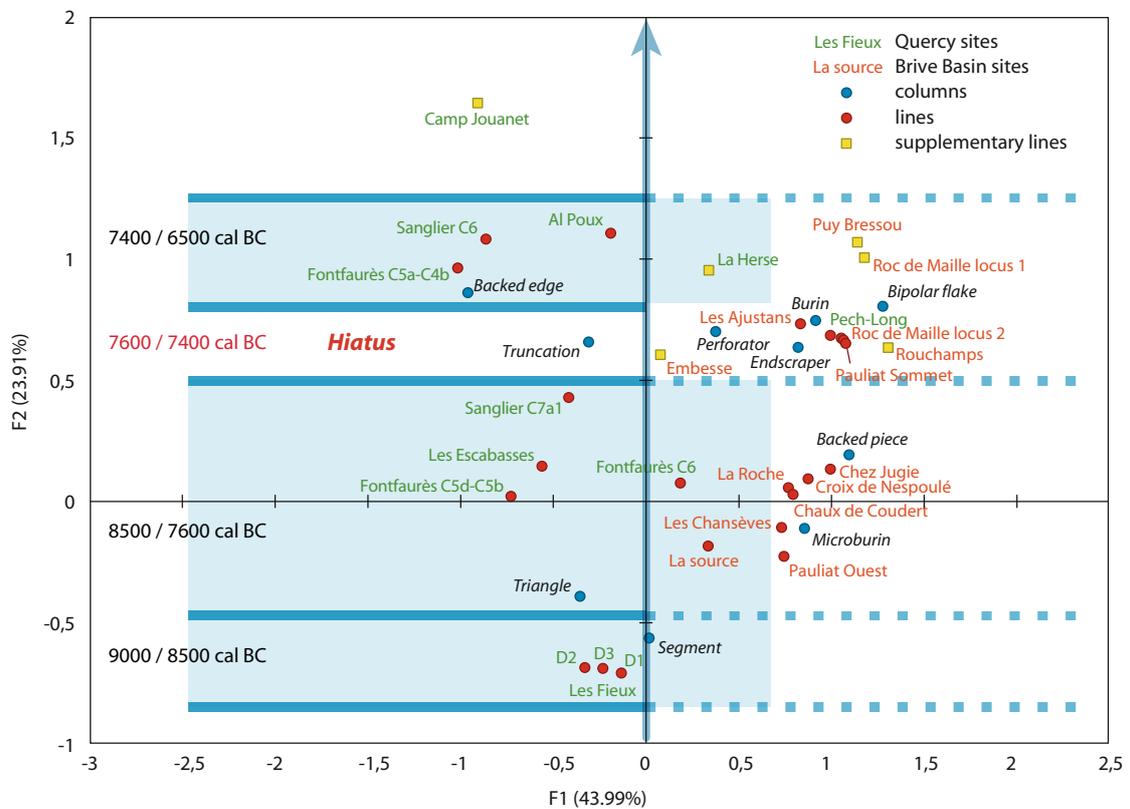
Though it is impossible to apply a single model to the organization of these Mesolithic hunter-gatherer societies, how can the study of the resources they used (stone, animal and vegetal) contribute to answering the question raised at the beginning of this paper: what were the mobility strategies of Mesolithic populations in the Quercy and Brive Basin regions?

Though it may not be possible to identify mobility strategies in this study, is it possible to determine the territory covered by these Mesolithic groups? This territory can be apprehended through petrographic analyses. The choice of a source depends mostly on its distance and accessibility, but also on the quality and quantity of its flint. The territory will differ depending on the manner of procuring the raw material, whether directly, in the context of movements, or indirectly, through exchange. The first situation would be associated with a subsistence territory, while the second would reflect a cultural territory. In the Brive region, Pierre-Yves Demars observed the disappearance of distant flints (over 100 km), such as Bergeracois and Fumelois, in Sauveterrian industries, while they are present in large quantities in Upper Paleolithic industries. In the Mesolithic, we thus observe a decrease in human movements in the context of lithic raw material procurement, and therefore a reduction of the size of territories (Demars, 2000: 281). This is perceptible in some behaviors, such as the collection of flint blocks in proximity, with morphologies that simplified the knapping actions realized during the manufacturing sequence. These behaviors can probably be associated with high mobility strategies.

The differences and similarities revealed through analyses of the lithic industries and animal and vegetal resources are generally functional in nature. The confrontation of these industries in a correspondence analysis results in two interpretations. The first, shown on the horizontal axis, clearly shows a distribution of Quercy sites on one side and Brive sites on the other (figure 4). We thus see a regional distinction and the confirmation of a functional distinction, since most of the Quercy sites are cave or rock shelter sites and most of the Brive sites are in the open-air. The second interpretation (figure 5), shown on the vertical axis, shows a probable chronological evolution: the oldest sites dated to between 9 500 and 8 000 cal BC; followed by an evolved phase between 8 500 and 7 600 cal BC; followed by a hiatus between 7 600 and 7 400 cal BC, which could be hypothetically filled by the sites in the Brive region; and finally, a late period between 7 400 and 6 500 cal BC. The lack of dates for the Brive sites is very problematical, since they would support



**Figure 4** - Factor analysis of the tool assemblage composition, horizontal axis (after Reversat, 2012).



**Figure 5** - Factor analysis of the tool assemblage composition, vertical axis (after Reversat, 2012).

this chronological hypothesis. If this group of sites indeed participated in the same territorial organization, this seems to have extended over a long time period, considering the chronological depth. The stable use of a range of raw materials throughout the Sauveterrian sequence, observed at Fontfaurès-en-Quercy, Les Escabasses and Les Fieux, could confirm this hypothesis. This group of sites could thus be integrated into a sort of *chaîne opératoire*, with different stages being represented by the diverse activities performed at the sites. These occupations could also be complementary to other sites, themselves associated with earlier or later phases of this *chaîne opératoire* (Fougère, 2008). In this geological context, can we propose the hypothesis that the open-air sites were habitat sites and that the cave and rock shelter sites were devoted to specific activities? According to Binford, it is most often the case that “caves and rock shelters were used as hunting or fishing camps by specialized groups, or as a *transient camp*, while the habitat sites were most often located in open-air contexts” (Fontana, 2011: 2).

In general, this study did not enable us to define an organization type, but rather to observe functional similarities and differences between the sites, reflecting the economic strategies of the Mesolithic groups. The establishment of a chronology first showed that these sites extend from 9 500 BC to 6 500 cal BC, with a hiatus between 7 600 and 7 400 cal BC in the Quercy region that is probably filled by the sites in the Brive region. Finally, it also enabled us to inventory the available documentation and to synthesize the data.

## Annexes

Sites	Type	Method	Attribution	Altitude	Bibliographic references
Les Ajustans	Open-Air	Survey	Sauv. undet.	450 m	Demars 1999, 2007, 2010, 2011
Les Chansèves	Open-Air	Survey	Sauv. undet.	465 m	Demars 1993, 2007
Les Chaux de Coudert	Open-Air	Survey	Sauv. undet.	558 m	Demars 2007; Demars, Soulier 2001
La Croix de Nespoulé	Open-Air	Survey	Middle Sauv.	545 m	Demars 1991, 2007
Embesse	Open-Air	Survey	Sauv. undet.	560 m	Demars 2007; Lenôtre, Demars, Dubreuil 2003
Puy Bressou	Open-Air	Survey	Sauv. undet.	Absent	Demars 2007
Puy de Pauliat sommet	Open-Air	Survey	Sauv. undet.	520 m	Bouyssonie 1927; Demars 2000, 2007, 2011
Puy de Pauliat ouest	Open-Air	Survey	Early Sauv.	475 m	Demars 1988, 2000, 2007, 2011
Roc de Maille locus 1	Open-Air	Survey	Sauv. undet.	565 m	Demars 2007
Roc de Maille locus 2	Open-Air	Survey	Sauv. undet.	560 m	Demars 2007
La Roche d'Allasac	Open-Air	Survey	Middle Sauv.	380 m	Albarellero 1981; Demars 1976, 2000, 2007, 2011
Rouchamp	Open-Air	Survey	Sauv. undet.	Absent	Demars 2007
Pech Long	Open-Air	Survey	Sauv. undet.	618 m	Reversat 2011
Al Poux	Open-Air	Excavation	Undetermined	Absente	Amiel, Lelouvier 2002; Gigounoux 2008; Valdeyron 2002
Camp Jouanet	Open-Air	Excavation	Undetermined	87 m	Amiel, Lelouvier 2002; Valdeyron 2002
Les Brouals	Open-Air	Test Pit	Undetermined	Absent	Aucun accès
Trigues	Open-Air	Test Pit	Early Sauv.	350 m	Valdeyron <i>et al.</i> 2005
Chez Jugie	Shelter	Excavation	Early Sauv.	300 m	Chelotti 2010, 2011; Demars 2011; Mazière, Raynal 1979
La Doue	Shelter	Excavation	Middle Sauv. Evolved Sauv.	144 m	Demars 2011; Gigounoux 2008; Martin 1994; Martin, Le Gall 1987, 1989; Valdeyron 1994
La Source	Shelter	Excavation	Undetermined	300 m	Demars 2011
Fontfaurès-en-Quercy	Shelter	Excavation	Early Sauv. Evolved E. Sauv. Middle Sauv.	350 m	Barbaza <i>et al.</i> 1991; Gigounoux 2008; Philibert 1995, 1999, 2002; Roussot-Laroque 2009; Valdeyron <i>et al.</i> 2008
Le Cuzoul-de-Gramat	Cave	Excavation	Undetermined	350 m	Lacam, Niederlender, Vallois 1944; Rozoy 1938; Valdeyron 2009
Les Escabasses	Cave	Excavation	Undetermined	320 m	Briand 2005; Guilbault 2009; Rivière 2006; Valdeyron <i>et al.</i> 2008
Les Fieux	Cave	Excavation	Early Sauv.	380 m	Briand 2004, 2005; Marcus 2000; Valdeyron <i>et al.</i> 2008
La Grotte de Sanglier	Cave	Excavation	Sauv. moyen	350 m	Dufau 2001; Gigounoux 2008; Seronie-Vivien 2001
La Herse	Cave	Test Pit	Sauv. undet.	Absent	Valdeyron, Challard, Martin 1998

**Annex 1** - Site corpus (Sauv. undet.: Undetermined Sauveterrian; Early Sauv.: Early Sauveterrian; Evo. E. Sauv.: Evolved Early Sauveterrian; Evo. Sauv.: Evolved Sauveterrian; Middle Sauv.: Middle Sauveterrien).

Sites	Activites	Seasonality	Evidence
Grotte du Sanglier	Diverse hunting activities, stable through time	Occupation from May to November/ year-round, but non-continuous	Segmented <i>chaîne opératoire</i> : weapon element percentage higher than that of microburins
Les Fieux	Hunting activities with some evidence for vegetal and osseous material working	Non-continuous occupation	Segmented <i>chaîne opératoire</i> : absence of Senonian and Jasperoid flint cores, few cortical pieces and weapon element percentage higher than that of microburins
Fontfaurès-en-Quercy	Hunting activities for butchery. Can correspond to a hunting camp. Hide working	Occupied in the beginning and during the warm season, or year-round, but non-continuous	Flaking oriented toward bladelet manufacturing. Segmented <i>chaîne opératoire</i> : weapon element percentage much higher than that of microburins. Ochred endscrapers found in place.
Les Escabasses	Hunting activities: red deer hunting during the bellowing season and complementary antler collection	Year-round, non-continuous occupation	Segmented <i>chaîne opératoire</i> : weapon element percentage higher than that of microburins
La Doue	Hunting camp for carcass processing	Year-round, non-continuous occupation	Evidence provided by animal resources
La Herse	Transformation or use of osseous materials	Year-round, non-continuous occupation	Evidence provided by animal resources
Camp Jouanet	Stone flaking activities		High number of weapon elements and cortical pieces
Al Poux	Habitat temporaire		Aurochs present, indicating a large quantity of mead
Pech Long	Temporary habitat		High number of cores and cortical pieces
Rouchamp	Possible stone flaking activities		High number of cores and cortical pieces

**Annex 2** - Summary of the site functions revealed by the resources and their procurement (Reversat, 2012).

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## WHAT ROLE DOES THE MESOLITHIC SUBSTRATUM PLAY IN THE NEOLITHIZATION OF THE GRANDS CAUSSES?

Study of the Lithic Industry of Combe-Grèze  
(Cresse Commune, Aveyron)

Elsa DEFRANOULD

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## WHAT ROLE DOES THE MESOLITHIC SUBSTRATUM PLAY IN THE NEOLITHIZATION OF THE GRANDS CAUSSES?

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Elsa DEFRANOULD

### Abstract

*In the Grands Causses region, south of the Massif Central, there are a few sites attributed to the original Early Neolithic, (6<sup>th</sup> millennium). Due to their position at the edge of the region in which the southern Cardial emerged, they play an important role in debates concerning the Neolithization of southern France. Were these autochthonous sites with a production economy invented without influence from the Cardial domain? Or were they occupied by acculturated Mesolithic groups? Were their facies peripheral to the Cardial?*

*The site of Combe-Grèze, excavated in the 1970's by Jean Maury and Georges Costantini, was used like the others to develop these different theoretical models. For this reason, it appeared useful to reexamine the lithic assemblage of this site with the aim of distinguishing the different techno-typological entities based on a reconstruction of their 'chaînes opératoires' (reduction sequences). This study can be considered as an additional element of response to questions concerning the borrowing and transmitting of technical know-how between the horizons of the Second Mesolithic and the Early Neolithic. It is also intended to explore the role of the Mesolithic substratum in the emergence of a production economy in this region that is peripheral to the Mediterranean zone considered to be fully Neolithic.*

### Keywords

*Neolithization, Aveyron, Combe-Grèze, mixed facies, lithic industry.*

The term 'Neolithization' is generally seen to designate all of the historic steps in the transition from a predation economy to a production economy, from the last hunter-gatherer-collector communities to the first farming societies. In archaeology, we can perceive this process through the observation of changes in subsistence economies and material culture. In this manner, analyses of the variability of lithic industries contribute to our understanding of this historic process over the long term since they were associated with both the last predation societies and the first agro-pastoralist communities, in contrast to pottery, which most often does not appear until the full Early Neolithic.

The Early Neolithic in the French Mediterranean zone (5 800-4 500 cal BC) can be divided into three distinct entities: *Impressa*, Cardial and *Épicardial*, which are not articulated with each other in a strictly chronological manner: though one succeeds the other, it is by phenomena that are still poorly understood, indicating a nonlinear evolution of the settlement of these regions by the first agriculturalists (Manen, Guilaine, 2010). In the French Midi region, we distinguish three main

phases in the settlement and development of the first farming societies. This process began with a first occupation of the coast, believed to have resulted from the arrival of pioneers from the Italian coasts through cabotage (the *Impressa facies*), followed by a larger territorial domination and expansion toward the Rhône Valley and the western Languedoc region, and finally, a second and later wave of settlement toward the inland regions, in particular the Massif Central.

One of the questions underlying interpretations of the Neolithization process concerns the role of the Mesolithic substratum in this phenomenon. What became of the last hunting societies? Were there interactions between the Mesolithic and Neolithic spheres? To detect possible borrowings and transmissions of technical know-how between these two worlds, it is thus useful to take a long-term approach, and thus to explore the material culture productions of the Second Mesolithic. However, the core region of the southern Early Neolithic has yielded only fragmentary data on these contexts (Perrin, 2014). On the contrary, the margins of this zone have yielded numerous sites from the Second Mesolithic, enabling us to address this question.

## 1 - Regional context around the end of the 6<sup>th</sup> Millenium

The southern foothills of the Massif Central, and particularly the Aveyron department, have yielded numerous sites at which the material culture remains are different from those found in the Mediterranean Early Neolithic sphere *sensu stricto*.

In this region, a theoretical model of autochthonous Neolithization was developed in the 1970's by Julia Roussot-Larroque based on the site of Martinet (Lot-et-Garonne) and Level C of Roucadour in the Lot department (Roussot-Larroque, 1977, 1990), and extended to the Grands Causses region by Gaston-Bernard Arnal (Arnal, 1987, 1995). These same authors then extended this cultural facies, known as the Roucadourian, over the entire peripheral zone of the southern Early Neolithic. The sites used to support this model were thought to associate a so-called crude pottery type that had little decoration and was poorly fired, with a lithic industry typical of the Second Mesolithic, leading the authors to identify an early and autonomous Neolithization process in this region. These continental facies would thus be specific in their double composition, having both typical Mesolithic and Neolithic features. The "mixed" nature of this industry was historically considered as a reflection of acculturated hunter-gatherers.

The Combe-Grèze rock shelter is located in the eastern part of the Aveyron department, on a sinkhole on the Causse Noir plateau. The site was discovered by Marcel Lacas, who excavated the inside of the diverticulum in the early 1960's. Three occupations were recognized at this time: "Chalcolithic", "Late Tardenoisian" and "Classic Mesolithic" (Maury, Lacas, 1965). Jean Maury and Georges Costantini then explored the outside of the rockshelter during three field seasons between 1979 and 1981 (figure 1). They described a stratigraphy 2 meters deep (figure 2). Levels 1, 2 and 3 were nearly sterile, or at least had very few artifacts and could not be considered as undisturbed archaeological levels. They attributed Level 4 to the Early Neolithic. This level yielded the majority of the artifacts and contained associated pottery and lithic artifacts. Level 5 was much more cautiously qualified by the excavators as "Protoneolithic" (Costantini, Maury, 1986), following the definition of Jean Guilaine at the time as a period "following the true Mesolithic, immediately before the Cardial. The term Protoneolithic can also be understood in economic terms given that the presence of *ovicaprids* might suggest a possible orientation towards breeding and thus a process of Neolithization" (Guilaine, 1979: 124-125). Finally, Level 6 is composed of sterile sand and was excavated to 80 cm in depth, where the Bathonian substratum was reached.

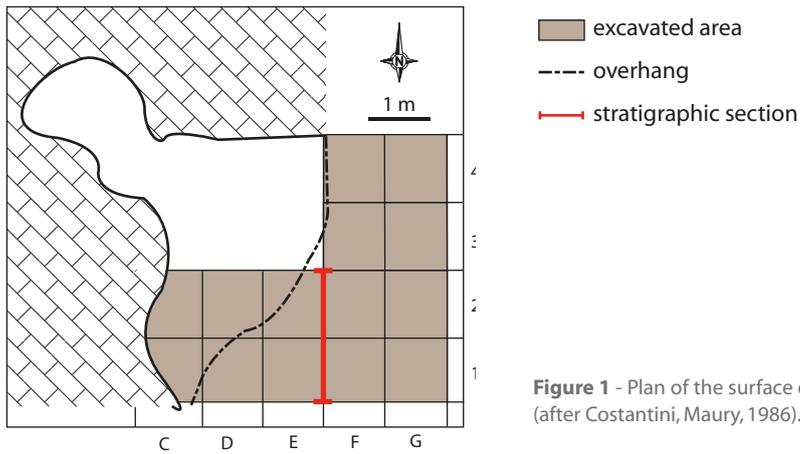


Figure 1 - Plan of the surface excavated between 1979 and 1981 (after Costantini, Maury, 1986).

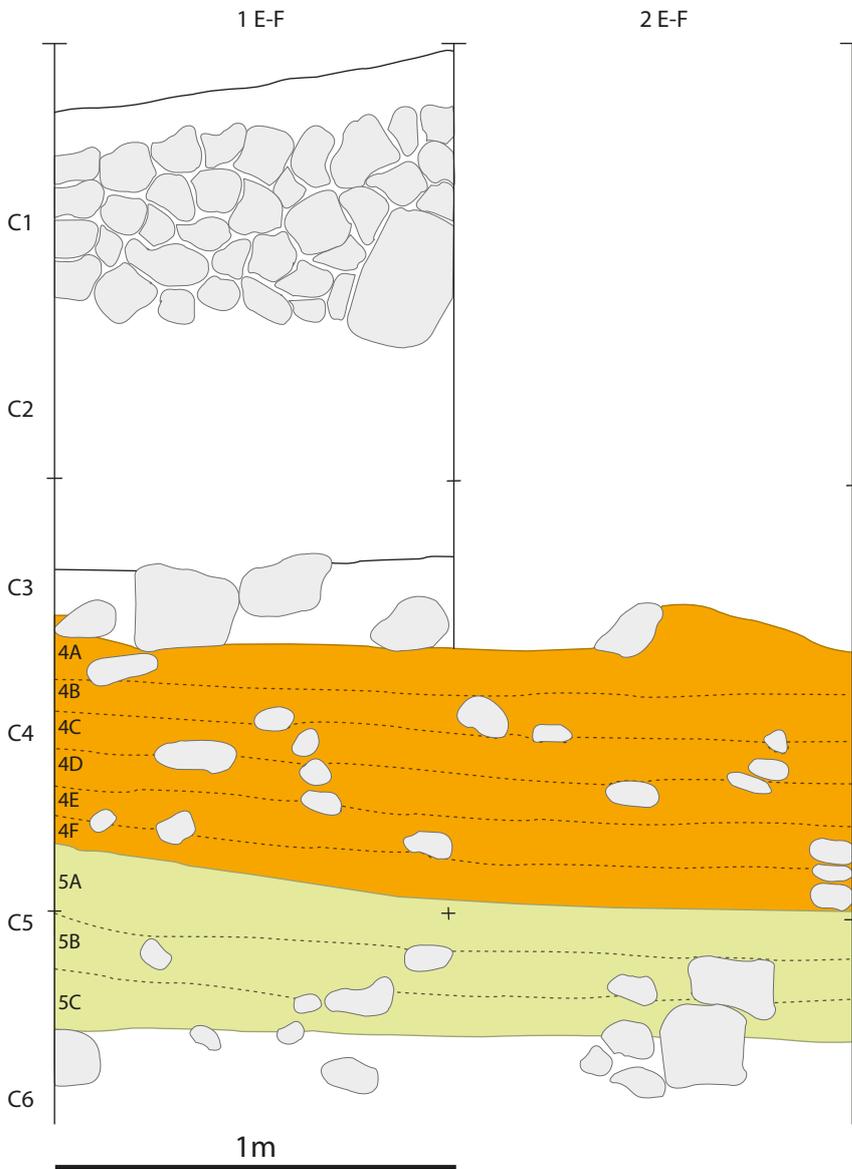


Figure 2 - Stratigraphy determined during the excavations by Costantini and Maury (after Costantini, Maury, 1986).

Levels 4 and 5 were distinguished only by a difference in sediment colors and the site was excavated by arbitrary levels of 10cm, which in no way reflects the true sedimentary configurations. We can thus justifiably doubt the reliability of the stratigraphy identified during the excavation. This is why this study did not at first take into account the spatial positions of the artifacts, and there was no discussion of their altitudes until later.

We have only one radiocarbon date for this site, obtained during the first excavation seasons in the 1960's, for a level attributed to the Late Tardenoisian:  $6\,420 \pm 180$  BP (Gif-446), situating this level between 5 600 and 5 200 BC in calibrated dates (calibration at  $1\sigma$  with the IntCal09 curve).

The zooarchaeological study realized by Thérèse Poulain indicates the presence of sheep and pig, though the levels in which these domestic faunal remains were found in majority are not stated. Moreover, these remains represent “*between half and one third of the fauna*”, despite a continuation of intensive hunting practices (Costantini, Maury, 1986: 450). No vegetal macro-remains were identified, preventing us from knowing if agriculture was practiced. Most of the recovered pottery fragments were found in Level 4. A recent study of the pottery manufacturing sequences (*chaînes opératoires*) at Combe-Grèze seems to indicate a high skill-level for the production of vases, challenging the idea of acculturated and inexperienced potters (Caro, 2013).

## 2 - The *chaînes opératoires* (reduction sequences) present

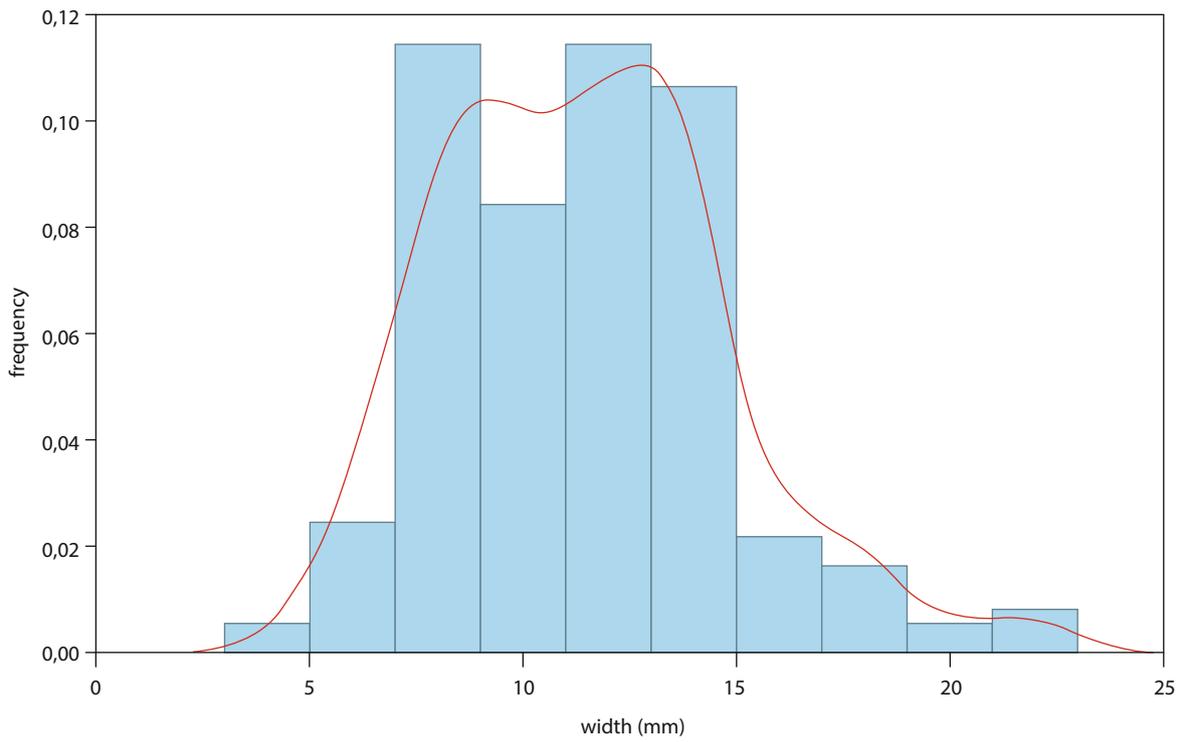
The aim of this study of the lithic industry is to distinguish the different techno-typological entities and reconstruct the *chaînes opératoires* present in order to ultimately propose a chrono-cultural attribution of the flaked stone industries of Combe-Grèze.

The large number of burned pieces made the petrographic analysis of many of them difficult, generally preventing us from identifying their nature, in which case it was only possible to distinguish between chert and flint. In any case, due to the dominance of Bajocian cherts in the assemblage (80% of the collection, taking into account the undetermined pieces), we chose not to divide the industries in function of the different raw materials used, but to rather consider the assemblage as a whole, given that siliceous materials other than chert were rarely used.

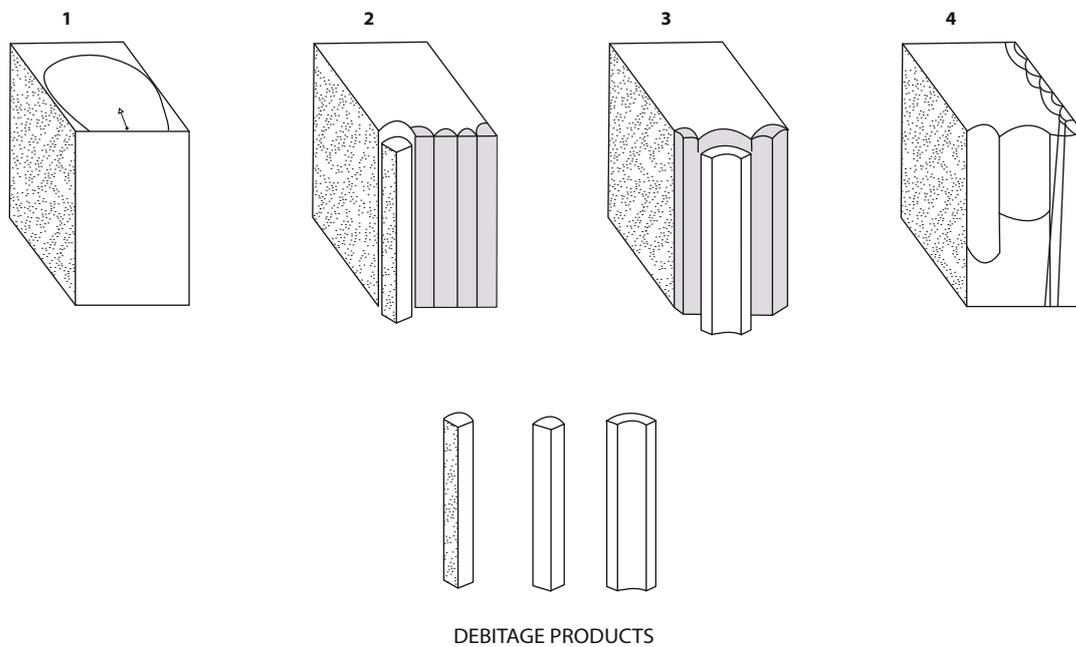
The great majority of the assemblage corresponds to the manufacturing of blade blanks, detached by indirect percussion. We observe a bimodal distribution of the width of the pieces (figure 3), with part of the blank widths centered around 9mm and the other around 12-13 mm, the widest blanks most often having three surfaces. The differentiated production of two blade types thus enables the distinction of two different *chaînes opératoires*.

The first employs a core with a striking platform and unidirectional or bidirectional flaking (figure 4), according to the typology of Thomas Perrin for the study of cores (Perrin, 2001). The high number of blades with a natural surface suggests flaking on a restricted surface, thus on the narrow face of a block, which would be situated between two wide, natural surfaces. A variant of this *chaîne opératoire* may be suggested by certain features of the cores: once the first flaking surface is abandoned, a new flaking sequence is sometimes initiated on the wide face of the initial block, following the same procedure. The great majority of the products obtained display traces characteristic of indirect percussion, with deliberately plain or concave butts. In addition, there is no specific preparation of the impact point – no abrasion or removal of the overhang on the cores or blanks.

This type of flaking enables the detachment of wide blanks with parallel edges and regular ridges, sometimes with three surfaces. The relatively small number of blades with three surfaces, relative to the rest of the assemblage, is probably due to the narrow width of the flaking surfaces, which does not permit a serial production of this type of blank since it is frequently necessary to repair or maintain the flaking surface.



**Figure 3** - Frequency histogram of the widths of whole blanks using a frequency interval of 2 mm (in blue) and a density curve of these widths (in red).



**Figure 4** - Diagram of *chaîne opératoire* #1. **Sequence 1:** conception and selection of a narrow volume. A natural surface serves as the striking platform or one is created by detaching a thick flake (hypothesized modalities for creating a striking platform). **Sequence 2:** initiation of a flaking surface. The blades obtained retain parts of the original stone surface on their upper face. **Sequence 3:** full-flaking phase, blade production. The narrow flaking surface explains the low number of blades with three surfaces. **Sequence 4:** variant of the method: after abandoning the narrow face, a second face is used and a new flaking sequence is initiated.

One of the uses of these wide blades (around 13 mm) could have been as blanks for geometric bi-truncations, also known as *flèches-tranchantes*, which have flat, direct retouch on their upper face, and are generally associated with the Early Neolithic (figure 5). Meanwhile, we must admit that these weapon elements are not really standardized and that only one or two specimens can be considered as true “Montclus Arrowheads”.

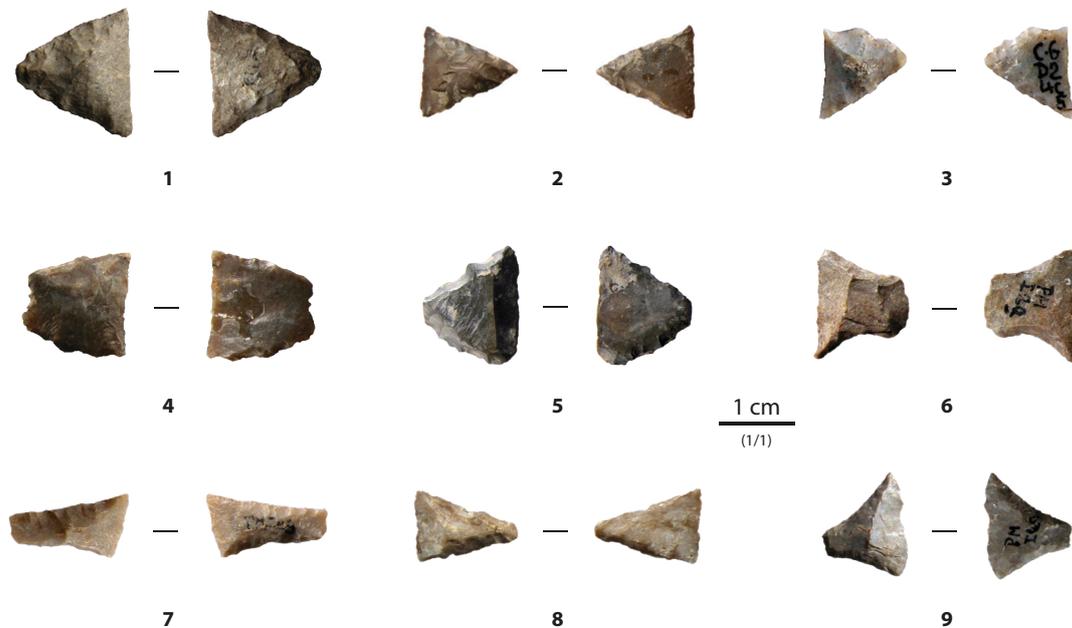


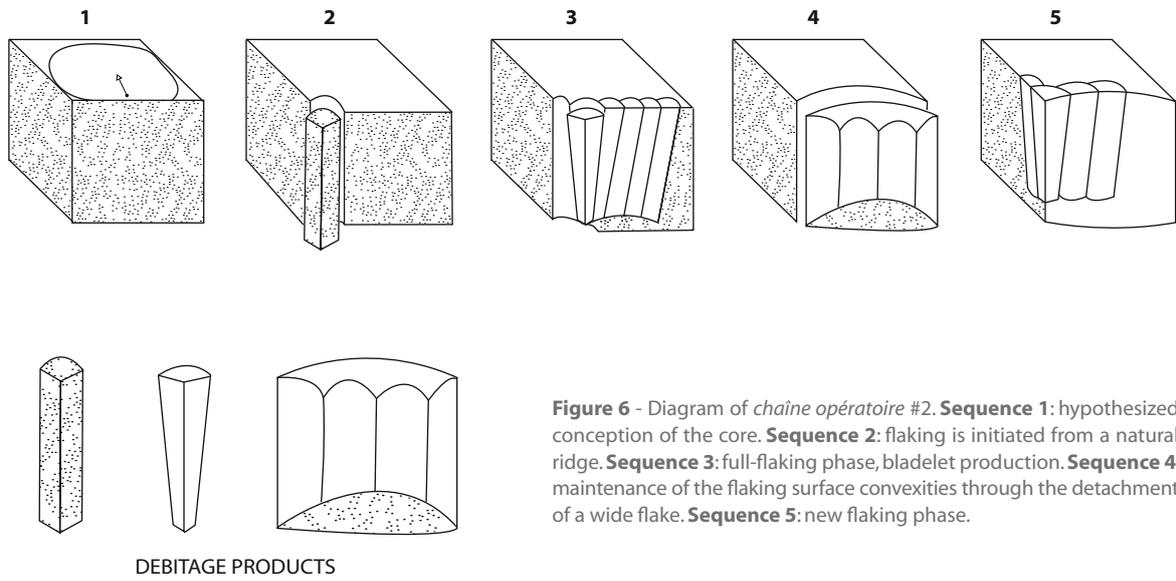
Figure 5 - Geometric bi-truncated weapon elements with an abrupt truncation and flat, direct retouch.

We can already affirm that the production of narrow bladelets (around 9 mm wide), with a triangular section and convergent edges, corresponds to a *chaîne opératoire* distinct from the preceding one (figure 6). It does consist simply of a reduction in the size of the pieces resulting from a reduction of the size of the cores at the end of the reduction sequence. Several arguments permit us to affirm this: first, the last removals from the cores with one striking platform, characteristic of *chaîne opératoire* 1, are always too wide; these cores are usually reduced until exhaustion and could not have been used to produce narrower blanks; and second, we observe a clear dichotomy between the dimensions of the two blank types, which would be impossible in the case of a single *chaîne opératoire* (the size would be reduced in a linear and continuous manner).

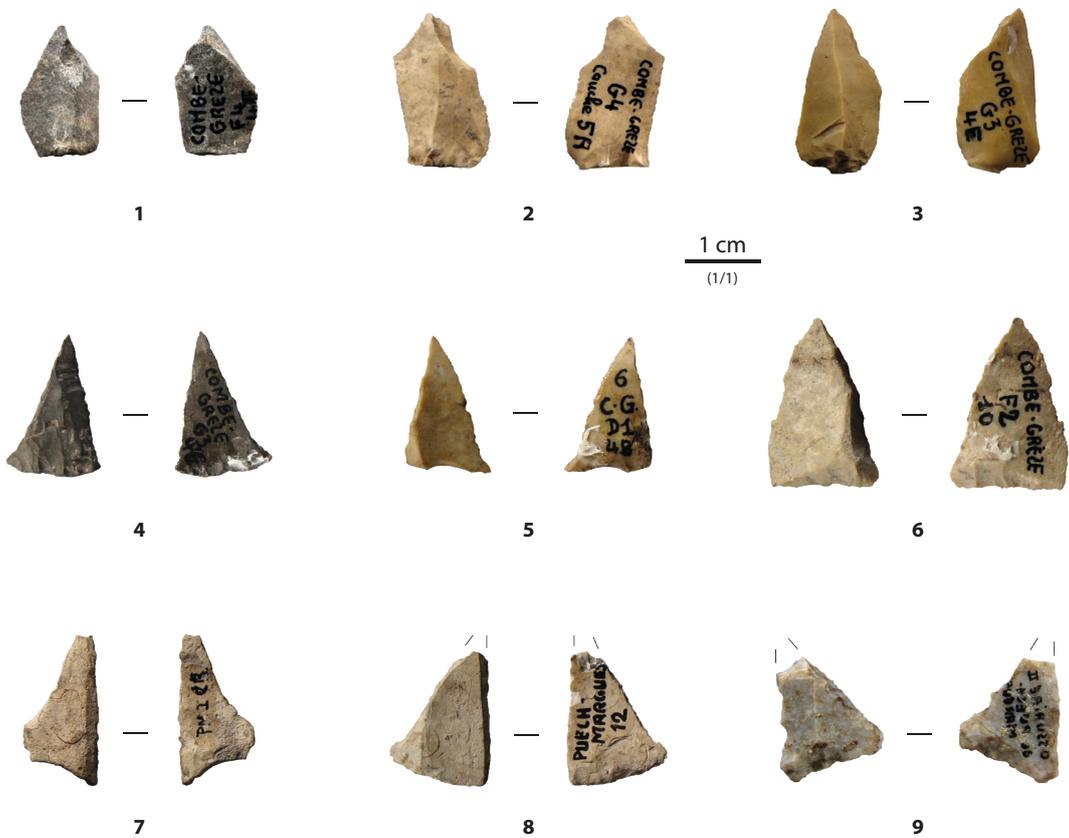
We did not observe any cores that appeared to correspond exclusively to this type of production. Therefore, our understanding of the flaking strategies, their rhythm, and the core preparations is considerably limited.

Wide, curved flakes with cortex on their distal part indicate a phase of maintenance of the flaking surface. Their function would have been to reduce the curvature of the flaking surface in order to produce blanks with a relatively straight profile. They also indicate that cores were not prismatic in shape, but that they had more rectangular flaking surfaces, since it was necessary to maintain their convexities during flaking.

Though we cannot establish a strict correlation, it is possible that this *chaîne opératoire* was used to manufacture trapezoidal weapon elements using the microburin technique (these represent 15% of the tools) and flat, inverse retouch on the base (figure 7). These Martinet trapezes are usually attributed to the techno-typological realm of the Second Mesolithic.



**Figure 6** - Diagram of *chaîne opératoire* #2. **Sequence 1:** hypothesized conception of the core. **Sequence 2:** flaking is initiated from a natural ridge. **Sequence 3:** full-flaking phase, bladelet production. **Sequence 4:** maintenance of the flaking surface convexities through the detachment of a wide flake. **Sequence 5:** new flaking phase.



**Figure 7** - 1-3: Microburins and 4-9: geometric bi-truncated weapon elements with flat inverse retouch.

The third *chaîne opératoire* identified corresponds to around thirty pieces. It provides evidence for the manufacturing of micro-bladelets, with an average width of approximately 6 mm. Only one core corresponds to this *chaîne opératoire*. It is small, made from a thick flake on an exotic flint, and was flaked in two orthogonal directions. The bladelets were detached by marginal percussion with an organic billet. The blanks were sometimes modified with abrupt retouch to create a back. This microlithic production is usually attributed to the techno-typological realm of the First Mesolithic.

### 3 - Stratigraphic distribution of the artifacts

Observations of the stratigraphic distribution of the elements associated with these three *chaînes opératoires* can provide arguments in favor of the diachronic or synchronic nature of these different manufacturing strategies. The graph made based on the diagnostic elements of these *chaînes opératoires* (figure 8) shows that there is indeed an altitudinal distribution of these technical strategies, even if no interruption can be detected. The elements associated with the micro-bladelets, indicating a First Mesolithic occupation, are mostly found at the bottom of the sequence. The central part of the stratigraphy contains a higher number of elements associated with the manufacturing of bladelets and trapezes, indicating a Second Mesolithic occupation. Finally, the upper part of the sequence is dominated by elements related to the manufacturing of wide bladelets, which, in association with the appearance of pottery, suggests an Early Neolithic occupation.

It therefore appears that the identification of a mixed Mesolithic-Early Neolithic facies is more likely the result of a stratigraphic mixing, at Combe-Grèze at least, of two successive occupations associated with industries that have specific technological features. At present, this study thus contests the existence of a hybrid industry in the Grands Causses region, with Mesolithic cultural traits persisting into the Neolithic. The hypothesis of a Neolithization of this region through acculturation can now be refuted at Combe-Grèze. Nonetheless, in order to better understand this Early Neolithic in the Aveyron region, we must explore its relationships with the more Mediterranean spheres. A synthetic approach will also require a more systematic inclusion of faunal and ceramic data, new datings, and new excavations in contexts offering more reliable sedimentary information.

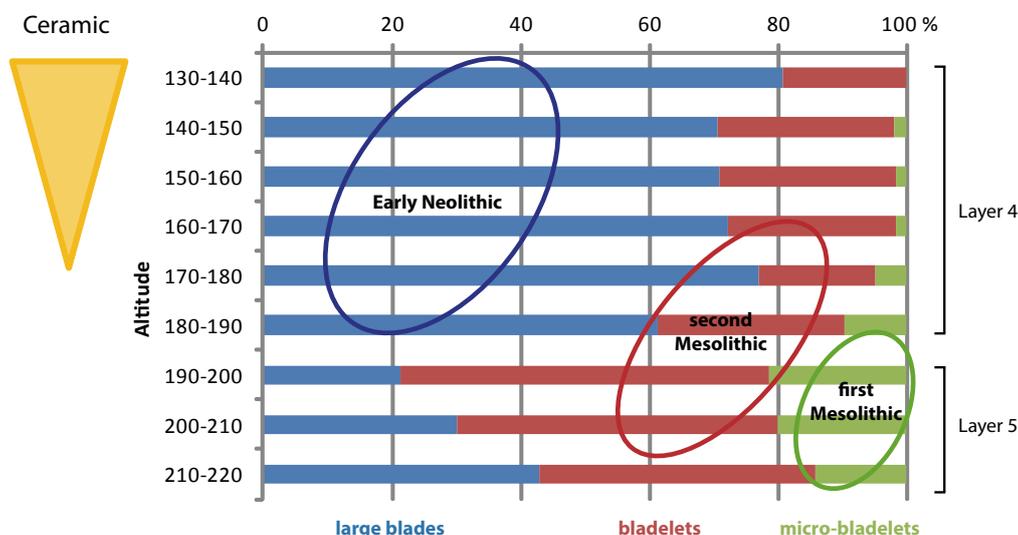


Figure 8 - Proportions of the different *chaînes opératoires* in relation to their depth.

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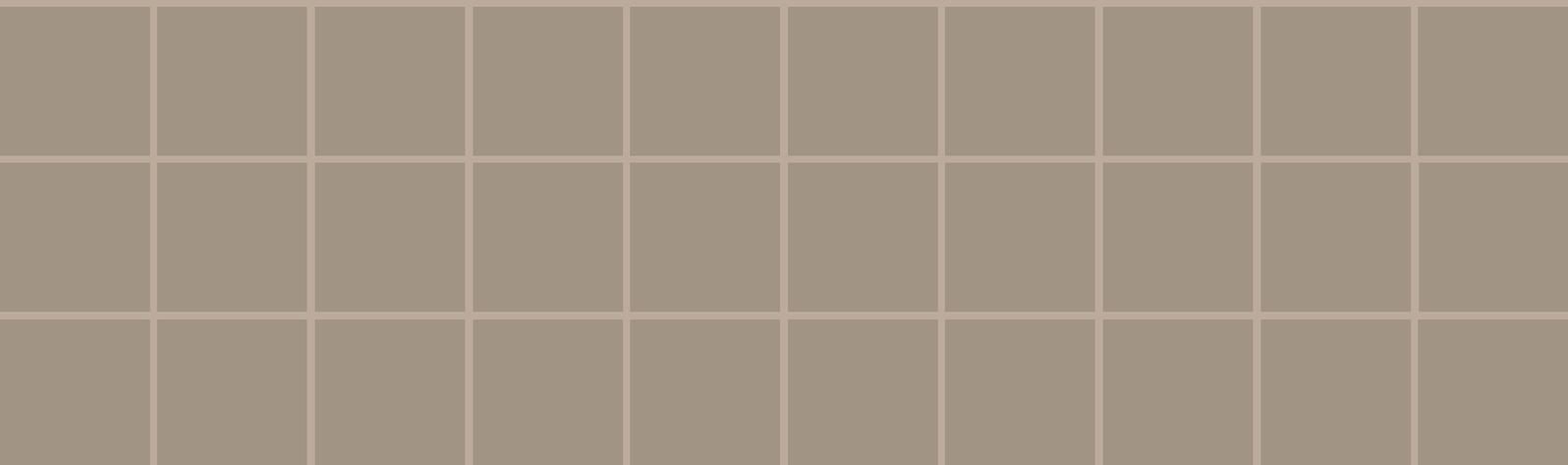
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## RESEARCH NEWS



## AN ATYPICAL EARLY MESOLITHIC OCCUPATION IN THE SOUTHERN PO PLAIN:

Evidence from the Site of Collecchio (Parma, Italy)

**Davide VISENTIN, Federica FONTANA, Stefano BERTOLA**

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## AN ATYPICAL EARLY MESOLITHIC OCCUPATION IN THE SOUTHERN PO PLAIN:

Evidence from the Site of Collecchio (Parma, Italy)

**Davide VISENTIN, Federica FONTANA, Stefano BERTOLA**

### Abstract

*Dating back to the ancient phase of the Sauveterrian the site of Collecchio represents the oldest known evidence of human occupation in the southern Po plain area after the LGM as confirmed by a radiocarbon date. Techno-economical analysis carried out on the lithic assemblage has focused on the reconstruction of raw materials provisioning systems and reduction sequences. Results highlight that the site was characterised by a complex and intense occupation mostly addressed to domestic activities. One of the most peculiar aspects of the lithic assemblage is represented by the high number of burins, which could imply a certain degree of economical specialisation of the site as it will be further investigated by ongoing analyses.*

### Keywords

*Sauveterrian, southern Po plain, raw materials, lithic technology, burins.*

## Introduction

The site of Collecchio (Parma, Northern Italy) is located in the southern part of the Po plain, on the top of the Taro river alluvial fan (106 m a.s.l.), close to the Apennine foothill (figure 1). Excavations at the site, conducted under the supervision of the Soprintendenza Archeologica of Emilia Romagna<sup>1</sup>, have yielded several Neolithic structures and a Mesolithic layer. The latter contained more than 7 500 lithic artefacts, clustered on an area of about 65 m<sup>2</sup>, together with several charcoals, land snails, burnt hazel nuts, bone fragments and clay chips (Visentin, 2011, Visentin *et al.*, in press).

## 1 - Techno-economic analysis

The lithic assemblage is formed by a great variety of raw materials – including both silicified and non silicified rocks – with different technical properties and knapping suitability. In particular rocks belonging to different stratigraphic sequences of the northern Apennines have been exploited: radiolarites, cherts and limestones of the Ligurid Ophiolitic units (Jurassic-Cretaceous), cherts of the Ligurid Flysch units (Paleocene-Eocene), silicified marls and siltstones of the Epiligurid units

1. We would like to thank M. Bernabò Brea for allowing access to the archaeological material.

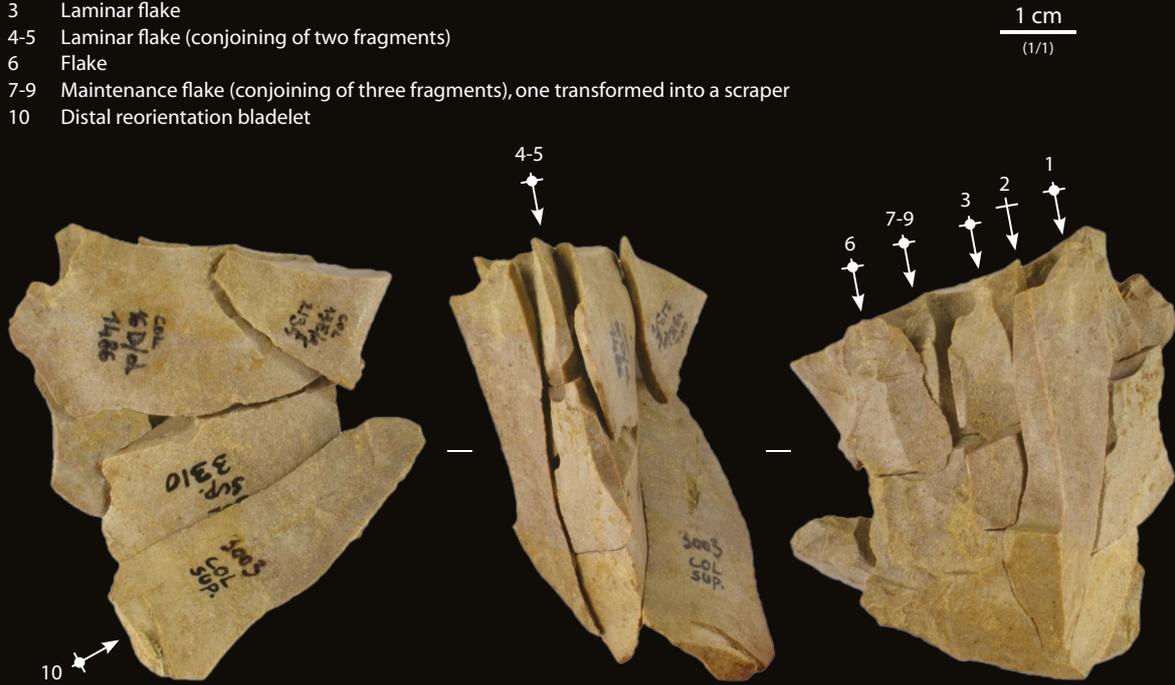


Figure 1 - Location of the Sauveterrian site of Collecchio at the southern margin of the Po plain.

(Oligocene-Miocene) and cherts of the Umbro-Tuscan units (Triassic-Cretaceous). Raw materials provisioning took place mostly within the alluvial and slope deposits of the main northern Apennine valleys (Taro, Baganza, Enza) (Fontana *et al.*, in press). The adoption of both fine crystalline cherts and radiolarites along with coarser cherts, marly siltstones and non silicified limestones represents a peculiar character of Collecchio and the other Mesolithic sites of the southern Po plain, which has never been observed so far in the Alpine context (Fontana *et al.*, 2009a-b).

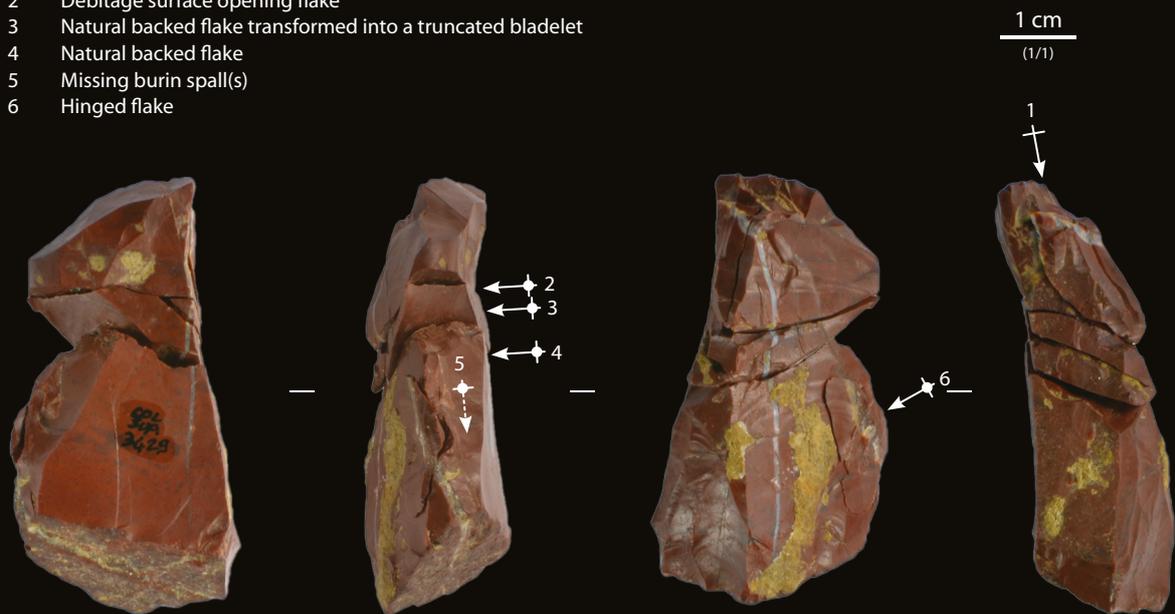
The reduction processes documented at Collecchio are strictly connected to the different raw materials exploited and two separated sequences have been identified respectively applied to fine quality cherts, radiolarites, spiculitic wakestone cherts (figure 2) and non silicified limestones and to the coarse siltstone. The first sequence aims at the production of different kinds of blanks – bladelets, elongated flakes and flakes – spanning between 15 and 40 mm in length. Although for the debitage of the different stone types included in this class (cherts, radiolarites, limestones) the same reduction schemes have been adopted, some differences have been observed: chert production appears more standardised and characterised by a higher frequency of lamellar modules; its cores are more exploited than those obtained from lower quality materials that have been generally abandoned at an earlier stage. At the beginning of the reduction sequence larger flakes were obtained, which were then systematically transformed into cores (figure 3). The second reduction sequence starts from the exploitation of large flat siltstone cobbles for the production of thick semi-cortical flakes. The dimensional range of products is wide spacing between 20 and 70 mm both in length and width. The reduction scheme is based on the recurrent reorientation of the core exploiting the cortical surfaces of the cobbles as striking platforms.

- 1 Bladelet
- 2 Bladelet
- 3 Laminar flake
- 4-5 Laminar flake (conjoining of two fragments)
- 6 Flake
- 7-9 Maintenance flake (conjoining of three fragments), one transformed into a scraper
- 10 Distal reorientation bladelet



**Figure 2** - Refitting assemblage showing the exploitation of a spiculitic chert block by the adoption of a reduction scheme involving orthogonal reorientation of the core (photo: D. Visentin).

- 1 Partially cortical bladelet
- 2 Debitage surface opening flake
- 3 Natural backed flake transformed into a truncated bladelet
- 4 Natural backed flake
- 5 Missing burin spall(s)
- 6 Hinged flake



**Figure 3** - Burin-like core reduction scheme. The original blank is a large radiolarite flake (photo: D. Visentin).

## 2 - Typological features of the assemblage

Among retouched blanks (n=230) tools dominate over armatures (table 1).

Tools	Total	%
Burins	55	23,0
End-scrapers	7	3,0
Truncated bladelets	19	8,3
Backed flakes	16	7,0
Scrapers	13	5,7
Blade scrapers	3	1,3
Denticulates	22	9,6
<i>Pièces écaillées</i>	2	0,9
Retouched fragments	11	4,8
<b>Armatures</b>		
Backed points	13	5,7
Backed bladelets	3	1,3
Backed and truncated bladelets	8	3,5
Crescents	11	4,8
Scalene triangles	1	0,4
Backed fragments	46	20,0
<b>Total</b>	<b>230</b>	<b>100,0</b>

Table 1 - Typological structure of the retouched assemblage.

This character appears rather unusual among Italian Sauveterrian sites and is usually associated to a residential function (Lanzinger, 1985). All retouched blanks belong to the first reduction sequence whilst siltstone flakes were probably produced only in order to obtain raw edges.

Armatures are represented by backed points (n=13) and bladelets (n=3), crescents (n=11), backed and truncated bladelets (n=8) and one triangle plus a few backed fragments (n=45).

Among tools burins are particularly numerous (n=55, 23.9% of all retouched blanks) in comparison to endscrapers (n=7) and other tools, an aspect that could reflect specialised activities taking place at the site.

Nonetheless, the definition of this aspect appears rather complex also due to the presence of a high number of burin-like cores (figure 3) with characteristics that appear very close to those of burins. These two categories have currently been sorted according to some specific morphological features but ongoing specialized studies involving functional analysis and geometric morphometric methods are expected to help solving the question.

In accordance with its Preboreal radiometric date (9 251-8 814 cal BC, 2 $\sigma$ , 9 643 $\pm$ 70 BP, LTL6147A, burnt hazelnut) the typological assemblage indicates an ancient chronology for the site which represents so far the earliest known occupation of the Apennines after the LGM (Visentin, 2011).

## Concluding remarks

The site of Collecchio is one of the main reference sites for the reconstruction of Early Holocene settlement dynamics in the southern Po plain area (Fontana *et al.*, 2013). In particular available data indicate Collecchio as a site attesting a wide spectrum of activities. Some of the aspects highlighted by the techno-economic and typological analysis carried out, such as the presence of a high percentage of burins, the peculiar association of microliths characterised by the rarity of triangles and the exploitation of a great variety of raw materials with very different properties reflect the great diversification of features in the Italian ancient Sauveterrian.

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## LITHIC TECHNO-TYOLOGY AND CHRONOMETRY IN THE LATE MESOLITHIC OF THE SADO VALLEY:

the Case of Amoreiras Shell Midden  
(Alcácer do Sal, Portugal)

**Diana NUKUSHINA**

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## LITHIC TECHNO-TYOLOGY AND CHRONOMETRY IN THE LATE MESOLITHIC OF THE SADO VALLEY:

### the Case of Amoreiras Shell Midden (Alcácer do Sal, Portugal)

Diana NUKUSHINA

#### Abstract

*Amoreiras, a shell midden in the Sado valley (Southern Portugal), was during years considered one of the most recent sites of the Sado Mesolithic complex, and a place of interactions between the last hunter-gatherers and the Neolithic groups. Nevertheless, the data about the lithic industry was poorly known. The absolute chronology and the complexity of the stratigraphy were not analyzed in detail. In this paper, we present the results from a techno-typological analysis of a set of lithic materials recovered from the first excavations in Amoreiras during the 1950's and 1960's.*

#### Keywords

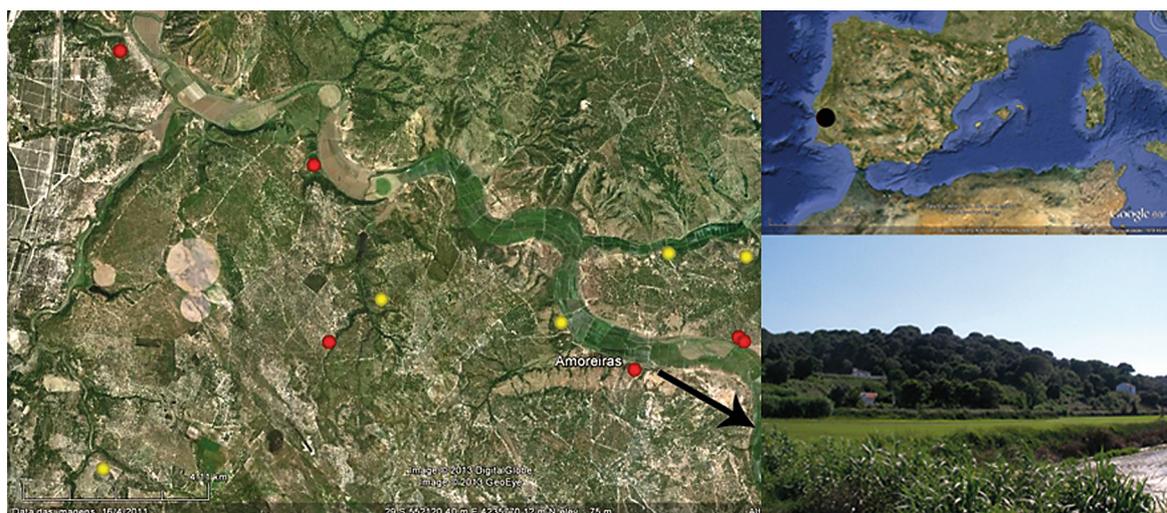
*Amoreiras shell midden, Sado valley, Late Mesolithic, lithic techno-typology.*

### 1 - The Amoreiras shell midden: an overview of the data and problems

The known shell middens of the Sado valley are located along a roughly 15 km long stretch of the river, at 40-50 km from the present estuary, in the municipality of Alcácer do Sal. The shell midden of Amoreiras (Cabeço das Amoreiras or S. Romão) – is located on a hill at the left margin of the Sado River (figure 1). It was excavated during the 1950's and 1960's by Manuel Heleno, director of the National Museum of Archaeology at the time (MNA). Thousands of archaeological materials were recovered, but the results were not published and the artifacts were only preliminarily studied in the 1980's under the research directed by J. Arnaud (1989, 2000).

In spite of the scarcity of systematic studies, Amoreiras was assumed as one of the most recent Sado shell middens and a place of interactions between Mesolithic and Neolithic groups. The presence of ceramic fragments with Cardial decoration in the lowest levels of the area excavated by J. Arnaud, and the radiocarbon dating results, led this researcher to defend an occupation during the transition from the 6<sup>th</sup> to 5<sup>th</sup> millennium BC, when the neolithization process was occurring (Arnaud, 2000). G. Marchand, focusing on the numerical dominance of segments among the geometrics referred by J. Arnaud (1989), inserted this site in the last phase of the Late Mesolithic chrono-typological model proposed for the Central-Southern Portugal (Marchand, 2001, 2005).

More recently, the dating of the “skeleton 5” from Amoreiras – Beta-125110: 7230 ± 40 <sup>14</sup>C BP (Cunha, Umbelino, 2001) – led to retreat the site occupation to the final of the 7<sup>th</sup> – beginning of the 6<sup>th</sup> millennium cal BC (Diniz, 2010). The ceramic analysis, which suggests different cultural occupations of the site during the Neolithic (Diniz, 2010), increased the controversy.



**Figure 1** - Location of the Amoreiras site in Iberian Peninsula and within the complex of shell middens of the Sado valley (cartographic base: *Google earth*). View of the Amoreiras hill from the Sado river (July 2011).

Given the problems of the Amoreiras site, a systematic analysis of the lithic remains from the excavations carried out by Heleno appeared to be imperative.

## 2 - The lithic industry of Amoreiras: excavations by Manuel Heleno

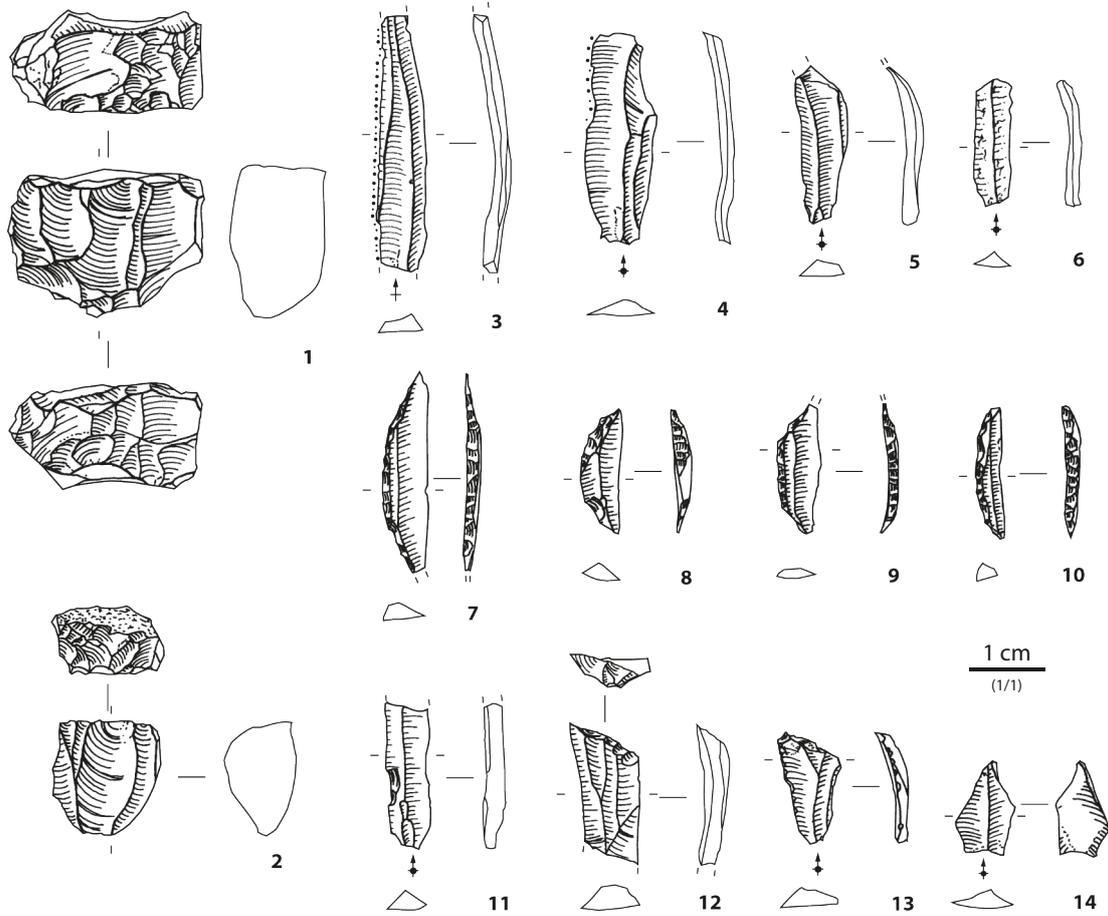
A sample of materials recovered from the central area excavated by Heleno (“extension of the survey A”) was analyzed, following the propositions of the “*chaîne opératoire*” concept. The lack of contextual data was restrictive to this study, since the excavations were done through artificial levels, leading us to consider the materials as a whole.

The analyzed 1 592 lithic remains document all the technological categories of the “*chaîne opératoire*”, representing a microlithic industry, with scarce variability and quantity of retouched tools (table 1; figure 2).

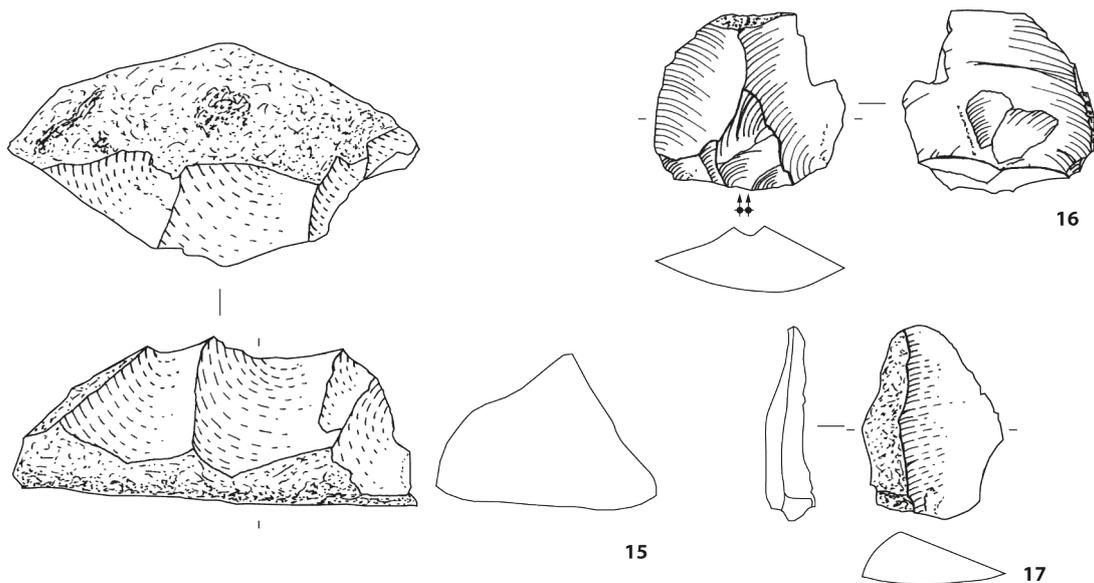
Category	Level 1	Level 2	Level 3	Total	
				%	N
<b>Cores</b>	34	21	11	4.15	66
<b>Core preparation/maintenance</b>	9	11	1	1.3	21
<b>Debitage products</b>	285	178	46	31.97	509
Blades	5	4	0	0.57	9
Bladelets	212	120	35	23.05	367
Flakes	68	24	11	8.35	133
<b>Retouched tools</b>	133	100	36	16.90	269
Geometrics	71	53	18	8.92	142
Retouched bladelets	26	20	10	3.52	56
“Common fund” tools	14	16	2	2.01	32
<b>Debris</b>	365	335	27	45,67	727
Fragments	331	281	24	39.95	636
Chips	12	33	2	2.95	47
Microburins	22	21	1	2.76	44
<b>Total</b>	<b>826</b>	<b>645</b>	<b>121</b>	<b>100.00</b>	<b>1 592</b>

**Table 1**- Lithic technological categories from Amoreiras (ext. of the survey A), by level (total assemblage, including fragments).

1 - Debitage from prismatic cores



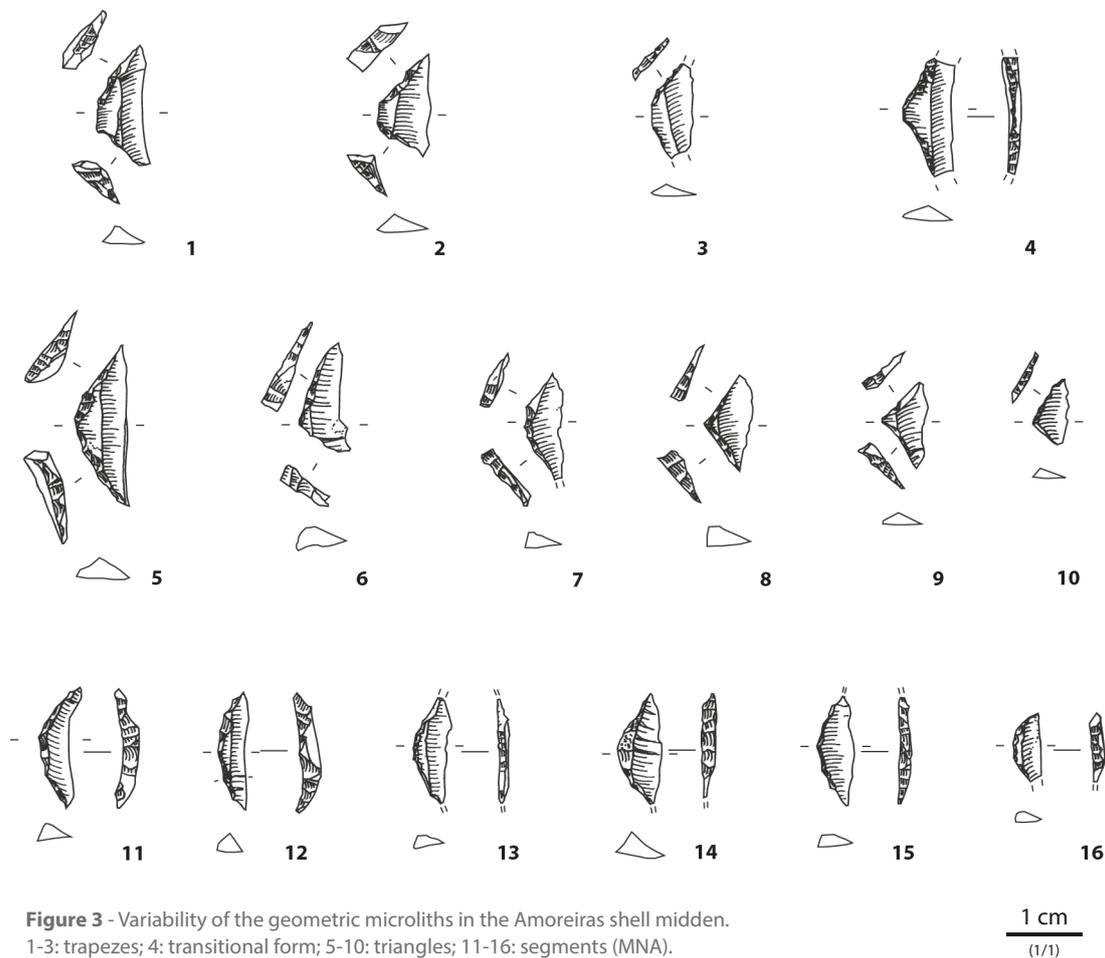
2 - Poorly standardized flake debitage and tool production



**Figure 2** - Lithic materials from the Amoreiras shell midden (Helena's excavations) and the two main technological strategies identified. 1-2: prismatic cores; 3-6: bladelets; 7-10: segments; 11-13: retouched bladelets; 14: microburin; 15: *chopper*; 16: marginally retouched flake; 17: semi-cortical flake (materials deposited in the National Museum of Archaeology – MNA).

The main knapping purpose would be the bladelet debitage from prismatic cores. Part of the bladelets was transformed, mainly into highly normalized geometric microliths. Segments are dominant (66.9% of the geometrics), mostly symmetrical forms (figure 3). The quantity of unretouched bladelets (23.1% of the whole lithic set) suggests that they would be used without transformation. The debitage of small and medium-sized flakes is also attested, although less expressively and mostly remaining unretouched.

The application of the prismatic method appears prevalent with the major exploitation of prismatic cores (72.7% of the complete ones), often until their exhaustion. Less expressive, the use of the 'random' method (Carvalho, 1998) to extract non-standardized flakes and scars is visible in some inform / polyhedral cores (16.4%) and flaked cobbles (2 exemplars). The production of tools (endscrapers and stone drills) from thick flakes, or directly using the cobbles as supports, is also significant.



The data does not show the existence of operative schemes depending on the raw material type. In spite of the diversity of the available rocks, there is a preferential use of siliceous slates and cherts for all the technological categories (table 2). Those rocks would be locally accessible as cobbles, in secondary deposits. A spared use of the best siliceous rocks from the core maintenance material exclusively obtained on chert is also visible.

Category	Chert	Siliceous slate	Jasper	Porphyr	Quartz-diorite	Quartz	Hyaline Quartz	Quartzite	Other	Undetermined
Cores	37.88	42.42	1.52	3.03	3.03	1.52	3.03	4.55	0.00	3.03
Core preparation/maintenance	52.38	47.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Debitage products	31.43	47.74	5.70	1.18	0.98	3.54	8.06	0.39	0.20	0.79
Retouched tools	43.87	42.75	8.92	0.00	0.74	0.00	1.86	0.37	0.00	1.49
Debris	20.77	57.91	9.22	0.55	0.55	2.89	6.46	0.14	0.00	1.51
<b>Total % (relative to the total assemblage)</b>	<b>29.27</b>	<b>51.32</b>	<b>7.60</b>	<b>0.75</b>	<b>0.82</b>	<b>2.51</b>	<b>5.97</b>	<b>0.44</b>	<b>0.06</b>	<b>1.32</b>

**Table 2** - Representation of the raw-material types in Amoreiras (%), by technological category.

Some signs of pressure bladelet debitage are present (table 3), but not in a dominant way. The employment of other flaking techniques, individually or in conjunction (Pelegrin, 2012: 467), is probable, namely the indirect percussion (table 4). Some flakes with big butts, pronounced bulbs and ripples (Carvalho, 1998: 79) also suggest the use of direct percussion. Although scarce, macroscopic signs of heat treatment were detected (thermic luster and homogenous texture, sometimes associated to more aggressive thermal alterations, following Boix Calbet, 2012) in 8.3% of the assemblage, mostly on chert. This procedure is attested in all the technological categories, namely on bladelets and microliths (table 5). Although often detected in several Neolithic contexts of the Southern Iberia (Manen *et al.*, 2007), the cultural origin of the heat treatment in Amoreiras – Mesolithic or Neolithic – is not clear, due to the scarcity of stratigraphic data.

The analysis shows the occurrence of knapping operations at this site, by using local resources and trying to spare both the provision and the manufacture efforts. The uniformity of the lithic set is visible, although there are some dissonant elements, like the heat treatment and a blade fragment with a pecked butt.

Character	%	Reference
Parallel edges	35.37 (complete bladelets)	Inizian <i>et al.</i> , 1999
Narrower butt than the max. width	5.38 (MNI)	Inizian <i>et al.</i> , 1999
Absent ripples	74.39 (total)	Pelegrin, 1984; Inizian <i>et al.</i> , 1999
Concave or plunging distal profile	59.76 (complete bladelets)	Binder, 1987; Brunet, 2012
Small and pronounced bulbs	46.24 (MNI)	Tixier, 1984; Binder, 2012
Facetted butts	17.20 (MNI)	Binder, 1987
Heat treatment	11.44 (total)	Inizian <i>et al.</i> , 1999; Boix Calbet, 2012
Character	mm	Reference
Mesial thickness (constancy)	2.36 ± 1.01 (MNI)	Inizian <i>et al.</i> , 1999

**Table 3** - Characters of the bladelets from Amoreiras suggesting the use of pressure technique.

Character	%	Reference
Flat butts	43.55 (MNI)	Binder, 1987; Carvalho, 1998
Fairly pronounced bulbs	41.94 (MNI)	Tixier, 1984

**Table 4** - Characters of the bladelets from Amoreiras suggesting the use of indirect percussion technique.

Technological category	%
Core preparation and maintenance	23.81
Cores	20.00
Bladelets	11.44
Blades	0.00
Flakes	6.02
Retouched tools	13.75
Debris	3.99

**Table 5** - Heat treatment incidence (%) on the lithic industry of Amoreiras (total assemblage).

### 3 - What cultural value for the lithic industry from Amoreiras?

Amoreiras has a long occupational diachrony - a burial dated to the final of the 7<sup>th</sup> millennium cal. BC, two radiocarbon dates fitted between the second half of the 6<sup>th</sup> and the beginning of 5<sup>th</sup> millennium cal BC, some Cardial ceramic fragments, vessels from different phases of the Neolithic, and finally, a microlithic industry with a clear predominance of segments.

The absence of domestic fauna (Albizuri Canadell, 2010) suggests that the post-Mesolithic occupations were incipient, but they cannot be excluded from the interpretation.

Thus, the inclusion of Amoreiras exclusively in the final phase of the Late Mesolithic, or its generic assumption as one of the recent shell middens of the Sado valley appears to be a maladjusted hypothesis. The late character of segments from the Mesolithic lithic assemblages also needs to be questioned, given the lack of stratigraphic data from the Sado shell middens.

### Acknowledgments

This work was done within my MA thesis project entitled *Techno-typology and chronometry in the Late Mesolithic of the Sado valley: the case of Amoreiras shell-midden (Alcácer do Sal)*, directed by Prof. Mariana Diniz (Lisbon University, Faculty of Letters) and concluded in 2012.

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## THE DECORATED MESOLITHIC ROCK SHELTERS SOUTH OF ÎLE-DE-FRANCE:

Revision of the Archaeological Data  
and Research Perspectives

**Alain BÉNARD, Colas GUÉRET**

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## THE DECORATED MESOLITHIC ROCK SHELTERS SOUTH OF ÎLE-DE-FRANCE:

### Revision of the Archaeological Data and Research Perspectives

Alain BÉNARD, Colas GUÉRET

#### Abstract

*The rock shelter art in the sandstone formations south of Île-de-France is mostly non-figurative. The blunted sandstone and flint objects interpreted as engravers and discovered in the stratigraphic levels of a few decorated caves enable use-wear analyses. A new study of ancient collections renews and refines chrono-cultural attributions in the Mesolithic.*

#### Keywords

*Rock engravings, non-figurative art, rock shelter, Mesolithic, new study of ancient collections, renewed typology, use-wear.*

## 1 - The main features of rock art south of Île-de-France

Known since 1864, the decorated rock shelters south of Île-de-France are dispersed among the Stampian sandstone formations known as the “Fontainebleau Massif”. Currently, approximately 1 200 of these sites of variable interest are known.

Mainly present in small cavities, this rock art comprises some Paleolithic, Protohistoric and Medieval engravings, but it is mostly attributed to the Mesolithic.

The majority of the engraved images are non-figurative (figure 1), consisting of single or parallel sets of grooves, cupules, grids, chevrons, cruciforms, arboriforms, scalariforms, etc. Most were realized by grooving, which favors the production of straight lines. The few circular representations are composed of small, straight lines that are joined together. A few semi-figurative engravings of humans or animals are also present, but are extremely schematic.

The proposed Mesolithic chrono-cultural attribution of this rock art is based on the presence of blunted objects interpreted as engravers and found only in the Mesolithic levels of the few shelters containing archaeological deposits. While the presence of these engravers supports the attribution of these engravings to the Mesolithic, an even more convincing element was discovered in the decorated shelter called the “Grotte à la Peinture” in Larchant, in the Seine-et-Marne department. Here, one part of the decorated wall collapsed onto a Mesolithic level and was then gradually covered by other Mesolithic and later levels (Hinout, 1993).



**Figure 1** - Boissy-aux-Cailles, Seine-et-Marne. Grid motifs in the Vallée du Jeton rock shelter.

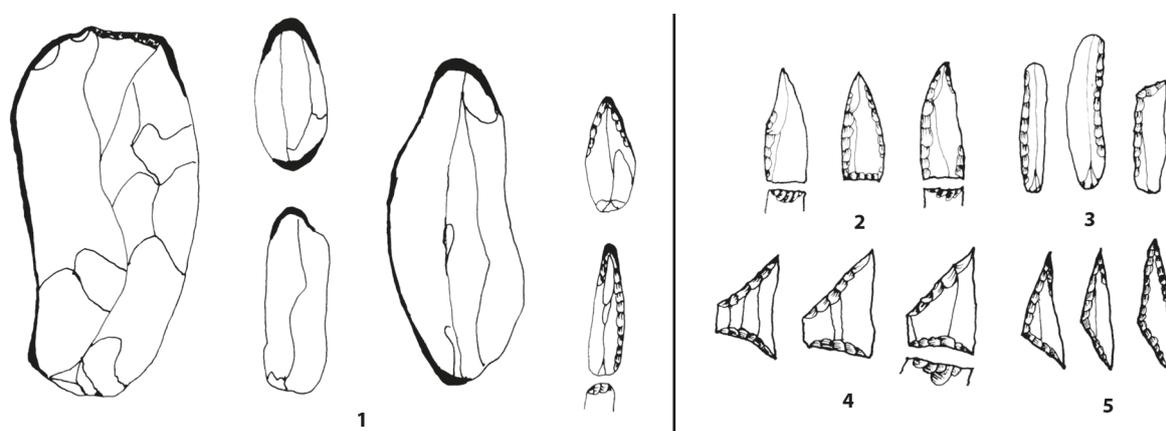
These engravings are dispersed on the rock shelter walls with no perceptible organization or preferential association. The locations of the rock shelters themselves also seem random. This rock art appears to be accumulative in nature. The engravers would thus have succeeded each other in time, realizing the graphic motifs imposed by their collective culture, but with no intention to create a coherent entity with the preceding engravings. Only the cavity itself seems to have been meaningful. The small size of nearly all of the decorated rock shelters allowed only individual actions. We currently know of no engravings in the open-air. We observe a relationship between the dispersion of the decorated shelters and the hydrographic system. This relationship may be nonetheless insignificant, being linked to the preferential location of campsites near water sources. We thus propose the concept of diffuse ritual sites in proximity to occupation sites.

## 2 - Archaeological data and research perspectives

The very abstract nature of the engravings has always complicated their chronological attribution. Beginning with the earliest studies, several researchers thus realized numerous test pits in order to find associated artifacts. Often very old and poorly recorded, these data are now of little value.

The four sites excavated by J. Hinout from 1974 to 1981, in the communes of Buthiers (Essonne) and Larchant (Seine-et-Marne), are exceptions. The published maps and drawings enable a revision of the data; the aim of this first phase of study is to verify the Mesolithic attribution of the majority of the engravings. To achieve this, it already appears necessary to distinguish the different occupation episodes (figure 2) associated at each site with elements from the last chrono-cultural studies. The Grotte à la Peinture also yielded faunal remains that might be datable by  $^{14}\text{C}$ . A specific analysis will focus on the 302 flint and sandstone engravers found at the four sites. Through a technological and typological approach, we will attempt to attribute the blanks to specific Mesolithic phases. Use-wear analysis will provide information on the correlations between the tools and the engravings by comparing dimensions of the blunted edges with the grooves made on the rock shelter walls.

If we are able to confirm the Mesolithic attribution, as indicated by our first observations, a large scale collective research program will be developed for the coming years. The sector of the cirque of Larchant was selected as a test zone due to its numerous engraved rock shelters and recorded Mesolithic elements. Survey and recording operations have recently increased in number and are currently being aided by the use of photogrammetry. From an archaeological perspective, new fieldwork will likely be necessary since the available data are insufficient and new questions have been raised. Re-excavating the stratigraphic sections of Hinout's excavation at the Grotte à la Peinture will enable us to make new observations of this 2.70 m deep sequence. The aim of a parallel survey program will be to identify the habitable rock shelters and evaluate their stratigraphic potential. An auger could be used to rapidly estimate their sedimentary depth and locate Mesolithic levels. The long term objective of this work is to revise and significantly augment the archaeological data in order to integrate the rock art of the region south of Île-de-France into the heart of the questions that currently orient research on the Mesolithic in the Paris Basin. Long neglected by the scientific community, this artistic entity unique in Europe must now play the role that it should have from the beginning.



**Figure 2** - Larchant - Grotte à la Peinture. 1: engravers (smoothed zones in black); 2: points with a retouched base; 3: backed bladelets; 4: trapezes; 5: triangles.

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## THE END OF THE MESOLITHIC ON THE SWISS PLATEAU AND THE NORTHERN JURASSIAN MASSIF

Laure BASSIN

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## THE END OF THE MESOLITHIC ON THE SWISS PLATEAU AND THE NORTHERN JURASSIAN MASSIF

Laure BASSIN

### Abstract

*The end of the Mesolithic and the transition toward the Neolithic in Switzerland is currently being studied through the technical systems of lithic tool manufacturing at two important sites: Arconciel / La Souche (Fribourg, Switzerland) and Lutter / Abri Saint-Joseph (Alsace, France). The various innovations and/or continuities in the lithic industries of these two sites have been analyzed with the aim of determining the evolution and distribution of lithic manufacturing techniques at the end of the Mesolithic and understanding, within these assemblages, possible influences from the Neolithic sphere.*

### Keywords

*Second Mesolithic, Mesolithic-Neolithic transition, Arconciel / La Souche (Fribourg, Switzerland), Lutter / Abri St-Joseph (Alsace, France), evolution of techniques.*

In Switzerland and in the Jura Massif, as in other regions of Western Europe, two phases are distinguished in the Mesolithic (Marchand, 2008). In terms of lithic industries, the first phase is characterized by diverse microliths (triangles, segments, diverse points) and by the manufacturing of products with little standardization. The second phase is distinguished by specific tool types (Montbani bladelets and trapezes) and the introduction of the indirect percussion technique. These modifications in the technical systems during the Second Mesolithic seem to have been diffused from the eastern or southern Mediterranean basin toward Western Europe starting in 7 000 BC (Perrin *et al.*, 2009). At around 6 600 BC, this change occurred in Switzerland with the first industries with Montbani bladelets and trapezes (or geometric bi-truncations), which probably arrived from the west (Nielsen, 2009: 684-685; Mauvilly, 2013: 108).

The diffusion of the Second Mesolithic in Europe, preceding that of the Neolithic, raises questions concerning its origin, developments and the relationships between hunter-gatherer and agropastoralist populations (Perrin *et al.*, 2009). In this context, the Swiss Plateau is an interesting study zone due to its geographic location in the center of Europe: on one hand, it is traversed by several natural circulation routes, such as the Rhone and Danube Valleys, and on the other, it is enclosed by two large mountainous massifs, the Jura and the Alps. Due to this paradox, it appears that its situation was unusual, especially at the end of this period: at around 5 000 BC, when nearly all of Europe ventured into the Neolithic, the status of the Swiss Plateau remains unknown (Voruz, 1991; Denaire *et al.*, 2011).

To gain a better understanding of the features linked to both continuity and innovation in the technical systems of regional Mesolithic populations, the lithic industries of two recently excavated stratified sites are currently under study: the first, Arconciel / La Souche (Fribourg, Switzerland), is located on the Swiss Plateau, at the foot of the Prealps, and the second, Lutter / Abri St-Joseph (Haut-Rhin, France), in the northern *Arc Jurassien*. These two rock shelters have several fundamental elements that can contribute to our understanding of the Second Mesolithic in this region.

First, in terms of geography, Arconciel / La Souche is located on the border of the Swiss Plateau, which has a natural north-east / south-west orientation, while Lutter / Abri St-Joseph is at the foot of the Jura Massif, turned toward the north: they are thus situated on two different circulation routes that are at the origin of distinct cultural differences. At Lutter / Abri St-Joseph, pot sherds attributed to the Grossgartach and two sherds with Linearbandkeramik type decorations, show contacts with Danubian Neolithic cultures (Arbogast *et al.*, 2011; Jeunesse *et al.*, 2014), while Arconciel / La Souche displays more ambiguous influences with both shell ornaments from the Mediterranean – probably arriving from the Rhone Valley, and a small decorated terracotta object resembling Balkan *pintadera* (Mauvilly *et al.*, 2008, 2013). The lithic industries of these two sites corroborate this cultural orientation. At Lutter / Abri St-Joseph, in the levels concerned, the stylistic influences can be linked with the northern Jura and the Danubian cultures; through Bavans points, for example, which are found at sites from the end of the Mesolithic in eastern France, as well as triangular weapon armatures of the Linearbandkeramik style. At the same time, a local component is seen in the typology with small symmetric points with invasive abrupt retouch and a concave base (Arbogast *et al.*, 2009: 42-44). The lithic industry of Arconciel / La Souche has not yet been linked to cultural spheres as Lutter / Abri St-Joseph has with the indigenous cultures of the northern Jura and the Danubian Neolithic cultures. A detailed study of the tools, weapon elements and their manufacturing techniques will provide information on the influences or local components of this assemblage.

Concerning raw material economy, these two sites are interesting in that they contain the main stones used for tool manufacturing in the region. These are the flints of the Jura Massif, the siliceous stones of the Prealps and Alpine quartz. These two sites each present specific examples of the organization of the *débitage* of these stones. At Lutter / Abri St-Joseph, the use, from the Mesolithic to the Neolithic, of the same raw material – small cortical nodules of different flints found nearby in the Jura Massif limestones – resulted in a dominant manufacturing strategy that was similar in the different phases of the occupation of the site. Blades and bladelets were the intended products. The latter, taking advantage of the natural convexity of the small flint nodules, did not involve extensive core preparation or intensive maintenance phases. At Arconciel / La Souche, the raw materials are much more diverse. Since there are no primary sources of siliceous rocks in immediate proximity to the site, various stones carried by glaciers and deposited by moraines, by river systems or by the movements of human groups, were used to manufacture tools. The three main rock types are from the Prealps: radiolarites, fine-grained quartzites and flint. There is also flint from the Jura Massif, as at Lutter / Abri St-Joseph, as well as flint imported from eastern France (Mauvilly *et al.*, 2006: 115-121). Since these stones have very different qualities, different manufacturing strategies were employed by the knappers at Arconciel / La Souche, and the results of studies of the economy of raw materials at this site will thus be interesting.

Finally, in terms of chronology, the two sites are complementary. At Arconciel / La Souche, the archaeological levels are more than three meters deep; they are radiocarbon dated to between 7100 and 4800 BC, with intensive occupations between 6600 and 5800 BC. At Lutter / Abri Saint-Joseph (Alsace, France), the stratigraphy is more compact, but extends from the Early Mesolithic to the Roman period. The levels that interest us, those of the Second Mesolithic and the beginning of the Neolithic, are dated to between 5700 and 4700 BC. Therefore, the specific qualities of these sites are, for Arconciel / La Souche, a succession of occupations throughout the Second Mesolithic, and for Lutter / Abri St-Joseph, the probable existence of contacts with the Danubian Neolithic.

The technical systems of the lithic tool manufacturing at these two sites are currently under study<sup>1</sup> with the objective of obtaining information on the evolution and distribution of techniques during the Second Mesolithic in Switzerland and in the Jurassian arc. Through this study, we aim to determine the role played by the circulation networks of ideas and by the somewhat marginal aspect of certain geographic zones in the composition of lithic assemblages. The final objective is to enrich and renew reflections on the origin and development of the Second Mesolithic in Europe.

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1. In the current state of research, we do not yet have results on this subject. This research is the subject of a PhD thesis at the University of Neuchâtel (Switzerland). It is funded by a project of the *Fond National Suisse* of the scientific research held at the University of Zurich (100012\_140419) and the Archaeological Service of the State of Fribourg for Arconciel/La Souche. It is realized in collaboration with the University of Strasbourg (CNRS UMR 7044) for Lutter/Abri St-Joseph.

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## LATE MESOLITHIC AND EARLY NEOLITHIC COASTAL ENVIRONMENTS IN SOUTH-EASTERN FRANCE:

### the Contribution of Pollen Data from the Loup and Cagne Plains (Alpes-Maritimes)

Sébastien GUILLON

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Sébastien GUILLON

#### Abstract

*During the first half of the Holocene, climatic conditions, anthropogenic conditions and sea levels underwent numerous and significant modifications. To qualify the response of the coastal alluvial vegetation to these changing conditions between the end of the 8<sup>th</sup> and the 5<sup>th</sup> millennia, a high-resolution pollen analysis of two sedimentary alluvial sequences (Le Loup and La Cagne basins) was realized. The results, obtained through a multidisciplinary approach, show the precise evolution of the coastal and alluvial ecosystems. The rise in sea level and climatic forcing played a fundamental role in this evolution. While anthropogenic forcing during the Mesolithic was not significant, the Neolithization of the region also contributed to shaping the coastal landscapes. From the first decades of the 6<sup>th</sup> millennium onwards, the recurrence of the *Cerealia* pollen type shows the importance of coastal alluvial plains in the production economy of the first Neolithic groups.*

#### Keywords

*Palynology, Mediterranean coast, Mesolithic, Neolithic, sea level rise, climatic variations.*

## Introduction

The region of the Liguro-Provençal arc is of great interest for understanding the societies of the end of the Mesolithic and the Neolithic, in terms of both the diffusion of techno-cultural complexes in the north-west quarter of the Mediterranean (Binder *et al.*, 2008; Binder *et al.*, 2012; Binder, 2013), and the management and occupation of natural environments (Thiébaud, 2001). In this context, the palynological recording of the evolution of the vegetal environment of the Le Loup and La Cagne coastal plains (Alpes-Maritimes) (figure 1) during the Mesolithic / Neolithic transition is highly useful.

To achieve this aim, a multidisciplinary approach was applied to two coastal sedimentary sequences collected from the Le Loup and La Cagne plains. Based on several radiocarbon dates and the realization of an age depth model (Guillon, 2014) it was possible to record the evolution of the coastal vegetation during the 7<sup>th</sup> and 6<sup>th</sup> millennia cal BCE. The variations occurring in this biogeographic evolution can be divided into three categories: eustatic variations, paleo-hydrological and climatic variations, and anthropogenic variations.

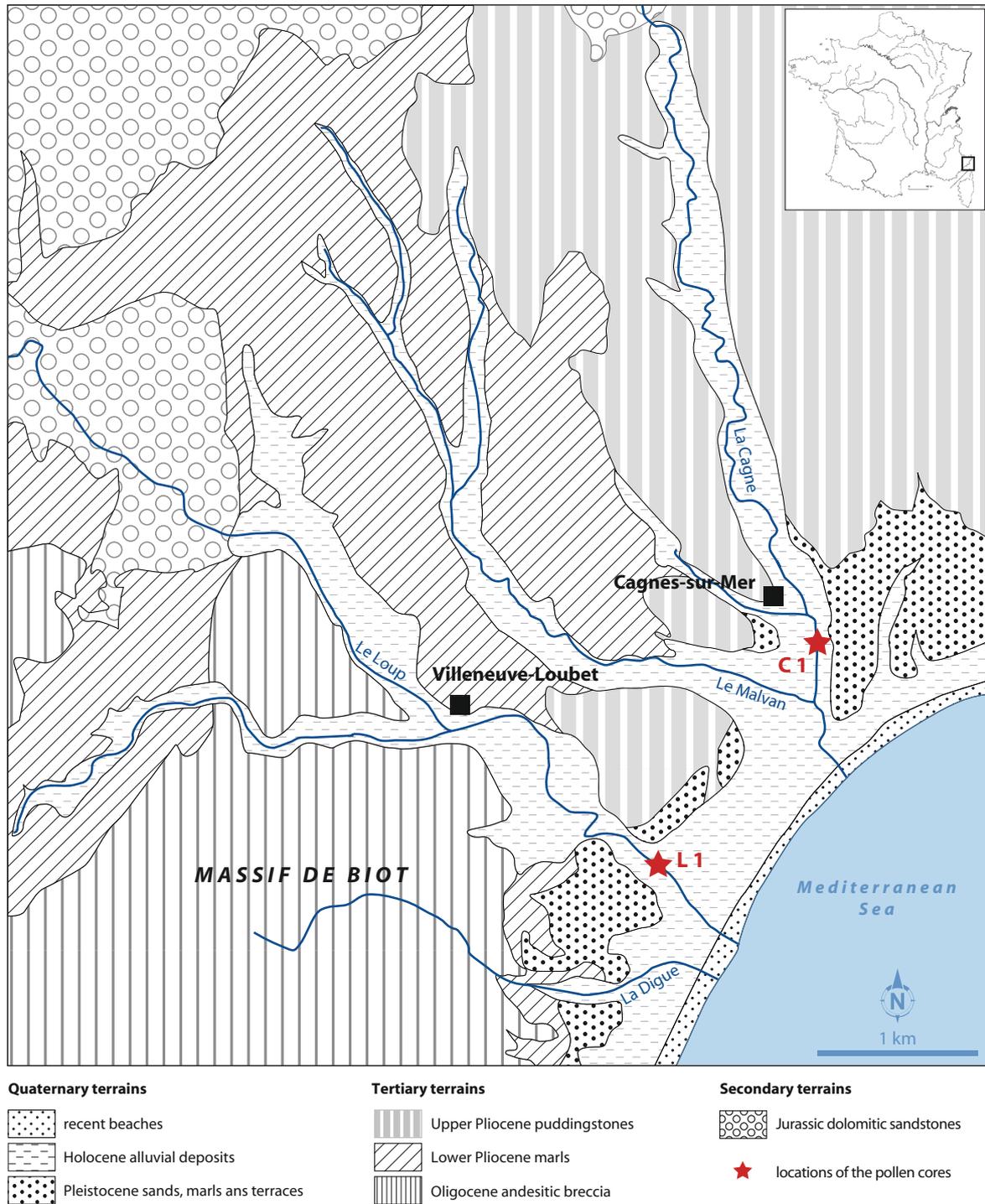


Figure 1 - Locations of the pollen cores.

## 1 - Geomorphological forcing

The geomorphological forcing of the coastal plains is mainly dictated by the balance between the eustatic mechanisms and the fluvial detrital energy (Dubar, 2003). From this balance emerge the transgressive and prograding processes that define the coastline and result in its mobility. The analyses of the pollen cores of Le Loup and La Cagne showed that numerous variations recorded by the pollen spectra are defined by the eustatic forcing. This is the case for the appearance of alder in the pollen cores of both sites (figure 2), as well as on the plains of La Brague (Alpes-Maritimes) (Nicol-Pichard, Dubar, 1998) and Rapallo on the Ligurian coast (Bellini *et al.*, 2009), for example. This appearance reflects the installation of a lagoon and the development of an alder swamp following a rapid rise in sea level. These lagoon environments appear in the diagrams of Le Loup and La Cagne between 6 400 and 6 200 cal BCE.

## 2 - Climatic and paleohydrological forcing

The influence of the paleohydrological process and, on a larger scale, that of the climatic variations between the 7<sup>th</sup> and 5<sup>th</sup> millennia BCE also had an impact on the composition of the pollen spectra of Le Loup and La Cagne. Using high-resolution analysis, it was possible to observe within the evolution of pollen recordings, different stages in the vegetal succession, linked to flood regimes. When floods increased in frequency, the riverine vegetation underwent several regression or renewal phases that are characterized by the development of a herbaceous pioneer stratum, identified in the diagram (figure 2) by the increasing values of miniature cattail (*Typha minima*), included in the curve of helophyte plants and Cyperaceae (Rameau *et al.*, 2001). When the flood regime diminished in intensity, or when the active canal course moved away from the location of the test-pit during the process of deflection, the association of *Thyphetum minima* was replaced by post-pioneer and mature aborescent taxa, including alder (*Alnus*), willow (*Salix*) and ash (*Fraxinus*), whose sum is represented in the diagram by the riverine forest curve (*ripisylve*) (figure 2). This succession was observed several times in the Le Loup and La Cagne sequences and should be used as a direct marker of the paleohydrological dynamic. The drought and atmospheric humidity conditions also played a structural role in the coastal alluvial vegetation. Here the increasing values of Fir (*Abies*) indicate an increase in humid conditions during the 6<sup>th</sup> millennium BCE, compared to the 7<sup>th</sup> and 5<sup>th</sup> millennia BCE. This humidity is not linked to the annual flood regime, but enables us to record the seasonal variations of atmospheric humidity, as well as the summer drought conditions (Guillon, 2014). When we compare the increasing values of fir in the Le Loup and La Cagne valleys with the pollen data of La Brague at Biot (Nicol-Pichard, Dubar, 1998) and those of Accesa on the Tuscan coast (Finsinger *et al.*, 2010), it is possible to show that during the 6<sup>th</sup> millennium there was a regional climatic trend characterized by warmer and more humid summers. By decomposing the pollen spectra, it is thus possible to distinguish the different determinant ecological factors: eustatic, geomorphological, paleohydrological and climatic. The last one, human activity, is probably the most difficult to identify.

## 3 - Anthropogenic forcing

While during the Late Mesolithic, there is no evidence for anthropogenic forcing of the vegetal environment, from the very beginning of the Early Neolithic, practices linked to grain cultivation resulted in several successive phases of Mediterranean oak-elm forest regression (figure 2).

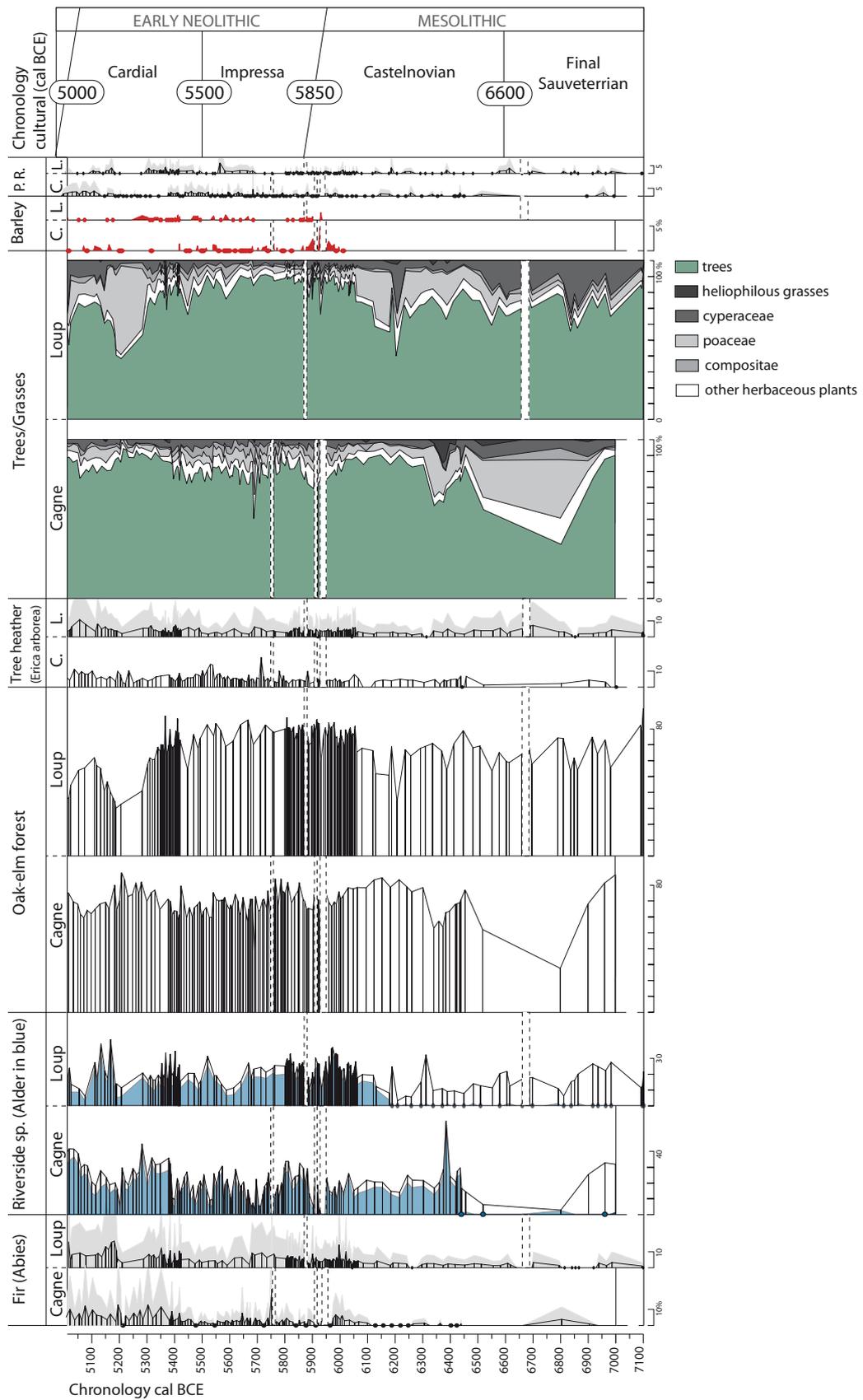


Figure 2 - Synthetic pollen diagrams of the Loup and Cagne cores (Alpes-Maritimes). C.: La Cagne; L.: Le Loup; P.R.: ruderal plants.

When the first Early Neolithic groups (Impresso-Cardial) settled on the Azur coastline, the appearance of *Cerealia* types (*Hordeum*) in the diagram is accompanied in both river basins by an expansion of ruderal plants (especially at La Cagne), and a regression of the deciduous forest cover (figure 2). This continues for around a century at La Cagne, between 6 000 and 5 900 cal BCE. It also occurred at Le Loup, but more variably, and concentrated in two episodes. The first was at around 5 925 cal BCE, and the second at around 5 875 cal BCE. This parallel evolution of paleo-ecological evidence tends to show that the Impresso-Cardial settlements of the Alpes-Maritimes were associated with a management of the alluvial zones. This rapidly extended to the mature oak-elm forest, which for the first time shows signs of human impact in the middle-term. This double observation made at Le Loup and La Cagne also shows that as soon as the first agro-pastoral groups settled there, the coastal/alluvial zones were occupied and exploited, and thus considered as favorable locations for a Neolithic economy.

## Conclusion

This comparison of pollen data with the archaeological record of the river basins has proven to be very useful. Even if the archaeological record in this area is very poor, in terms of both chronology and the surveyed and/or excavated sectors, the confrontation of these data appears to be very relevant.

The absence of anthropogenic forcing during the final phase of the Sauveterrian and the Castelnovian on the alluvial vegetation of Le Loup and La Cagne could be explained by two main observations. The first concerns the absence of Mesolithic sites in the river basins, even if some indications of a Castelnovian occupation were recently observed on the Biot massif (oral communication D. Binder). The second concerns the predation economy of Mesolithic societies, which in contrast to the production economy of Neolithic groups, in theory has only a minor impact on the vegetation in which they evolved.

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# THE MESOLITHIC – NEOLITHIC TRANSITION ON THE SOUTH-WESTERN PORTUGUESE COAST: Preliminary Data on the Shellmidden of Paço Velho 2

**Helena REIS**

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Helena REIS

### Abstract

The Portuguese south-western coast was a pivotal point of social interactions between hunter-gatherers and Neolithic communities (~6500-4000 BC). Despite being located between two central areas on the debate of the neolithisation process in Portugal, the south-western coast and the Mira valley have occupied a peripheral place on the investigation. The present investigation research was developed under a master thesis study which aim was to analyse the territory of those communities, as well as searching for their settlement patterns. The identification of a new Mesolithic site on this region, Paço Velho 2, reveals some characteristic details of the lives of the last hunter-gathers communities of the southern Portugal.

### Keywords

Neolithisation, Portuguese south-western coast, Mira river landscape.

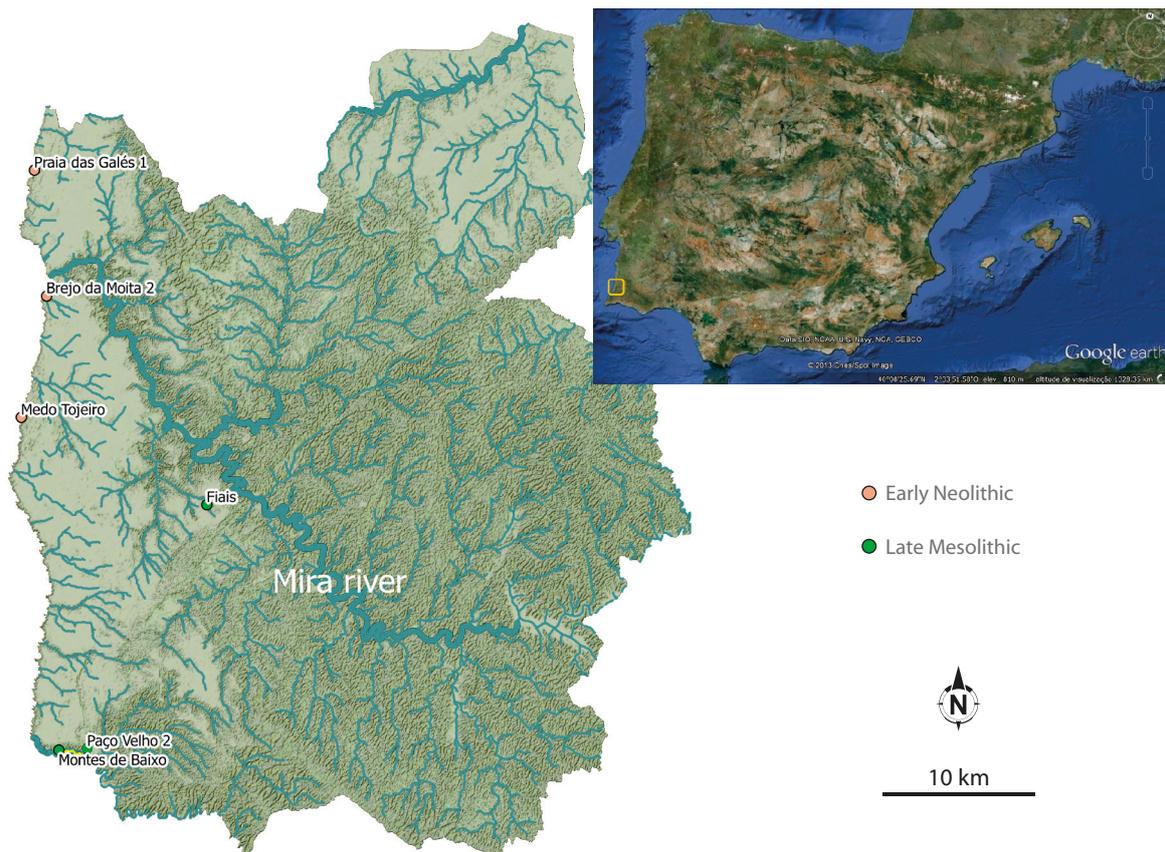
## Introduction

The area under study is located on the south-western coast of Portugal (*Alentejo Litoral*), more restrictively on the municipality of Odemira, comprising the lowest part of the Mira valley. Geomorphologically, the archaeological sites are located on the “*Planície Litoral Ocidental*” which consists on a thin zone constituted by smooth slopes. This geomorphological unit covers the Palaeozoic bedrock and is covered by very thin sands and small pebble stones (Feio, 1984: 11-14).

Between 6000 and 4000 cal BC, this area has been the place of cultural changes and transformations that have been investigated during the 1970’s and 1980’s based, mainly, on the sites that have absolute chronometry. Two sites have been dated as Late Mesolithic: Fiais (González Morales, Arnaud, 1990; Lubell *et al.*, 2007) and Montes de Baixo (Silva, Soares, 1997). One site, Medo Tojeiro, has been dated as Early Neolithic<sup>1</sup> (Silva *et al.*, 1985; Lubell *et al.*, 2007) ([figure 1](#)).

In the frame of an on-going project<sup>2</sup>, we conducted archaeological surveys following the criteria connected to the known settlement patterns of Mesolithic and Neolithic sites on this region. Apart from identifying new sites, we revisited the known ones in order to verify their actual state of conservation and to identify probable geological sources of the lithic artefacts. At the end of the surveys, within this chronological range of time, we had identified the Mesolithic shell midden of

1. Besides Medo Tojeiro, there are also two other sites excavated and attributed to Early Neolithic (Água da Moita and Praia das Galés: Soares, 1997), without any published absolute date.
2. “The Mesolithic and Early Neolithic Settlement on the Valley of Mira, and its regional context”, under the responsibility of Helena Reis and Professor Mariana Diniz.



**Figure 1** - Location of the archaeological sites excavated and/or dated mentioned in the text in Odemira (municipality) (Image of the author; Map from Google Earth and water courses from Atlas do Água water courses from Google Earth and Atlas da Água, <http://geo.snirh.pt/AtlasAgua/Default.aspx>).

Paço Velho 2<sup>3</sup> and the Neolithic / Calcolithic site of Paço Velho 6. Concerning the state of conservation, we concluded that some of the old known sites are endangered. Because of their location, mainly on the cliffs near the beaches, they are exposed to natural erosion and human factors.

## 1 - The site of Paço Velho 2 and its place in the landscape

The site of Paço Velho 2<sup>4</sup> is located near the Ribeira de Seixe, on a smooth hill, at an altitude of about 64 m, at approx. 4.5 km from the ancient coast line<sup>5</sup> (figure 1). The site has a very good visual dominance over the landscape and it is located very close to a water source. The geological background consists of Plio-Pleistocene sands (Pereira, 1987: 75). Despite the poor visibility of the soil in some places, we were able to identify numerous shell remains, highly concentrated in some areas, but mixed on the soil surface. The identified species clearly testify of the exploitation of the littoral coast near the site (*Patella* sp., *Mytillus* sp. and *Thais haemastoma*) and the estuary area of the nearby riverine environment (*Cerastoderma edule*, *Ruditapes decussata*, *Ostrea edulis* and *Crassostrea angulate*).

3. We thank to our colleague Joel Rodrigues for the information about this new site.
4. Municipality of Odemira, CMP: 568; coordinates: 37,437825 N-8,759783 W.
5. These values were calculated based on Dias, 2004.

The archaeological materials recovered were essentially flint bladelets (mostly unretouched), debitage waste, a bladelet core, some tools (a trapeze and a scraper) and an artefact made of siliceous schist (punch?) (figure 2).

The lithic raw materials found on Paço Velho 2 can now be attributed to two major sources. The local availability of quartzite, quartz and siliceous schist is represented on flakes and knapping waste. On the other hand, the siliceous rocks found on Paço Velho can all be classified as flint. The probable source of this flint is the region of Cape S. Vicent (approximately 50km of distance) (personal communication of geologist Nuno Pimentel), although no chemical analysis on the flint samples was performed. Other probable flint sources are recorded in the geological map near the town of S. Teotónio (approximately 9 km from Paço Velho 2), but they have not been found yet. The available data and its archaeological context do not allow us to define if Paço Velho 2 was a base establishment or a logistical one.

Chronologically, Paço Velho 2 can be ascribed to the second half of the 6<sup>th</sup> millennium BC, taking into account a radiocarbon date recently obtained (table 1).

Provenience	Sample	Lab. Reference	Age BP	Calibrated Age (cal BC)	
				1 $\sigma$	2 $\sigma$
Surface	Marine shells	Sac - 2847	6930 $\pm$ 60	5464-5350	5518-5288

**Table 1** - Paço Velho 2: <sup>14</sup>C date. The calibration of the radiocarbon date was made using the Marine 13 calibration curve (Reimer *et al.*, 2013) and the program Calib 7.0.0 (Stuiver, Reimer, 1993). The correction for the oceanic reservoir effect was based on Soares and Dias, 2006 ( $\Delta R = 95 \pm 15$  years <sup>14</sup>C).

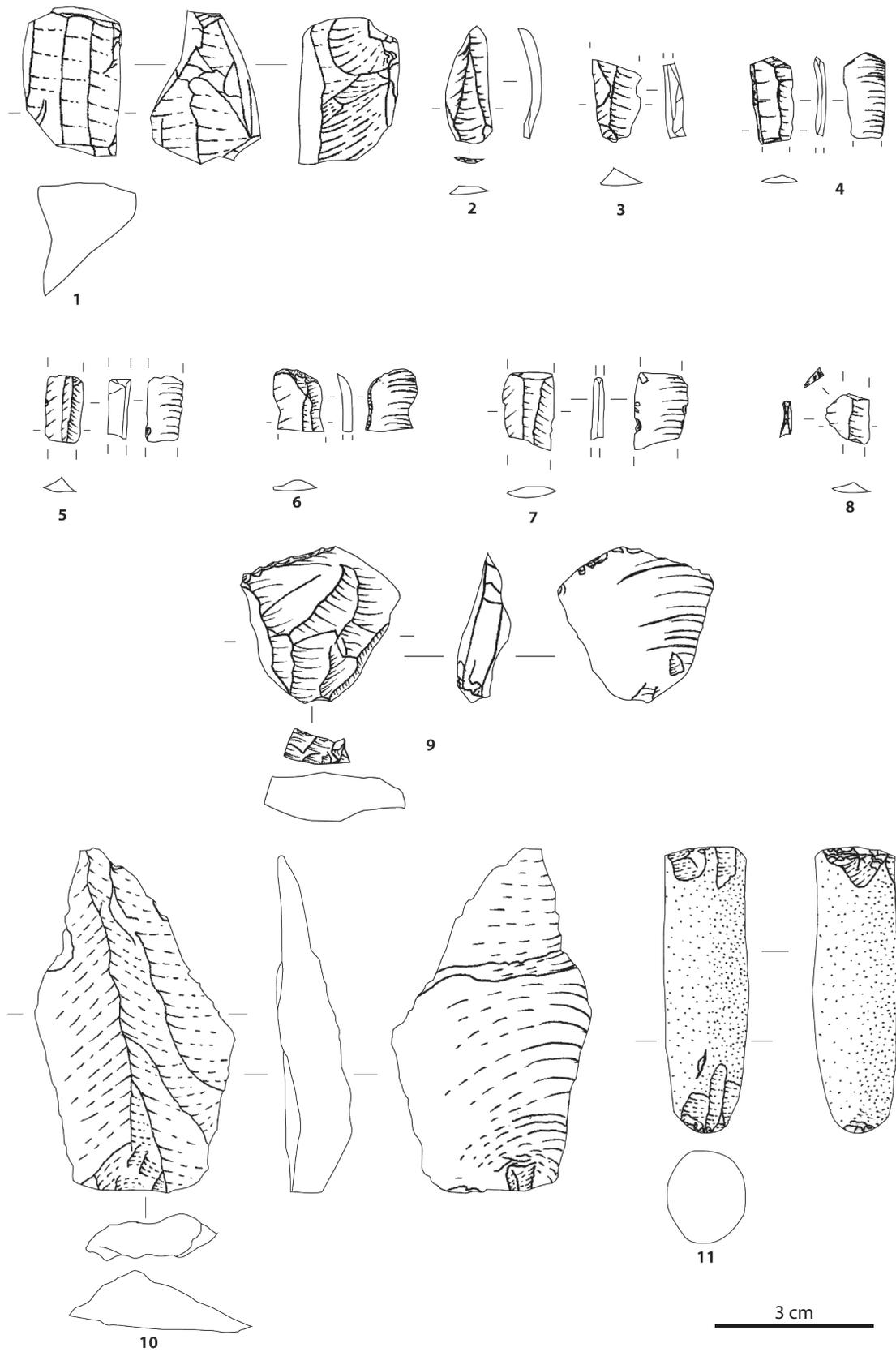
The discussion of this date brings some relevant issues – first of all, the context of the recovered sample. The dated shells were recovered from the surface of a restricted area on the site. Nevertheless, the sample can be originated from different archaeological contexts. The date (5518-5288 cal BC) cannot be correlated with an initial or a final occupational moment of this site.

Although the contexts for some dates are not very clear, and despite the different interpretations (Carvalho, 2010), we can suggest that Neolithic groups at Vale Pincel (Soares, Silva, 1981), Vidigal (?) (Straus, Vierra, 1990), Medo Tojeiro (?) (Silva *et al.*, 1985), Rocha das Gaivotas (Carvalho, Valente, 2005), Cabranosa and Padrão (Carvalho, 2008) are already in scene in this region and at that time opposing to the still occupied Mesolithic sites like Samouqueira I (Soares *et al.*, 2005-2007) and Fiais (Lubell *et al.*, 2007). This situation and the fact that no ceramic fragments were found suggest that Paço Velho 2 might represent a place occupied by the last hunter-gatherers of the region.

By looking at the settlement patterns on the region under study, we can point out that the Late Mesolithic sites stand near the important water courses (Fiais: González Morales, Arnaud, 1990; Montes de Baixo: Silva, Soares, 1997; Paço Velho 2) and that the Neolithic sites are located more closely to the coast line and the small water courses (Medo Tojeiro: Silva *et al.*, 1985; Praia das Galés, Água da Moita: Soares, 1997).

## 2 - Final Remarks

The identification of Paço Velho 2 contributes to a better understanding of the South-western coast cultural landscape on the beginning of the Holocene. Placing this site on a landscape that is shared by different cultural groups may be not clear at the first sight, but some paths of investigation can now be appointed. We still need more chronological data to understand if there is contemporaneity between the sites, and so, if this truly is a shared landscape. Also more survey works are necessary to clarify the role of the big territorial unit (Mira river) on the lives of the hunter-gatherers and the Neolithic societies, since for now it remains unclear.



**Figure 2** - Lithic materials from Paço Velho 2. 1: Bladelets' core on a metamorphic rock; 2-4: Flint bladelets; 5-7: Retouched flint bladelets; 8: Trapeze; 9: Flints' scraper; 10: quartzite flake; 11: possible punch on silicious schist (drawings : H. Reis).

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