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Lithic Tool Kits: a Metronome of the Evolution of the Magdalenian in Southwest France (19,000–14,000 cal BP).

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abstract

Under the Magdatis project a new evolutionary model has been proposed for the Middle and Upper Magdalenian based on a review of several lithic assemblages from southwest France. The Lower Magdalenian is not addressed in this article. Single lithic assemblages and stratigraphic sequences have been compared according to several parameters: the origin of the siliceous raw materials, the interconnection between domestic tool production and hunting armatures, and the typo-technology of the microliths. Alongside the new techno-economic data, the geographical distribution of certain practices and particular artefacts in southwest France has led to a discussion of the cultural geography of the different phases of the Magdalenian between 19,000 and 14,000 cal BP. The Early Middle Magdalenian covers an extensive European cultural territory, demonstrating social interactions over vast distances both in the circulation of raw materials and in the distribution of certain morphotypes of lithic armament. The Late Middle Magdalenian appears to correspond to a phase of population contraction in which cultural emulation is observed among lithic tool kits in the socio-economic value placed on large blades. The Early Upper Magdalenian coincides with the renewed settlement of the north Aquitaine plains. Among the technological innovations observed is the development of lithic points on small blades, leading to a first geographical division of the southwest (Aquitaine Basin versus Pyrenees). Finally, the Late Upper Magdalenian confirms this evolution of lithic equipment with new developments in lithic armaments in parallel with some easing off of the technical constraints associated with blade production. This period thus coincides with the progressive dilution of Magdalenian norms. With these four phases of the Middle and Upper Magdalenian, it is possible to gain a clearer understanding of the sequence of technical and economic changes observed in an environment in recomposition. At the same time, population fluctuations over these five millennia can be associated with developing phenomena of regionalism, particularly in the southwest of France.

Keywords: Final Palaeolithic, Magdalenian, Lithic Tool Kits, Armaments, Territory, Settlement.

1. Introduction & Regional Setting

In recent years, several extensive studies of the lithic tool kits of the Middle and Upper Magdalenian (19,000-14,000 cal BP) have allowed the existing literature in Western Europe

to be renewed (e.g. Valentin, 2008; Fullola et al. dir., 2009; Mangado ed., 2010; Langlais, 2010, 2011; Mevel, 2010, 2013; Zubrow et al. eds., 2010; Béréziat, 2011; Cattin, 2012; Straus et al. eds., 2012; Taylor, 2012; Angevin and Surmely, 2013; Cretin et al. dir., 2014, Julien and Karlin dir., 2014). In southwest France, the pioneering studies of the 1960s-1990s were a fundamental step in this research, allowing the data to be organized at a regional level (e.g. Le Tensorer, 1981; Lenoir, 1983; Sacchi, 1986). After an attempt to modelize Magdalenian with statistical tools (Bosselin and Djindjian, 1988), the incorporation of typo-technological analyses from 1990 to 2005 then allowed some of regional models to be established in greater detail (Lacombe, 1998, 2005; Cazals, 2000, 2005; Bündgen, 2002; Dachary, 2002; Langlais, 2007a). The years 2000-2015 were marked by the introduction of new “typo-techno-economic” approaches and the systematization of taphonomic analyses (e.g. Langlais, 2010; Mevel, 2010; Béréziat, 2011; Langlais et al., 2015).

The geographical area studied was the French southwest. Covering an area of around 100,000 km², it is bounded to the north by the Poitou and to the south by the Pyrenees. The foothills of the Massif Central form the easterly limit of our study area (Figure 1). To the west, the Atlantic coast has seen its coastline evolve (-120 to -100 m at the time; Fairbanks, 1989; Deschamps et al., 2012). The Landes de Gascogne, which recent research has shown to have involved a sandy desert in the Pleistocene (Bertran et al., 2013; Sitzia, 2014), is also a geographical feature that structured the landscape during the Magdalenian. While the main rivers in the Aquitaine Basin are orientated east-west, the valleys of the Pyrenees are orientated north-south and their accessibility significantly evolved with the retreat of the glaciers just before the start of the period discussed in this article (Calvet et al., 2011). The French southwest involved a mosaic of biotopes as demonstrated in particular by the variability of the faunal spectra exploited (Langlais et al., 2012, 2014; Castel et al., 2013; Pétillon et al., 2014; Costamagno et al., this volume).

The objective of this study was to propose a new chronostratigraphic framework for the Middle and Upper Magdalenian based on the review of several lithic assemblages. While in the first half of the twentieth century, prehistorians Breuil (1913, 1937) and Peyrony (1936) subdivided the main phases of the Magdalenian into different stages according to the presence of lithic and osseous markers, these successions of stages, which were defined according to uncontrolled stratigraphy, are now considered too linear and did not take regional variations sufficiently into account. As a result, they have been abandoned by the majority of prehistorians. At the same time, the use of phases (i.e. lower, middle, and upper) has become widespread even though they do not always cover the same archaeological realities (see the debates on the Magdaleniense Inferior Cantabrico and the Magdalénien Moyen on either side of the Pyrenees in e.g. Utrilla et al., 2012; Langlais, 2013; Montes and Domingo, 2013). Recent comparisons of lithic and osseous weaponry (Langlais et al., 2012, 2014, in press; Pétillon et al., 2014) have complexified the unilinear two-phase model of the Middle and Upper Magdalenian. This is also supported by analyses of stratigraphic data in correlation with new radiometric dates on specific bone artefacts (Barshay-Szmidt et al., this volume; Pétillon, this volume). Within this context, we have focused on the Middle and Upper Magdalenian and will not discuss here the Lower Magdalenian. This new division has allowed us to establish a dynamic overview of the period of 19,000 to 14,000 cal BP taking into account the evolution of lithic tool kits together with the changes in territorial distribution and social interaction in the French southwest.

2. Material & Methods

The lithic material analyzed under the Magdatis project was taken from around 15 sites on either side of the Sable des Landes and two sites within the Pleistocene sandy desert itself. This was supported by studies carried out under the Programme Collectif de Recherches coordonnées by P. Paillet around the valleys of the Dronne and the Tardoire; results obtained from programmed excavations (Peyrazet, Lot; Sainte-Colome and Laa 2, Pyrénées-Atlantiques); and comparative studies published elsewhere. The analyzed corpus was thus composed of almost 40 lithic assemblages from the French southwest as well as assemblages from the margins of the study area (Figure 1, Table 1).

In parallel to the discovery or reassessment of the few open-air sites in the region (Mangado et al., 2010; Lacombe et al., 2015; Langlais, in press), the bulk of our work has focused on stratified assemblages in caves and rockshelters. In such contexts, the homogeneity of the assemblages is questionable and should be approached with caution. While lithic refits can help us to understand operational sequences and to carry out palethnological analyses of a habitat, they are also proving an effective tool in establishing stratigraphic reliability (e.g. Bordes, 2002; Langlais et al., 2007; Béreziat, 2011). Furthermore, the projection of chrono-cultural lithic or osseous markers on a vertical plane, as well as that of some animal species, has also contributed to this reassessment of early excavations (which nonetheless benefitted from a three-dimensional record of the artefacts). Under the Magdatis project, studies of this kind have been carried out at some of the sites in the Gironde, such as at Saint-Germain-la-Rivière and Roc-de-Marcamps 2 (Langlais et al., 2015; Kuntz et al., in press). In the case of sites where no coordinates were recorded, it has been possible to operate in terms of density per level, such as at Morin rockshelter (Mallye et al., submitted).

Once they had been assessed from a taphonomic perspective, the lithic assemblages were compared according to several parameters: interconnection between the domestic tools and hunting armatures, typo-technology of the microliths, and origin and distribution of the siliceous raw materials. Alongside the new chrono-stratigraphic and techno-economic data acquired, the distribution of practices and certain innovations in the southwest of France and its fringes lead to the discussion of the cultural geography of the different phases of the classic Magdalenian. Based on a corpus of reassessed ¹⁴C dates (Barshay-Szmidt et al., this volume), we have been able to distinguish four phases in the evolution of the Middle and Upper Magdalenian, between 19,000 and 14,000 cal BP, according to the typo-technological and stylistic characteristics of the lithic (this paper) and osseous industries (Pétillon, this volume). Between each of these phases, transition periods reflect the lack of clarity in the stratigraphic records of caves and rockshelters (Figure 2).

3. Results

Within a revised radiometric framework, we here present the main characteristics of the lithic tool kits for each of the phases, and then place them in their cultural and economic settings. The four phases of the Middle and Upper Magdalenian experienced a succession of climate changes, reflected in the various archives used (Heinrich stadial and event, Greenland ice core GICC 05, Sea Surface Temperature graphs; see Figure 2). The environmental impacts of these climate changes are visible in the faunal spectra (Costamagno et al., this volume) as well as in the varying extent of the available territories due to changes in the elevation of the coastlines and the retreat of glaciers (see below).

3.1. Early Middle Magdalenian (ca. 19,000-17,500 cal BP)

This first phase is mainly known in Western Europe through two "facies" defined by the presence of certain elements of osseous equipment: Lussac-Angles points and *navettes*. The distribution of these two elements has structured its cultural geography from Poland to the Cantabrians (e.g. Allain et al., 1985; Bertrand et al., 2003; Pétilion and Averbouh, 2013). This period, which belongs to the same phase of the glacial chronology (GS 2.1b) as the Lower Magdalenian and to the first stage of the Heinrich 1 event according to Stanford et al. (Figure 2), demonstrates a marked development in the hunting spectra of the north Aquitaine in the hunting of the saiga antelope (e.g. Costamagno, 2001).

In the field of lithic industry, several arguments converge on the idea of the dissociation of blade and bladelet production processes. While from a strictly dimensionally point of view, there is some overlap in the sizes of the untreated blanks for the smallest blades and the largest bladelets, there is a marked division between the blanks for tools and microliths (Figure 3). Standardized blades extracted with a soft organic hammer were transformed into tools for domestic use. The knapping sequence, which was preferentially unipolar, was based on the transverse management of convexities and reflects a desire to optimise the length of the blanks (Figure 4). Due to the constraints of the raw materials required for this techno-economic preference, local flint could be supplemented by raw material and blanks from a radius of 250 km around the settlements. Among the newly identified sources of flint for the regional Magdalenian, we have been able to demonstrate, in varied proportions, flint from Saintonge (50-80km), Poitou (150 km), and the Cher valley (200 km) in the north, as well as Chalosse (200 km) in the south (Langlais et al., 2015; Sécher, in press; Langlais et al., in press). It is difficult to make quantitative estimates on early excavations, as a selection of "fine blades" could have lead to an overrepresentation of flint from the Lower Turonian in the Cher valley in Saint-Germain-la-Rivière upper terrace (Blanchard and Mirande excavations) and Les Féés (Daleau excavations). Nonetheless, the contrast between the low lithological diversity of the industries of Saint-Germain-La-Rivière (Trécolle excavations) and the comparatively high presence of flint from the Cher and Chalosse at Moulin-Neuf level 2 are significant and illustrate the complexity of the socio-economic networks of this period (see below).

The different assemblages attributed to the Early Middle Magdalenian (EMM) that we examined include domestic tools on relatively robust calibrated blades of around 20 mm in width and 5–6 mm in thickness on average. This equipment is generally dominated by burins, end scrapers, retouched blades, and truncated pieces (Table 2, Figure 4). There is a relative inter-site variability of certain tools such as the high presence of pointed blades at Saint-Germain-la-Rivière and splintered pieces at Moulin-Neuf (Table 2). These variations can be related in part to the nature of the settlements. While the length of the initial blades allowed the lifespan of end tools such as burins, end scrapers, and pointed pieces to be optimised, the demand for wide blanks reflects a particular management of blade edges, frequently with deep scaled retouch.

Disassociated from blade knapping, bladelets were produced in a variety of ways according to their different initial morphologies. Local raw materials were greatly put to use. Some pieces with narrow fronts were produced from flake edges while others progress in a more encompassing manner on nodules. These two main methods yielded bladelet blanks adapted to the straight profile and transformed into armatures with a cutting edge (Figure 4). This mainly involved backed bladelets among which, if we consider the pieces for which at least one extremity has been conserved, truncated backed bladelets and/or scalene bladelets represent a large proportion, along with simple backed bladelets, sometimes with denticulated edges (Table 2). In the assemblages studied, the relationship between tools and weapon tips is homogeneous (index = 0.5). Among the lithic assemblages that can be attributed to the Lussac Angles point Magdalenian of the French southwest (Les Féés, Canecaude level 2, Plantade

lower level, and some of the artefacts from Isturitz II), some truncated backed bladelets and scalene bladelets are observed as well as a few bladelets with denticulated backs and edges. Strong similarities are observed between these assemblages and those of Roc-de-Marcamps and Moulin-Neuf level 2 which are generally attributed to the *navettes* Magdalenian (Kuntz et al., in press; Langlais et al., in press). Only the upper level of Saint-Germain-La-Rivière, which is dominated by scalene bladelets shows some originality (Langlais et al., 2015). Both the truncated backed bladelets and scalene bladelets have identical dimensions in terms of length (20-30 mm), width (4-5 mm), and thickness (2 mm on average). Furthermore, bladelet blanks with a relatively straight profile were obtained by similar production processes on nodules or flake edges. If we consider the lateralization of the backs and truncation however, a clear contrast is observed between the truncated backed bladelets, which are non-lateralized, and the scalene bladelets, which tend to be lateralized (> 85%; Langlais, 2007b, 2008). A detailed comparative analysis of these elements is currently underway, incorporating other sites in order to gain a more precise understanding of this variability (Sécher, in progress).

3.2. Late Middle Magdalenian (ca. 18,000-16,000 cal BP)

This second phase is contemporary with the Heinrich 1 event (Figure 2), and its geographical distribution appears more greatly restricted than the EMM. Indeed, it is mainly encountered among the Pyrenean foothills and the western fringes of the Massif Central, and seems absent or very rare in the northern Aquitaine and the Poitou (see below). It is difficult to accurately establish its relationship with the previous phase, as no archaeological sequence associating these two phases of the Middle Magdalenian has been reassessed to date. Research is underway, however, at Laa 2 in the Arudy Basin (Pétillon et al., 2014). Other examples include Isturitz (Pyrénées-Atlantiques) and Laugerie-Basse in the Dordogne, which were unfortunately excavated too early, and Enlène in the Ariège and Gazel in the Aude, where these two phases of occupation appear to be mutually exclusive in different sectors of the sites.

The economic dichotomy of the manufacture of blades for domestic tools and bladelets for hunting armatures remains a pillar of the techno-economic architecture of these groups (Figure 3, Figure 5). As in the previous phase, blade production was unipolar and was carried out with a soft organic hammer. The management of convexities, notably the preservation of the longitudinal curvature in order to optimize the desired lengths, was carried out in the same manner as before. In contrast, widths (around 15 mm for 3-4 mm thickness) are lower than in the EMM, indicating a more arched surface. Domestic equipment (Table 3) is mainly dominated by end tools (burins and end scrapers). In terms of the retouched blades, there is an abandonment of the deep modifications to the cutting edge typical of the EMM. In the foothills of the Pyrenees, raw materials were abundant in the form of blade tool blanks from the northern Aquitaine and the southern part of the mountain range (Lacombe, 2005; Simonnet, 2007; Langlais, 2010; Pétillon et al., 2014; Sánchez, 2015, see below). The segmentation of the blade production sequences indicates an intense search for large blanks, which required materials that were rare locally and therefore had to be imported. The variations in the composition of domestic equipment (Table 3) and the relationship between domestic equipment and hunting weaponry can be explained by the types of occupation of these sites (decorated caves and rockshelters) as well as the different excavation methods. At Tuc d'Audoubert, although it involved sondages, we can highlight the high proportion of splintered pieces in the Salle du Bouquetin and armatures in the Galerie du Bison. At Peyrugues level 3 and Labastide trench 2 there was a relatively high proportion of becs and borers (Table 3). Beyond the search for imported tool blanks with long lifespans, the social value placed on the blade is also reflected in some sites in the hiding places used for large

blades in decorated caves such as Labastide, Le Mas d'Azil, and Enlène (Simonnet, 1982; Angevin and Langlais, 2009).

In the Pyrenean sites, large imported flint blades did not exclusively serve the purpose of domestic or symbolic activities. At Saint-Michel d'Arudy (Pyrénées-Atlantiques) and Labastide (Hautes-Pyrénées), flint blades from the Bergerac were imported as core matrices, knapped on the edge to produce narrow blanks that could be transformed into backed bladelets (Figure 5). This production on blades and flakes is found at other sites too, such as Isturitz (Grand Diverticule and SI), Laa 2 level 3, Duruthy level 4, Le Tuc d'Audoubert, and Forcas 1 level 15–16 in the south of the Pyrenees (Langlais, 2010, 2014a; Pétilion et al., 2014). It is also observed at Gazel level 7 in the Aude, where some elements yielded from Bergerac flint imported to make blades have been knapped on the edges (Langlais, 2007a). The armatures thus produced are narrow backed bladelets, often with points. They exhibit dimensions of around 3–4 mm in width for 1–2 mm in thickness and more variable lengths. At the sites of Gazel and Peyrugues level 3 (Lot) these narrow backed bladelets are associated with scalene bladelets, indicating a cultural heritage from the EMM (Table 3). Finally, it should be noted that research is ongoing at Sainte-Colome in Arudy (Pétilion et al., 2014) and Peyre Blanque in the Ariège (Lacombe et al., 2015), where the presence of geometric lithic armatures has complexified the regional model of the Late Middle Magdalenian (LMM).

3.3. Early Upper Magdalenian (ca. 16,500–15,000 cal BP)

The first phase of the Upper Magdalenian coincides with the second half of the GS 2.1a of the glacial chronology corresponding to the third phase of the Heinrich 1 stadial (Figure 2). At this time there was a renewed occupation of certain regions of the study area, particularly the north Aquitaine plains (see below). There was a continued demand for large blades according to a segmentation of the production sequence that varied in its extent depending on locally available raw materials (Morala, 1999; Langlais in press). One of the new developments of this period was blade-bladelet volume reduction (Figure 6; Bodu and Valentin, 2003; Langlais, 2007a). Tools and weapon tips were thus now produced in part from the same core (Figure 7). Assemblages that are representative of this period include many old excavations, yielding artefacts that have been sorted (Isturitz F1, La Madeleine, Fontarnaud, La Pique, Morin B, Teyjat, Faustin Terraza assemblage) or involving random stratigraphic divisions (La Vache T4). We must therefore remain cautious in interpreting these collections (Table 4).

On the northern slopes of the Pyrenees, the majority of lithic industry involves integrated blade-bladelet knapping on local or regional flint and autonomous bladelet knapping. The knapping of large blades is generally independent and is limited to domestic tool blanks. This phenomenon is partly due to the constraints of locally available raw materials. It is often more problematic here, without the radiometric dates, to clearly distinguish between an early or late upper Magdalenian, as the industries are so similar in techno-economic terms. In the Aquitaine, several assemblages reflect a continued demand for large blades as demonstrated by some blade cores abandoned in the production stages (Figure 7) at Morin B and Teyjat (Mège and La Mairie lower level), reflecting the perpetuation of techniques inherited from the Middle Magdalenian (Langlais, in press). Blade-bladelet knapping completes the tool blanks. Overall, we find the same typological balance within the domestic equipment, with a predominance of burins, end scrapers, and retouched blades (Table 4). The varying presence of becs, borers, and splintered pieces is probably due to the different functions of the sites. Retouched bladelets seem to be more predominant in the Pyrenean assemblages. Finally, the influence of excavation methods (presence or absence of fine water screening) helps to explain in part the variability in the relationships between domestic tools and microlithic hunting weaponry (Table 4).

During this period, one of the most significant innovations in the field of flint armaments is the appearance of lithic points on small blades. In particular, this involves long shouldered points and backed points sometimes with a thinned base of the Gravettian type (Figure 7, Table 4) made on intermediate blanks produced during blade-bladelet knapping. Present in varying degrees in the assemblages, we shall here discuss the sites in which they represent a significant proportion of the assemblage. Although its sequence remains difficult to fully establish, the eponymous site of La Madeleine (Dordogne) yields both these types of points (Bündgen, 2002; Taylor, 2012; Langlais, 2014b). Gravettian type backed points are also found in Teyjat in the cave of La Marie lower level and the Mège rockshelter. Finally, small pointed backed blades are found at Morin B and Fontarnaud (Lenoir, 1983). Shouldered points have been discovered in the Gironde, in particular at Morin B, Faustin, and La Pique (Lenoir, 2003), as well as in the Landes at Duruthy c.3 (Arambourou et al., 1978). These two types of lithic point present lengths of between 50 and 100 mm on average for 9–14 mm in width and 3–4 mm in thickness. These points on small blades are generally associated with pointed truncated backed bladelets, a few scalene triangles, and sometimes Couze type truncations (Demars and Laurent, 1989). In the Pyrenees, at the sites of Belvis (Sacchi, 1994), Parco level II (Langlais, 2010), Troubat level 8 (Lacombe, 1998), and La Vache (Schmider, 2003), lithic armaments composed of pointed backed bladelets and scalene triangles (Figure 7, Table 4) have been observed. These particular pieces are on average 1 mm in thickness for 2–3 mm in width and 8–15 mm in length. The backs and truncation do not exhibit preferential lateralization. They can be distinguished from the scalene bladelets of the Middle Magdalenian (see above) or certain more elongated examples from the EUM in the Aquitaine such as those at Morin B and Fontalès (Langlais, 2008).

3.4. Late Upper Magdalenian (ca. 15,500-14,000 cal BP)

The Late Upper Magdalenian (LUM) coincides with major environmental changes with the end of the GS 2.1a and the warming period of the GIS 1e of the glacial chronology (Figure 2). The sites of the LUM show a homogeneous distribution over the study area, extending to the north (see below). Recently excavated sites from this period include Bois Ragot levels 5 and 6 in the Vienne (Chollet and Dujardin eds., 2005); Peyrazet level 4 (Langlais and Laroulandie, 2009) and Murat rockshelter levels 5 and 6 (Lorblanchet, 1996) in the Lot; and Pont d'Ambon level 5 in the Dordogne (Célérier 1993). The open-air site of La Honteyre in the Gironde (Gourc Master's degree), can also be attributed to this phase as well as certain levels of Bourrouilla (Pyrénées-Atlantiques), which is currently under excavation (Dachary et al., 2008). Other sites that underwent early excavation, such as La Mairie upper level (Bourrinet excavations), Chancelade (Hardy excavations), Morin A (Deffarges excavations), and Rochereil (Jude excavations) have biased findings due to the methods used in recording artefacts at the time.

In the Aquitaine, the on-site production of large blades is observed at some sites where there was an abundance of raw materials with large dimensions, such as Villazette and l'Usine Henry in the Bergerac (Morala 1992; Langlais, in press). However, at the site of La Honteyre, in the Sable des Landes, a block of Charentais flint has been documented, imported from over 100 km away to be knapped on site (Gourc, 2015). In the Pyrenees, the assemblages indicate varying degrees of imported blades in the form of untreated blanks and domestic tools. This transported stock is complementary to the dominant productions, of a smaller size, manufactured on site according to a blade-bladelet reduction continuum (Figure 8).

Domestic equipment is once again dominated by burins, end scrapers, and retouched blades. Becks, borers, and splintered pieces present a lower inter-site variability than in the previous periods. The relationship between the proportion of domestic tools and weapon tips indicates

economic differences related in part to the types of activities carried out at the sites. In the Aquitaine, new types of lithic point (Figure 8, Table 5) replace the previous ones, with foliate forms (Laugerie-Basse type) and tangs (Teyjat type). The former measure on average 50–80 mm in length, 10–14 mm in width, and 3–4 mm in thickness. The latter are a little wider (16–22 mm) and thicker (4–5 mm). Often fractured, the lengths range from 50–80 mm. Sites where large numbers of these points have been recorded include Le Morin A (Bordes et al., 1973), Faustin (Lenoir, 1983), La Honteyre, Laugerie-Basse, Chancelade (Hardy excavations), La Mairie upper level in Teyjat, Rochereil (Jude, 1960), La Madeleine, Le Pont d'Ambon c.5 (Célérier, 1993), and Le Bois-Ragot levels 5 and 6 (Le Mignot, 2005; Le Licon, 2005). Blade-bladelet productions with a convergent or “triangular” surface (Le Licon, 2005; Taylor, 2012), hold a major place in the technical system. This is accompanied by bladelet productions on flakes, either “on the edge” or “*caréné*” (Figure 8). In terms of the microliths, we can observe the same development in the Pyrenees and in the Aquitaine of sharpened or pointed backed bladelets, sometimes with a modified base (Langlais, submitted, Figure 8). They generally measure between 25 and 40 mm in length, 4–5 mm in width, and 2 mm in thickness, and the backs are frequently lateralized on the right edge. Examples of this have been documented at the aforementioned sites, as well as at the caves of Belvis and Rhodes II in the Pyrenees, Peyrazet and Murat (Langlais, 2010, submitted) in the Quercy, and Parco and Bora Gran in the southern fringes of the southwest. Pyrenean scalene triangles (Rhodes II, Belvis, Troubat, etc.) and Couze type truncations in the Aquitaine Basin appear to persist during this phase. The presence of backed points at some sites (Table 5) indicates overlying Azilian intrusions, such as at Bois-Ragot and Peyrazet.

4. Discussion

The Upper and Middle Magdalenian can be sub-divided into four phases that can be distinguished above all by the techno-economic organization of lithic production and the composition of tool kits. The geographical distribution of the sites shows variations that can be understood from several perspectives: economic, demographic, and cultural. At the same time, the widespread or restricted distribution of certain lithic morphotypes in relation to the circulation of raw materials contributes to our understanding of the elasticity of the territories and social interactions over these five millennia.

At the European level, during the EMM elements of bone industry, such as *navettes* and Lussac-Angles points, are observed across a vast area extending from Poland to the Cantabrians. Within this, the French southwest is an original area in which the distribution of such artefacts together with other practices (individual graves, see Henry-Gambier, 2014; sculpted rockshelters, see Bourdier, 2010; or human representations, see Fuentes, 2009) are found alongside each other (Langlais et al., in press). Although more research remains to be carried out, particularly towards the Iberian peninsula, where there is currently a lack of data, the distribution of the two main lithic armature morphotypes (truncated and scalene backed bladelets) and the geographical distribution of raw materials clearly indicate interactions between these different “facies” (Figure 9-1). The French southwest thus appears to have been at a crossroads of new traditions during the EMM and at the heart of a process of cultural unification.

At the current point of research, the LMM appears to mark a sharp geographical contraction in the distribution of sites toward the foothills of the Pyrenees and the Massif Central to the detriment of the northwest Aquitaine plains (Figure 9-2). This period is particularly well documented in the Pyrenees in caves, often decorated caves (the caves of Volp, Labastide,

Montespan, Tastet, etc.), where Bergerac flint has been imported from over 200 km away. At other sites from this period, such as Duruthy level 4 to the west of the mountain range, several examples have been found of imported “grain de mil” type flint from Charentes over 200 km away, where no sites are known from this period. To the east, at the Magdalenian occupations of Gazel level 7 in the Aude, also a decorated cave, a wide diversity of exploited raw materials have been recorded, imported from a radius of 300–500 km around the site, encompassing territories where very little occupation has been documented, such as the delta of the Rhône (Langlais and Sacchi, 2006). At this site, Bergerac flint has partly been imported in the form of nodules, knapped on site to produce blades and bladelets (Langlais, 2010). Finally, other sites show links with the southern Pyrenees such as Laa 2 in Arudy (Pétillon et al., 2014; Sánchez, 2015). In parallel with this, a strong cultural emulation is observed during this period in terms of symbolic representations (parietal and portable art) and the social value placed on certain lithic objects such as large blades (Angevin and Langlais, 2009). Among the many examples of portable art from this period, *contours découpés* indicate a Pyrenean-Cantabrian unit (e.g. Sauvet et al., 2014) perpendicular to the raw material supply routes of the northern Aquitaine. To what extent did this involve the periodical movement of groups leaving the Aquitaine plains for the foothills of the Massif Central and the Pyrenees due to the environmental constraints of the Heinrich 1 event (Figure 2)? Or do these artefacts more likely reflect exchanges with groups that remained further north? Further research is required to establish whether human groups abandoned the North Aquitaine area during this period. Establishing the existence of a permafrost in this region during this period would also allow the specific conditions of occupation of these groups to be more clearly understood (Bertran et al., 2014).

The EUM marks the renewed settlement of the North Aquitaine area (Figure 9-3). The hypothesis of population growth is still to be investigated further however, particularly in relation to a possible increase in the biomass of large steppe ungulates (Delpech 1999). In the lithic industry of several sites, this period is marked by the systematization of new forms of lithic points on small blades, the geography of which reflects two different regional traditions between the plains and the foothills. In parallel to a continued focus on blade technology and bladelet knapping on flakes, blade-bladelet knapping of smaller dimensions develops. This change is at once related to the production of intermediate blanks for points and to an economic response to constraints in terms of the availability of local raw material. Thus, in the central Pyrenees, there is a certain reduction in the circulation of blades and raw material from the North Aquitaine in favour of the increased use of local and regional materials from either side of the Pyrenees, such as at Belvis and Parco (Sánchez, 2015). In the southwest of the Aquitaine Basin, such as at Duruthy level 3, flint originating from the Charente confirms a territorial link with the north of the Sable des Landes, where identical lithic points have been found. Elements of bone industry (fork-based points and barbed points, see Pétillon, 2006) show different interactions between the Pyrenees and the northern Aquitaine that complexify the bipartite division of the zones of distribution. The contents of flint weapon kits thus indicate a distinction between the groups occupying the Aquitaine plains and the foothills of the Quercy and those of the Pyrenean valleys and the Languedoc. To what extent is this bipartite division a consequence of the population contraction to the foothills in the LMM and the renewed occupation of the plains? In any case, the Sable des Landes does not appear to have structured this bipartite division and so doesn't have acted as a cultural frontier, for Magdalenian groups, as has recently been proposed (Bertran et al., 2013).

The LUM appears to be in total continuity with the previous period (Figure 9-4) with an even more marked expansion towards the north of France (Paris Basin in particular, see Valentin,

2008; Weber, 2012). In the Pyrenees, there is a significant contraction of flint supply areas, although flint tool blanks continue to be imported in smaller quantities from over 100 km around. The territorial bipartite division of lithic weaponry is clear between the Aquitaine Basin, where new points are observed, and the Pyrenees and Languedoc. Nonetheless, some elements of portable art (Sauvet et al., 2014) and bone industry (Pétillon, this volume) continue to transcend these divisions. Both in terms of the demand for high-technology blade blanks and in the investment in the supply of high-quality flint, this period reflects an easing off of technical constraints, signifying, in parallel with the schematisation of certain animal representations of the time (Paillet, 2014), the progressive dilution of Magdalenian norms.

5. Conclusions

The comparative analysis of several lithic assemblages from the French southwest and its fringes within a revised chronostratigraphic framework has brought a new perspective to the evolution of the Middle and Upper Magdalenian from 19,000 to 14,000 cal BP (Figure 2, Figure 9). Derived from an autochthonous substrate (Lower Magdalenian) that was homogeneous over an immense west-European territory (Langlais, 2010), the EMM occupies a vast cultural area extending from Poland to the Cantabrians, within which intense social interactions have been observed. During this period, equipment became standardized in a more systematic way (blades versus bladelets, distinction between domestic tools and hunting weaponry). This may have promoted a cultural unification over a vast territory, notably with the circulation of desirable materials. The LMM, which coincides with the Heinrich 1 event, represents a phase of geographical contraction in the distribution of sites. In parallel to this, there is a clear cultural emulation in terms of certain symbolic and technical productions. Lithic equipment is particularly marked by the technical complexification of socially-valued blade productions. The EUM experienced technical innovations in the development of lithic points on small blades. The sites show a geographical redistribution that is doubtlessly related to demographic growth along with a regional compartmentalization in the distribution of certain types of hunting weaponry. The LUM is in continuity with the previous period, especially in terms of regional variations in the distribution of certain innovations. There is a tendency towards a constriction in raw material sources, together with the easing off of technical constraints. This appears to be a first step in the dilution of cultural norms according to an evolutionary arrhythmia between the southern and northern Aquitaine. The influence of the quality and availability of local materials along with a reduction in the distribution of flint at a larger scale may have favoured the technical simplification of lithic production in the Pyrenees. Nevertheless, it is in the northern Aquitaine, where the concept of lithic points had already developed, that the beginnings of the Azilian appear (Fat Cheung et al., 2014). Finally, contrary to that which has been recently proposed (Bruxelles and Jarry, 2011; Bertran et al., 2013), neither the Sables des Landes nor the Garonne appear to have acted as significant cultural barriers during the Magdalenian (Figure 9).

Over the five millennia that make up the so-called classical period of the Magdalenian, in parallel to environmental fluctuations of varying degree, the occupation of the French southwest appears less homogeneous than may have been thought. Against the continuous, linear model traditionally proposed for the Middle and Upper Magdalenian, our research indicates economic and demographic pulses of varying magnitude and internal regional arrhythmias during certain phases, notably in terms of technical demand (which continued in the north and eased off earlier in the south). The complexified evolutionary model of the Magdalenian proposed here now remains to be taken from the southwest and tested elsewhere.

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9. Captions

Figure 1 - The French southwest and its fringes: study area (coastline: -120 m) and distribution of the studied sites (white star) and comparative sites (black star) discussed in the text (see table 1).

Table 1 - List of the sites mentioned in Figure 1 (studied sites in bold).

Figure 2 - Climate chronologies and subdivisions of the Magdalenian in its classical period in the French SW (Heinrich dates from Stanford et al., 2011; GICC 05 from Rasmussen et al., 2014; SST from Cacho et al., 2001; Bard, 2003; Cacho, 2006). Recovery phases of 500 years are based on C14 data (Barshay-Szmidt et al., this volume) and the lack of clarity in the stratigraphic records of caves and rockshelters.

Table 2 - Typological count of the assemblages from the EMM (RM1/Roc de Marcamps; RM2/Roc de Marcamps 2: Sécher in progress; MN/Moulin-Neuf c.2: Lenoir, 1983; SG/St-Germain-la-Rivière upper assemblage: Langlais et al., 2015).

Figure 3 - Example of blade and bladelet dimensions from the Middle Magdalenian (Saint-Germain-la-Rivière)

Figure 4 - Diagram of the techno-economic organization of lithic production in the EMM (drawings by S. Ducasse, M. Lenoir, and S. Pasty).

Table 3 - Typological count of LMM assemblages (Tuc d'Audoubert all sectors: Bégouen et al., 2009; Forcas I levels 15–16: Utrilla & Mazo, 2014; Gazel level 7: Langlais, 2010; Peyrugues level 3: *ibid.* Labastide T2: Lesage, unpublished).

Figure 5 - Diagram of the techno-economic organization of lithic production in the LMM (drawings by M. Allard, S. Ducasse, and S. Pasty).

Table 4 - Typological count of the EUM assemblages (Belvis: Langlais, 2010; La Vache T4: Schmider, 2003; Morin B, Mège, Mairie lower layer, this paper.).

Figure 6 - Examples of blade and bladelet dimensions from the upper Magdalenian (Le Morin B)

Figure 7 - Diagram of the techno-economic organization of lithic production in the EUM (drawings by P. Bourrinet, P. Laurent, S. Pasty, and D. Sacchi).

Table 5 - Typological count of the LUM assemblages (Honteyre, Gourc, 2015; Bois-Ragot c.5, Le Licon, 2005; Bois-Ragot c.6; Le Mignot, 2005; Peyrazet c.4, Murat c.5–6, this paper).

Figure 8 - Diagram of the techno-economic organization of lithic production in the LUM (drawings by S. Pasty, P. Laurent, C. Fat Cheung, and D. Sacchi).

Figure 9 - Diagram summarizing the technical, economic, and cultural changes over the four phases of the Magdalenian in the French southwest and its fringes according to lithic armature and origin of the siliceous raw material brought from over 100 km around the sites. 1: EMM sites (coastline: -120 m, black star: with scalene bladelet, white star: with truncated backed

bladelet, grey star: to be specified); 2: LMM sites (coastline: -120 m, white star: narrow pointed backed bladelet, black star: scalene bladelets, grey star: to be specified); 3: EUM sites (coastline: -100 m, white star: lithic points, black star: no lithic points); 4: LUM sites (coastline: -100 m, white star: lithic points, black star: no lithic points). From Fontana et al., 2003; Lacombe, 2005; Langlais and Sacchi, 2006; Langlais, 2010; Primault et al., 2010; Angevin and Surmely, 2013; Pétilion et al., 2014; Sanchez, 2015; Sécher, in press; Langlais et al., in press).

TABLE 1

n°	site	n°	site	n°	site	n°	site
1	Trilobite	15	Villepin	26	Combe-Cullier	40	Sta Linya
2	La Garenne	15	Cap-Blanc	26	Crozo Bastido	41	La Vache
3	Taillis-des-Coteaux	15	Reverdit	26 Murat		42	Rhodes II
4	Roc-aux-Sorciers	16 Teyjat_La Mairie		27 Petit-Cloup-Barrat		43 Enlène	
5	La Marche	16 Teyjat_Mège		27 Les Peyrugues		44 Tuc d'Audoubert	
6 Bois-Ragot		17 Pont d'Ambon		27	Ste-Eulalie	45	Les Harpons
7	Chaffaud	17 Rochereil		28	Fontalès	46	Troubat
8	Placard	18 Roc-de-Marcamps		28 Gandil-Plantade		47 Labastide	
9	Chair-à-Calvin	18 Les Féés		28	Lafaye-Montastruc	48 Laa-Ste Colome	
10	Petits-Guinards	19 St Germain-Rivière		29	Laroque	St Michel-	
11	Enval	20 Chancelade		30 Le Crès		48 Poeymau	
11	Le Bay	21 Le Morin		21	La Cruzade	48 Signalats	
11	Chabasse	22 Moulin-Neuf		32 Bize		49 Tizon	
11	Thônes	22	La Pique	33 Gazel		50	Brassempouy
12	Rond-du-Barry	22	Faustin-Fontarnaud	34 Canecaude		51 Dufaure	
13	Collandres	23 La Honteyre		35	La Teulera	51 Duruthy	
14	Puy-de-Lacan	24 Villazette-Usine Henry		35	Les Conques	52	Bourrouilla
14 Bouyssonie		24	Flageolet	36	L'Oeil	53 Isturitz	
15 Madeleine		25	Martinet	37	Fontlaurier	54 Ekain	
15	Laugerie-Basse	25	Roc-Allan	38 Belvis		54	Sta Catalina
15	Longueroche	26 Peyrazet		39 Parco		55	Abauntz
						56	Etxauri

TABLE 2

Type / site	RM1	%	RM2	%	MN	%	SG	%
Endscraper	21	10,6	13	9,6	106	19,6	89	28,0
Burin	88	44,4	43	31,6	165	30,5	93	29,2
Multiple tool	11	5,6	6	4,4	31	5,7	8	2,5
Perforator	1	0,5	0	0,0	20	3,7	1	0,3
Pointed blade	2	1,0	1	0,7	3	0,6	22	6,9
Retouched blade	60	30,3	41	30,1	88	16,3	71	22,3
Retouched flake	6	3,0	8	5,9	9	1,7	0	0,0
Truncated piece	9	4,5	23	16,9	91	16,8	31	9,7
Pièce esquillée	0	0,0	1	0,7	28	5,2	3	0,9
Domestic tools	198	100,0	136	100,0	541	100,0	318	100,0
Backed Bladelet (BB)	287	74,4	226	83,1	792	83,5	320	55,3
Truncated BB	80	20,7	39	14,3	148	15,6	28	4,8
Scalene Bladelet	8	2,1	7	2,6	3	0,3	188	32,5
Denticulated BB	11	2,8	0	0,0	6	0,6	43	7,4
Hunting armament	386	100,0	272	100,0	949	100,0	579	100,0
TOTAL	584		408		1490		897	

TABLE 3

Type / site	Tuc	%	Forcas	%	Gazel	%	Pey.	%	Lab.	%
Endscraper	16	8,8	24	21,6	188	16,8	23	13,1	17	11,0
Burin	78	43,1	48	43,2	386	34,5	66	37,5	50	32,5
Multiple tool	8	4,4	2	1,8	43	3,8	7	4,0	4	2,6
Perforator	5	2,8	14	12,6	73	6,5	29	16,5	29	18,8
Pointed blade	1	0,6	0	0,0	20	1,8	4	2,3	5	3,2
Retouched blade	15	8,3	8	7,2	90	8,0	17	9,7	18	11,7
Retouched bladelet	19	10,5	4	3,6	158	14,1	4	2,3	14	9,1
Retouched flake	14	7,7	2	1,8	82	7,3	7	4,0	8	5,2
Truncated piece	0	0,0	6	5,4	40	3,6	8	4,5	0	0,0
Pièce esquillée	25	13,8	3	2,7	40	3,6	11	6,3	9	5,8
Domestic tools	181	100,0	111	100,0	1120	100,0	176	100,0	154	100,0
Backed Bladelet (BB)	133	79,2	98	86,0	2999	76,7	227	68,2	40	64,5
Truncated BB	2	1,2	1	0,9	208	5,3	27	8,1	5	8,1
Double BB	0	0,0	0	0,0	77	2,0	13	3,9	6	9,7
Scalene Bladelet	0	0,0	0	0,0	539	13,8	46	13,8	0	0,0
Denticulated BB	0	0,0	1	0,9	46	1,2	17	5,1	0	0,0
Pointed BB	33	19,6	14	12,3	41	1,0	3	0,9	11	17,7
Hunting armament	168	100,0	114	100,0	3910	100,0	333	100,0	62	100,0
TOTAL	349		225		5030		509		216	

TABLE 4

Type / site	Belvis	%	La Vache	%	Morin B	%	Mège	%	Mairie inf.	%
Endscraper	49	9,4	292	25,5	161	23,5	26	17,1	15	16,0
Burin	185	35,4	357	31,2	289	42,2	90	59,2	51	54,3
Multiple tool	15	2,9	43	3,8	40	5,8	8	5,3	2	2,1
Perforator	60	11,5	110	9,6	86	12,6	4	2,6	3	3,2
Pointed blade	0	0,0	0	0,0	3	0,4	1	0,7	0	0,0
Retouched blade	14	2,7	39	3,4	54	7,9	18	11,8	7	7,4
Retouched bladelet	157	30,1	71	6,2	4	0,6	0	0,0	2	2,1
Retouched flake	5	1,0	19	1,7	8	1,2	1	0,7	4	4,3
Truncated piece	26	5,0	86	7,5	34	5,0	2	1,3	3	3,2
Pièce esquillée	11	2,1	126	11,0	0	0,0	1	0,7	6	6,4
Truncated-used blade	0	0,0	0	0,0	6	0,9	1	0,7	1	1,1
Domestic tools	522	100,0	1143	100,0	685	100,0	152	100,0	94	100,0
Backed Bladelet (BB)	1442	81,6	869	87,1	88	48,9	93	61,6	124	70,5
Truncated BB	56	3,2	25	2,5	13	7,2	5	3,3	1	0,6
Double BB	0	0,0	11	1,1	13	7,2	4	2,6	4	2,3
Scalene Triangle	185	10,5	4	0,4	2	1,1	0	0,0	0	0,0
Pointed BB	31	1,8	26	2,6	6	3,3	26	17,2	43	24,4
Denticulated BB	45	2,5	52	5,2	3	1,7	1	0,7	4	2,3
Shouldered point	0	0,0	0	0,0	47	26,1	0	0,0	0	0,0
Point of gravette Truncation type	0	0,0	0	0,0	0	0,0	22	14,6	0	0,0
Couze	0	0,0	0	0,0	5	2,8	0	0,0	0	0,0
Backed point	8	0,5	11	1,1	3	1,7	0	0,0	0	0,0
Hunting Armament	1767	100,0	998	100,0	180	100,0	151	100,0	176	100,0
TOTAL	2289		2141		865		303		270	

TABLE 5

Type / site	Honteyre	%	BR c.5	%	BR c.6	%	PRZ c.4	%	Murat	%
Endscraper	11	4,2	110	11,6	68	9,3	21	10,2	25	10,5
Burin	100	37,7	667	70,4	478	65,1	93	45,4	111	46,8
Multiple tool	6	2,3	40	4,2	39	5,3	8	3,9	3	1,3
Perforator	47	17,7	59	6,2	51	6,9	14	6,8	39	16,5
Pointed blade	1	0,4	1	0,1	0	0,0	1	0,5	1	0,4
Retouched blade	72	27,2	42	4,4	82	11,2	32	15,6	30	12,7
Retouched bladelet	7	2,6	0	0,0	0	0,0	12	5,9	0	0,0
Retouched flake	19	7,2	0	0,0	0	0,0	2	1,0	7	3,0
Truncated piece	1	0,4	19	2,0	11	1,5	15	7,3	14	5,9
Pièce esquillée	1	0,4	9	1,0	5	0,7	7	3,4	7	3,0
Domestic tools	265	100,0	947	100,0	734	100,0	205	100,0	237	100,0
Backed Bladelet (BB)	861	91,0	1665	90,7	791	87,1	115	63,9	217	71,4
Truncated BB	19	2,0	6	0,3	33	3,6	12	6,7	11	3,6
Pointed BB	24	2,5	39	2,1	39	4,3	43	23,9	30	9,9
Scalene Triangle	4	0,4	3	0,2	1	0,1	0	0,0	1	0,3
Double BB	4	0,4	0	0,0	22	2,4	4	2,2	36	11,8
Denticulated BB	32	3,4	24	1,3	8	0,9	1	0,6	7	2,3
Foliate point	2	0,2	26	1,4	14	1,5	0	0,0	0	0,0
Tanged point	0	0,0	59	3,2	0	0,0	0	0,0	0	0,0
Backed point	0	0,0	14	0,8	0	0,0	5	2,8	2	0,7
Hunting armament	946	100,0	1836	100,0	908	100,0	180	100,0	304	100,0
TOTAL	1211		2783		1642		385		541	

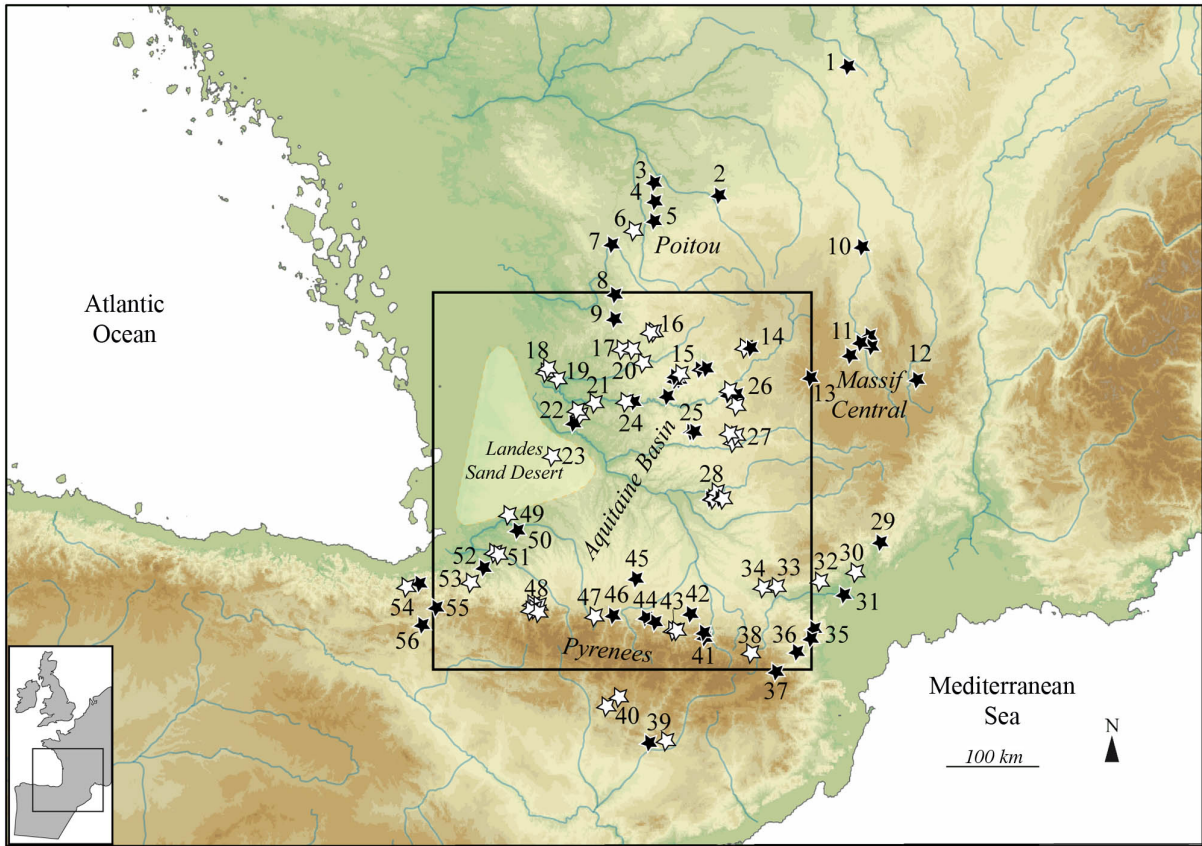


fig.1

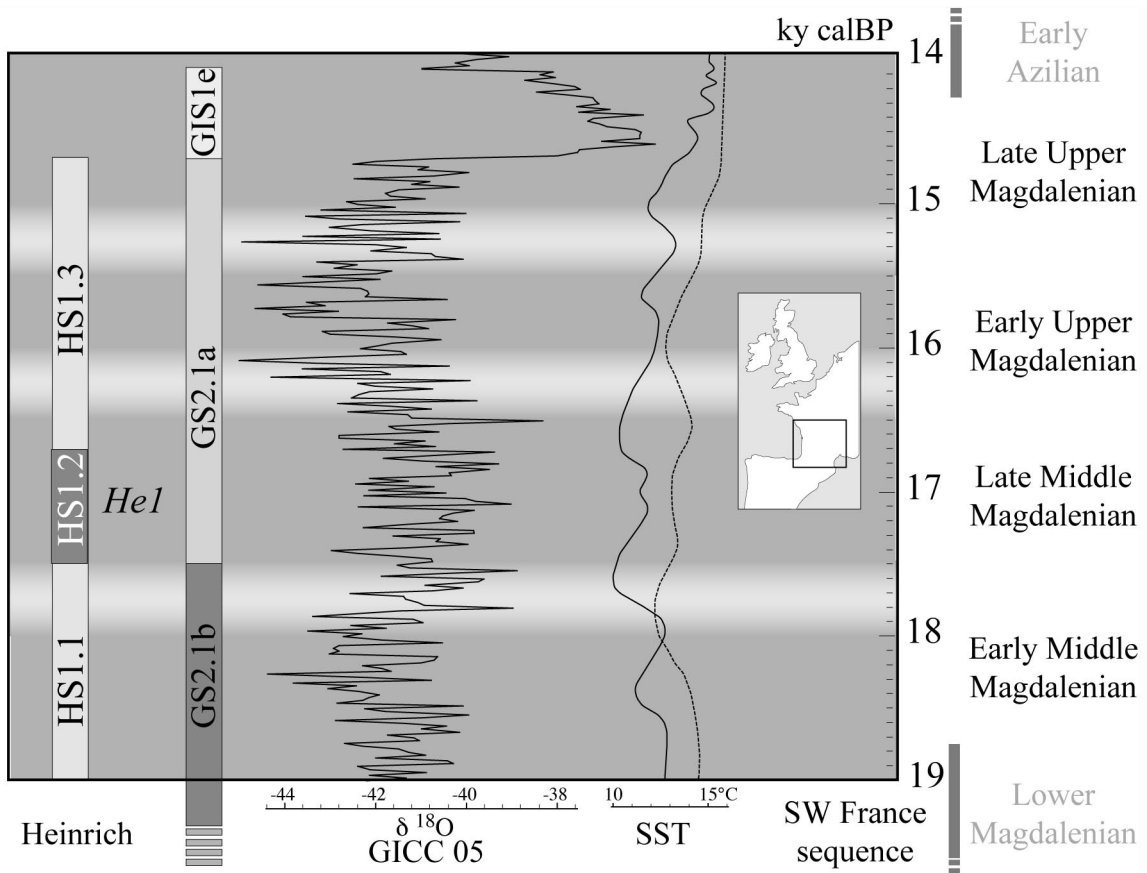


Fig.2

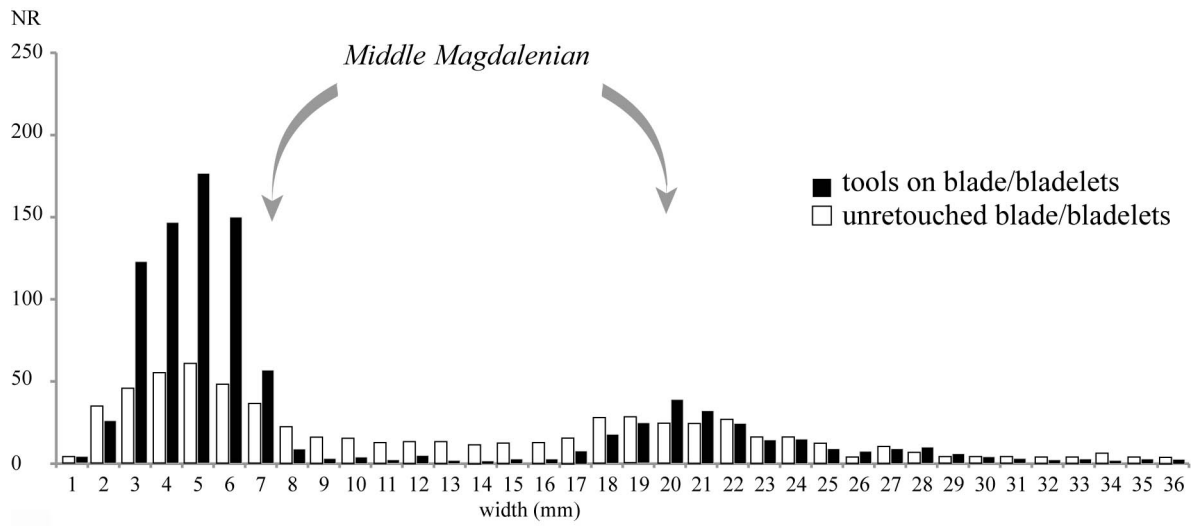


Fig.3

**Early Middle Magdalenian
(19-17,5 ky calBP)**

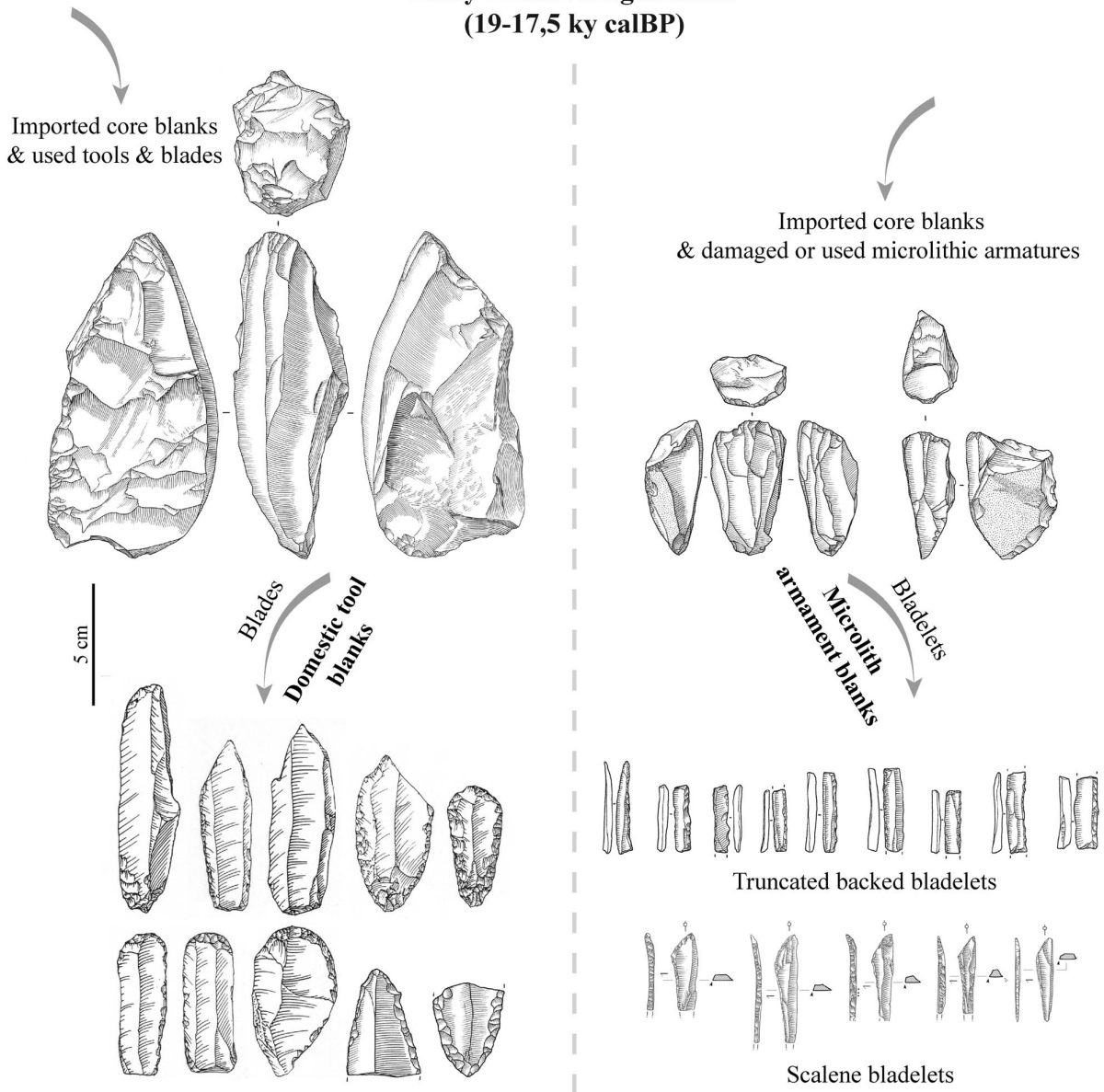


Fig.4

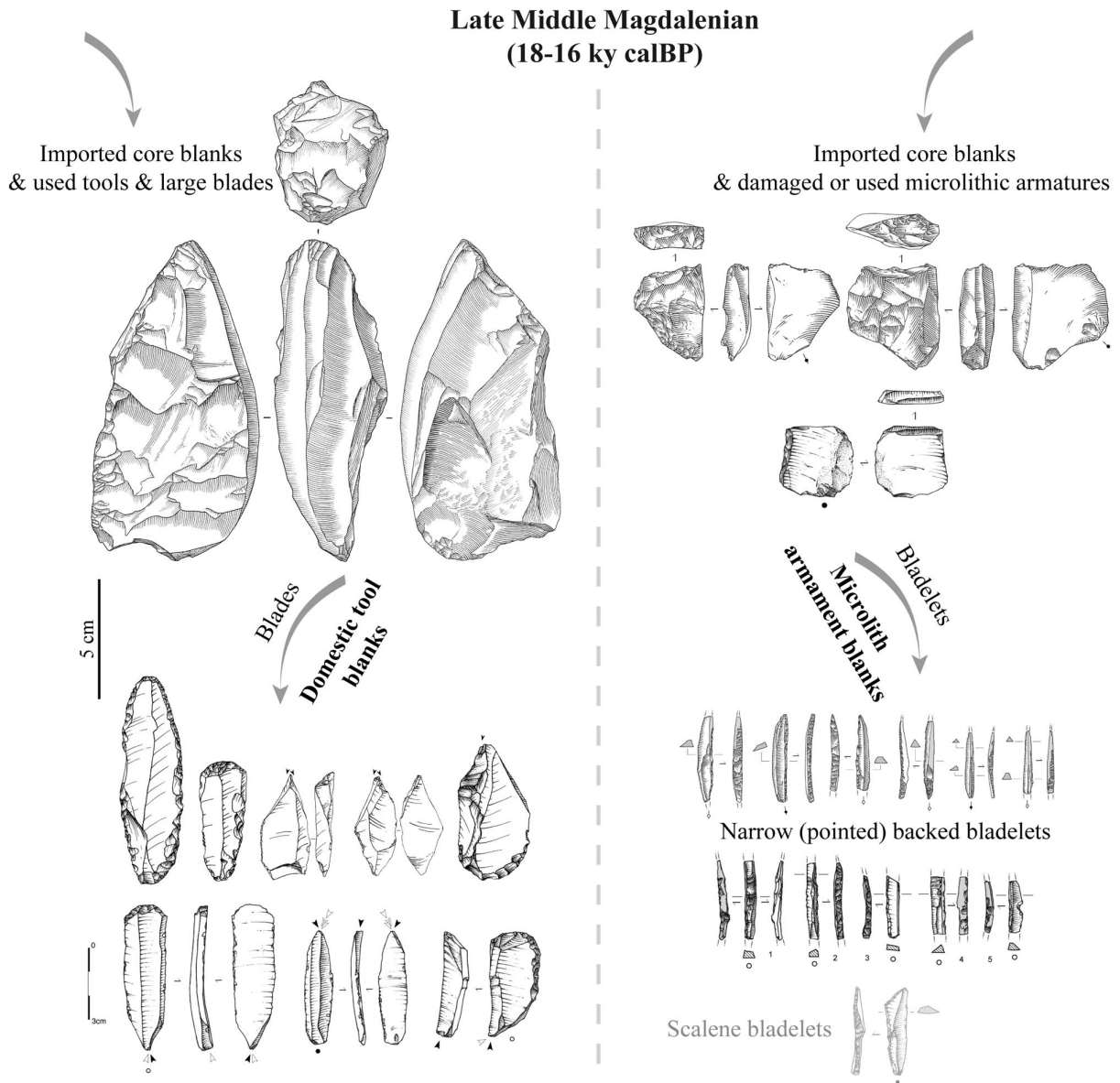


Fig.5

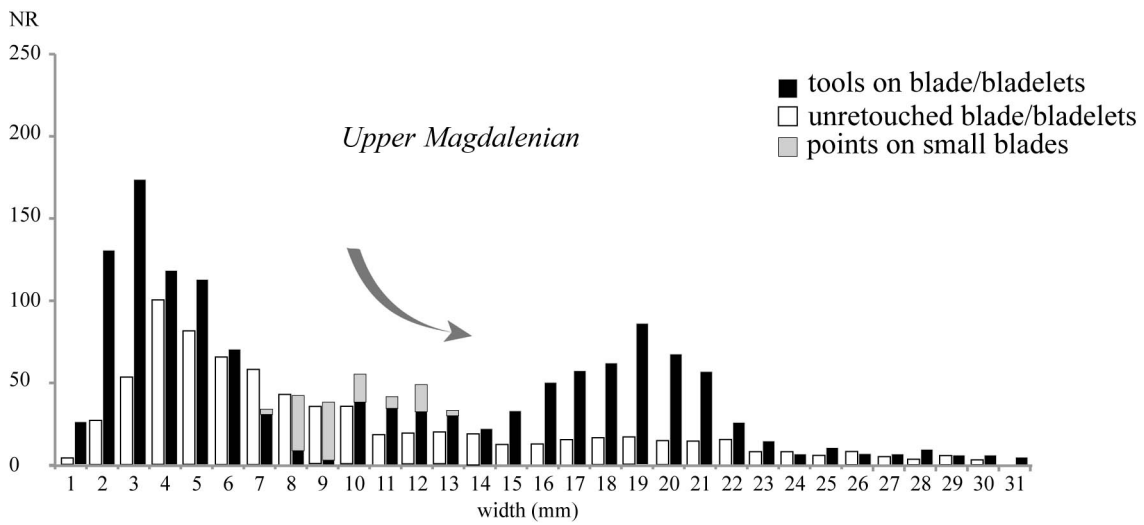


Fig.6

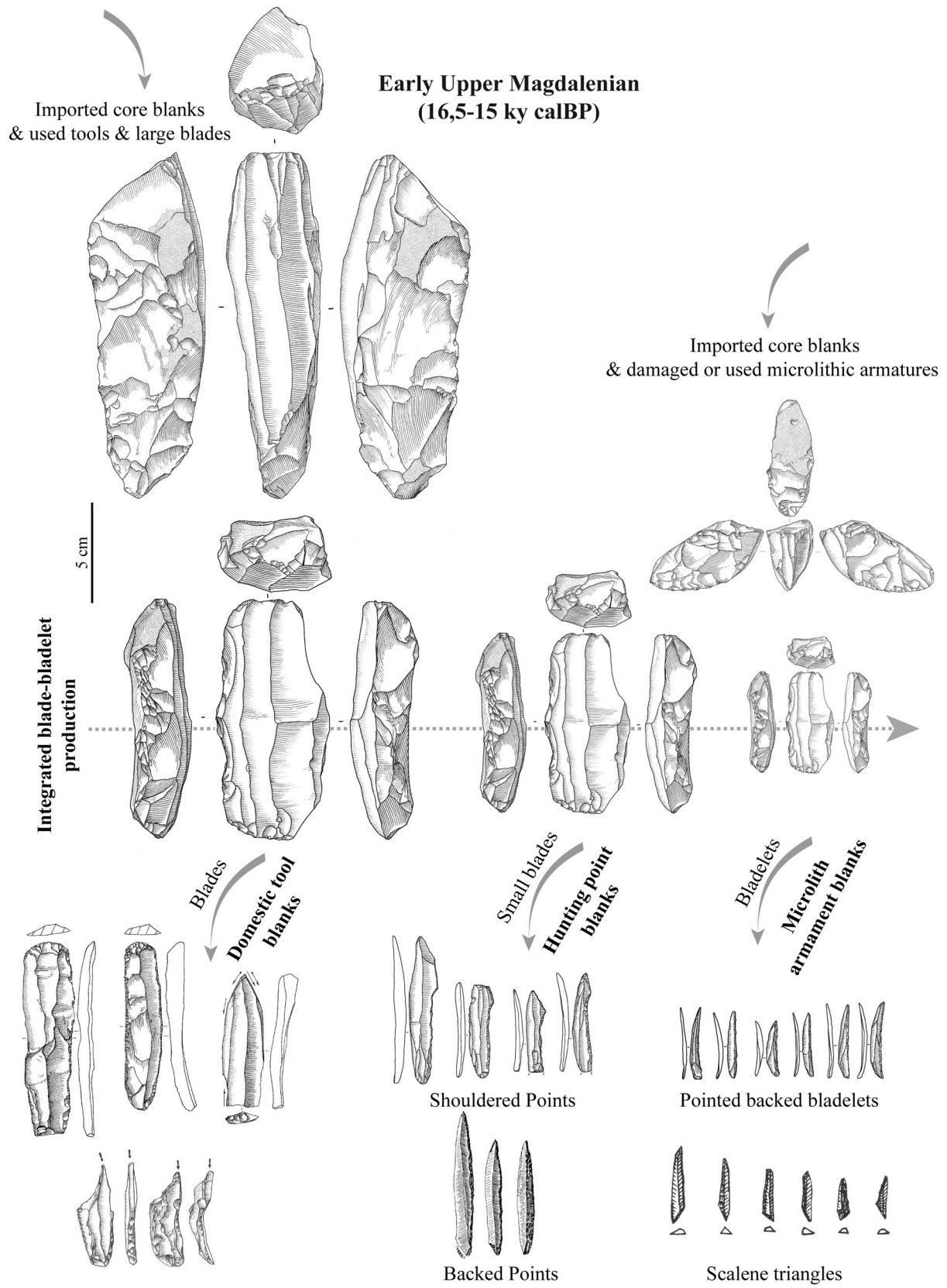


Fig.7

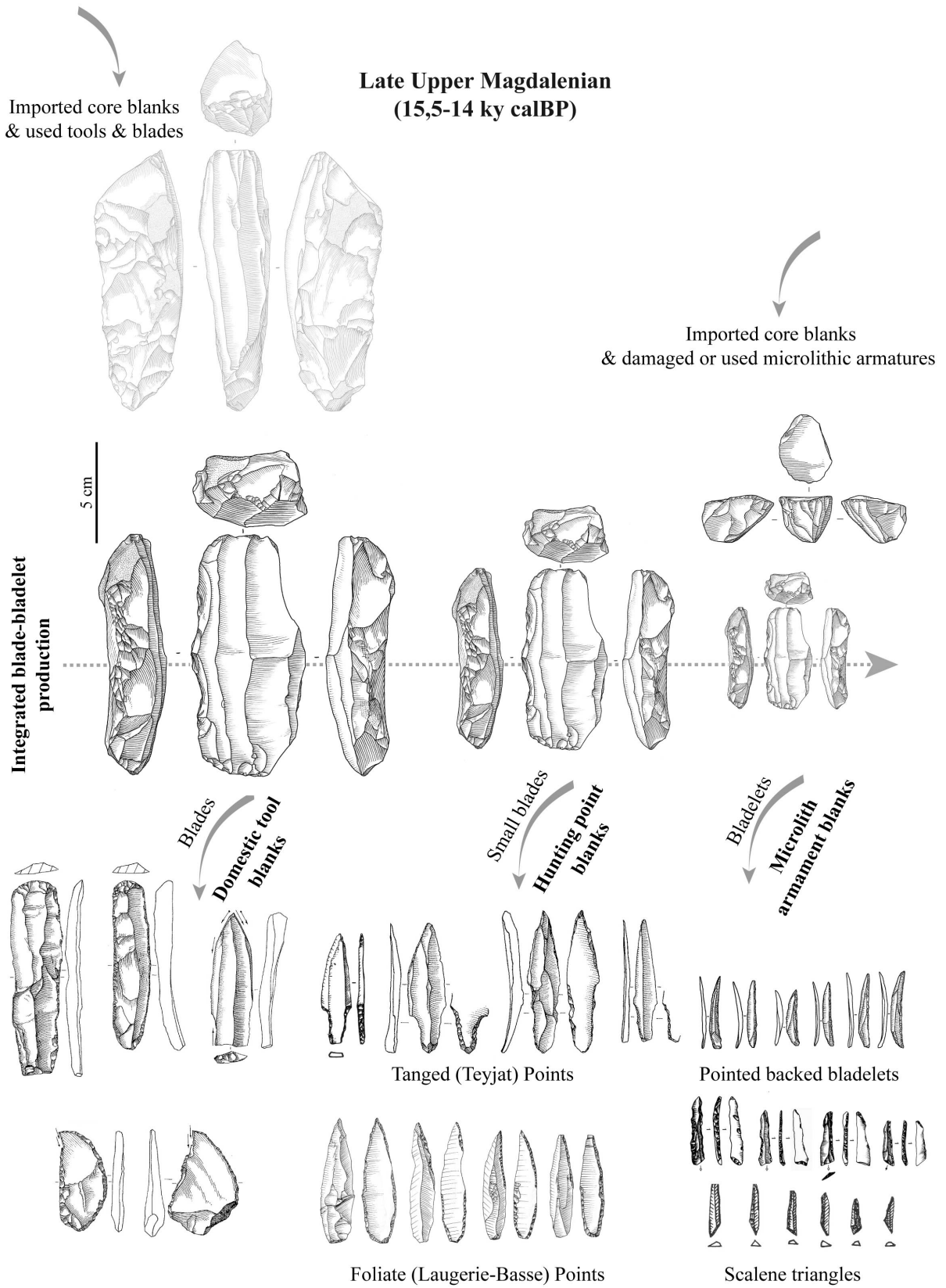


fig.8

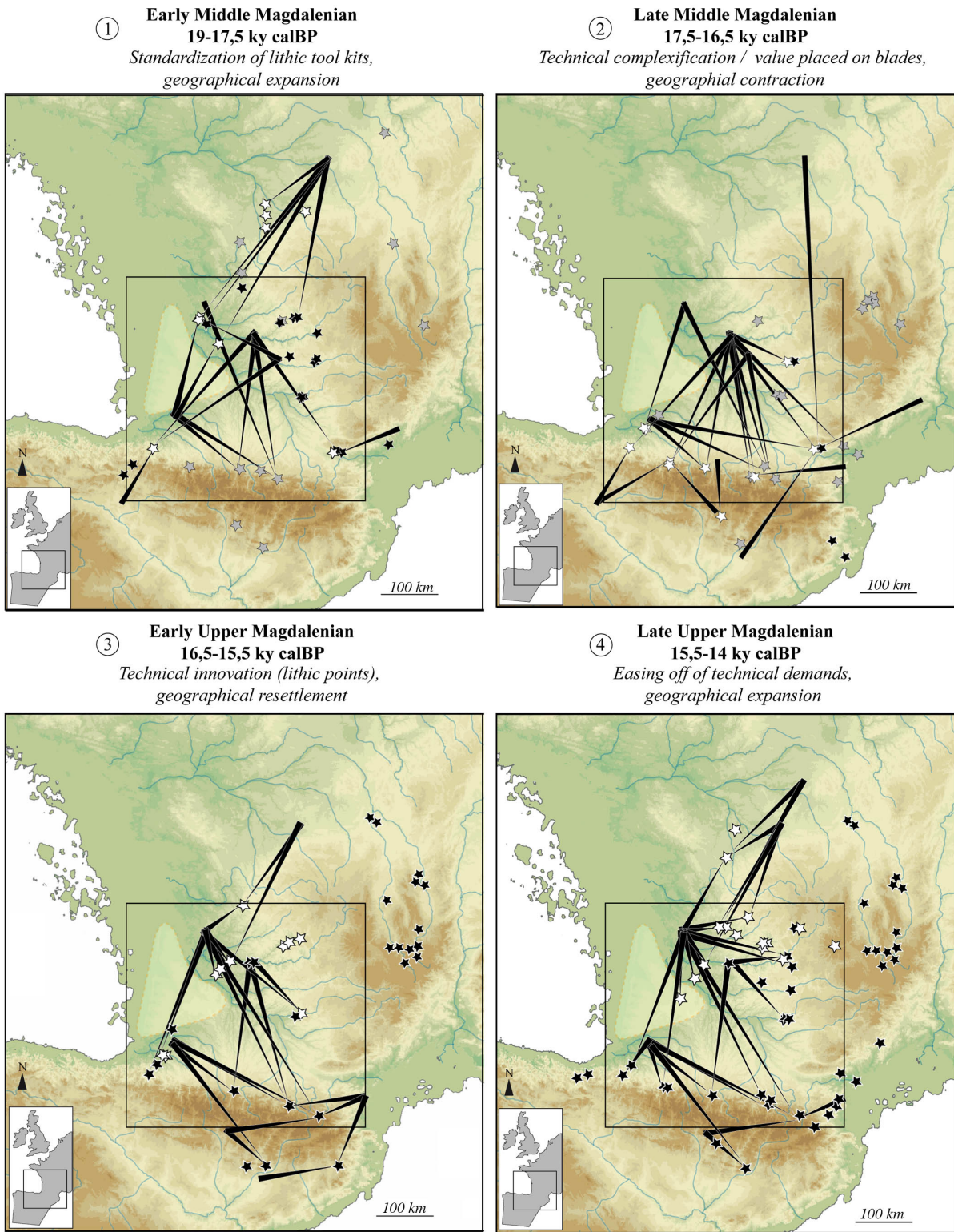


Fig.9