WHERE TO AND WHAT FOR?
Mobility Patterns and the Management of Lithic Resources by Gravettian Hunter-Gatherers in the Western Pyrenees

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Although it may seem paradoxical, the mobility patterns of nomadic Paleolithic hunter-gatherer groups are usually discerned based on the study of a single, static site. By statistically analysing patterns of lithic procurement at the Gravettian camp of Ametzagaina (Basque Country), we attempt to interpret how different raw material types influenced mobility and technological preferences. In order to overcome the static view created by analyzing a single site, this study provides new methodological keys with which to approach this question. Because this site is located very near a critical corridor between France and the Iberian Peninsula at the western end of the Pyrenees, it contains lithic materials from both sides of the mountain chain. It is argued that these materials were used differently according to their original source location and their physical characteristics (e.g., quality, size, shape). This information is compared with data from other Gravettian sites across the same region and on both sides of the Western Pyrenees.

The study of the provenience, catchment areas, and management of lithic raw materials can contribute greatly to an understanding of the mobility strategies of Paleolithic groups. Although many lithic resources may have been exchanged from group to group (Whallon 2006), such an important resource must, in most

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cases, be procured directly. The area studied here lies between two regions that are crucial for Upper Paleolithic research in Europe: northern Spain and southwest France. Each of these regions has developed different kinds of studies on lithic raw materials, mostly flint. Thus, pioneering work in northern Spain (Straus and Clark 1986) was conducted from the perspective of archaeology, whereas many studies in the French school have been based on premises rooted in geology (as, for example, in the long-term research by Robert Simmonet and by M. and M. R. Séronie-Vivien in the French Pyrenees). The present study aims to merge aspects of both perspectives so the area that links them geographically (the Western Pyrenees/Basque Country) can attain its maximum interpretative potential in relation to the uses that Upper Paleolithic hunter-gatherers made of lithic raw materials.

This study of the management and use of lithic resources and the mobility patterns of Gravettian groups at the open-air site of Ametzagaina (Donostia, Basque Country) aims to contribute to the solution of two concurrent problems. First, in the course of the recent history of research into Paleolithic human societies in the region (e.g., Arrizabalaga and Iriarte 2010a, 2010b), major advances have been made in our knowledge of lithic raw material sources (Tarriño and Elorrieta 2013). However, the geological aspects of the subject have still not been fully integrated within the body of archaeological knowledge. In the present study, we use an interdisciplinary perspective to explore the full potential of integrating geological and techno-typological data to examine a single lithic assemblage within a wider bi-regional context, one that is especially important as a "crossroads" between two large regions with partially distinctive Last Glacial ecological situations but that nonetheless shared many common cultural characteristics during the Upper Paleolithic.

Second, the site of Ametzagaina is located at the geographic "hinge" connecting western Iberian and French sites pertaining to the same vast cultural complex, the Gravettian. The methodologies utilized to examine sites in the Basque region (split today between two modern nation states) have been determined mainly by the country of origin of the respective French and Spanish researchers. The role the border played in the so-called Basque Crossroads (Arrizabalaga 2007) has led to a certain degree of mutual unawareness of research and interpretative dynamics utilized on either side of the Pyrenees. For example, until ten years ago there was limited, if any, knowledge of the geographic locations of lithic raw material sources used by prehistoric hunter-gatherers on the "other" side of the Pyrenees. However, the mobility of Paleolithic groups was not governed by modern geopolitical borders, although it is true that there were certain ecological differences between Aquitaine and Vasco-Cantabria during Ice Age times. Thus, it can be imagined that sites in the Iberian Basque Country were supplied with variable percentages of raw materials from north of the Pyrenees, while lithic resources from northern Spain are also found at sites in the Pays Basque and Aquitaine regions of France. In our opinion, Ametzagaina is an ideal site for contributing to an understanding of trans-Pyrenean raw material use and human mobility.

THE SITE OF AMETZAGAINA

Geographic and Geological Context

The Ametzagaina archaeological site is located on a hill in the northernmost portion of the Iberian Peninsula, at the "corner" of the Bay of Biscay. It is approximately 25 km from the modern border between Spain and France at the southern edge of the city of Donostia–San Sebastián in Guipúzcoa Province (Figure 1). Ametzagaina Hill is a small ridge with two knolls (maximum elevation: 120 m above present sea level) overlooking the San Sebastián–Irún–Hendaye corridor. This corridor is the easiest route between the peninsula and the rest of the European continent at the western end of the Pyrenees. This natural route passes through a NE-SW depression caused by the erosion of Upper Cretaceous rocks (shale, limestone, sandstone, and calcarenite). It is bounded to the north by the Jaizkibel Tertiary coastal mountain chain and to the south by the Mesozoic and Paleozoic massif of Cinco Villas.

From a Paleolithic forager's perspective, Ametzagaina Hill may have been an ideal location in terms of its geographical circumstances. To the northwest, the site is 2 km from the Urumea River estuary. To the south, it enjoys a panoramic view over the natural corridor described above. This would have been the main route for human groups and animal herds moving between the western and central Iberian Peninsula and the continent. During the Gravettian, the open-air occupations at Ametzagaina would have enjoyed this strategic position. However, the exact topographic and ecological conditions at the time of occupation are still not known in sufficient detail. Palynological data from the two Ametzagaina assemblages indicate that the youngest deposits may have coincided with a temperate phase before the Late Glacial Maximum (LGM). This period reflects conditions of environmental humidity and a landscape dominated by heaths and certain expansion of hydrophilic taxa (Calvo et al. 2013:232; Tapia et al. 2009:111). During the LGM, it is thought that marine regression reached its lowest level in Marine Isotope Stage 2 (between −100 and −120 m). This retreat exposed a coastal strip between 6 and 12 km wide. In this scenario, the mouths of the Oiartzun and Urumea rivers, which flow across the Spanish end of the above-mentioned corridor, would have been located further north, lengthening their respective courses and therefore situating Ametzagaina between the middle courses of these valleys.

The position of Ametzagaina in the interior of this natural Franco-Iberian corridor is significant because it lies on the communication route between some of the most significant Gravettian sites in the region (Isturitz,70 km away; Aitzbitarte III, 7 km; Amalda, 25 km; and Irikaitz, 30 km). In addition, this location is close to other strategic resources, particularly the flint outcrop at Gaintxurizketa and fords across the Oiartzun and Urumea rivers.

Archaeological Antecedents, Stratigraphy, and Age

The archaeological site of Ametzagaina was discovered in 2005 when an amateur found flint tools on the hilltop. The discovery was verified in 2006,

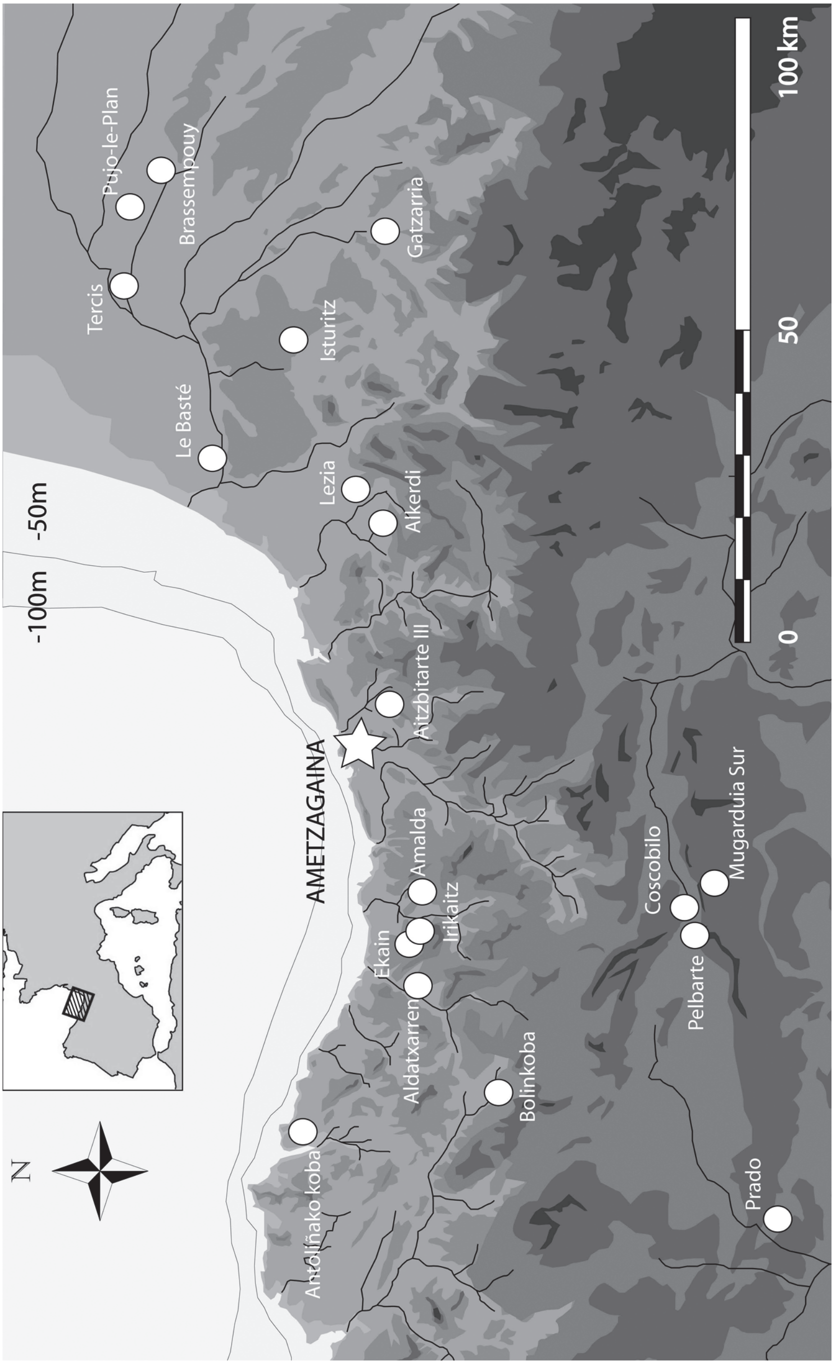

Figure 1. Map showing the location of Ametzagaina and the main Gravettian sites in the Western Pyrenees.

and archaeological investigation proceeded from 2007 to 2009 prior to the development of a city park. The archaeological work consisted of the identification and determination of the distribution of the archaeological remains. This was followed by small-scale excavations and test pits to determine the site's extent, stratigraphy, and the cultural age of the artifacts (Tapia et al. 2009).

The lithic materials occurred in two main areas: the east assemblage (E Assemblage) on the eastern knoll and the west assemblage (W Assemblage) on the western knoll. A gap in the distribution of remains was apparent between the two areas. In both cases, the greatest density of artifacts was found on top of the knolls. The finds were also dispersed along the hillsides, with the density decreasing in steeper areas further away from the hilltop. The lack of finds between the E and W Assemblages, which are about 300 m apart, may be due to a data sampling bias rather than a true absence of remains (Calvo 2012). In addition, because of the open-air context of the site, no organic remains (plants, macro- or micro-fauna, or bone) have been preserved. It has thus proved impossible to recover any such remains suitable for radiocarbon dating.

In order to (1) test the representativeness of the surface collections, (2) determine the site boundaries, and (3) examine the stratigraphic depth of each assemblage (E and W), 15 archaeological trenches and test pits were excavated seven in the east and eight in the west (Figure 2). The excavations identified only one area with artifacts in primary position. The other pits revealed little stratigraphic potential as they were severely impacted by recent disturbances. Although these activities did not involve the total loss of lithic materials, they did hamper the identification of the artifacts' stratigraphic context.

Sounding 7 on the eastern knoll contained the only area with intact stratigraphy; it had been covered by backdirt from a military trench dug in the nineteenth century. When that trench was created, some of the archaeological sediment was moved to serve as a rampart, sealing the deposits in the covered area. This intact stratigraphy (Figure 3) consisted of a sequence of three edaphic layers (surface, middle, and decomposed bedrock). Pollen samples extracted from these layers may clarify the temporal distribution of the lithic assemblages (Calvo et al. 2013).

The human occupations at Ametzagaina can only be dated with reference to the composition of the lithic assemblages and their techno-typological characteristics. As will be explained below, these traits attest to a mixing of Aurignacian and Gravettian materials in the W Assemblage. However, it is our opinion that the E Assemblage can be ascribed almost entirely to the Gravettian, for the following reasons:

- The quantitatively significant presence of retouched types with recognized chronological value in the region (Noailles burins), which are also well-represented in the stratigraphically intact remnant in Sounding 7. The other tools in the assemblage are coherent with this attribution. In general, the E Assemblage is perfectly comparable with assemblages from other well-stratified archaeological sites in the region that are dated to the Gravettian (Arrizabalaga and de la Peña 2013).

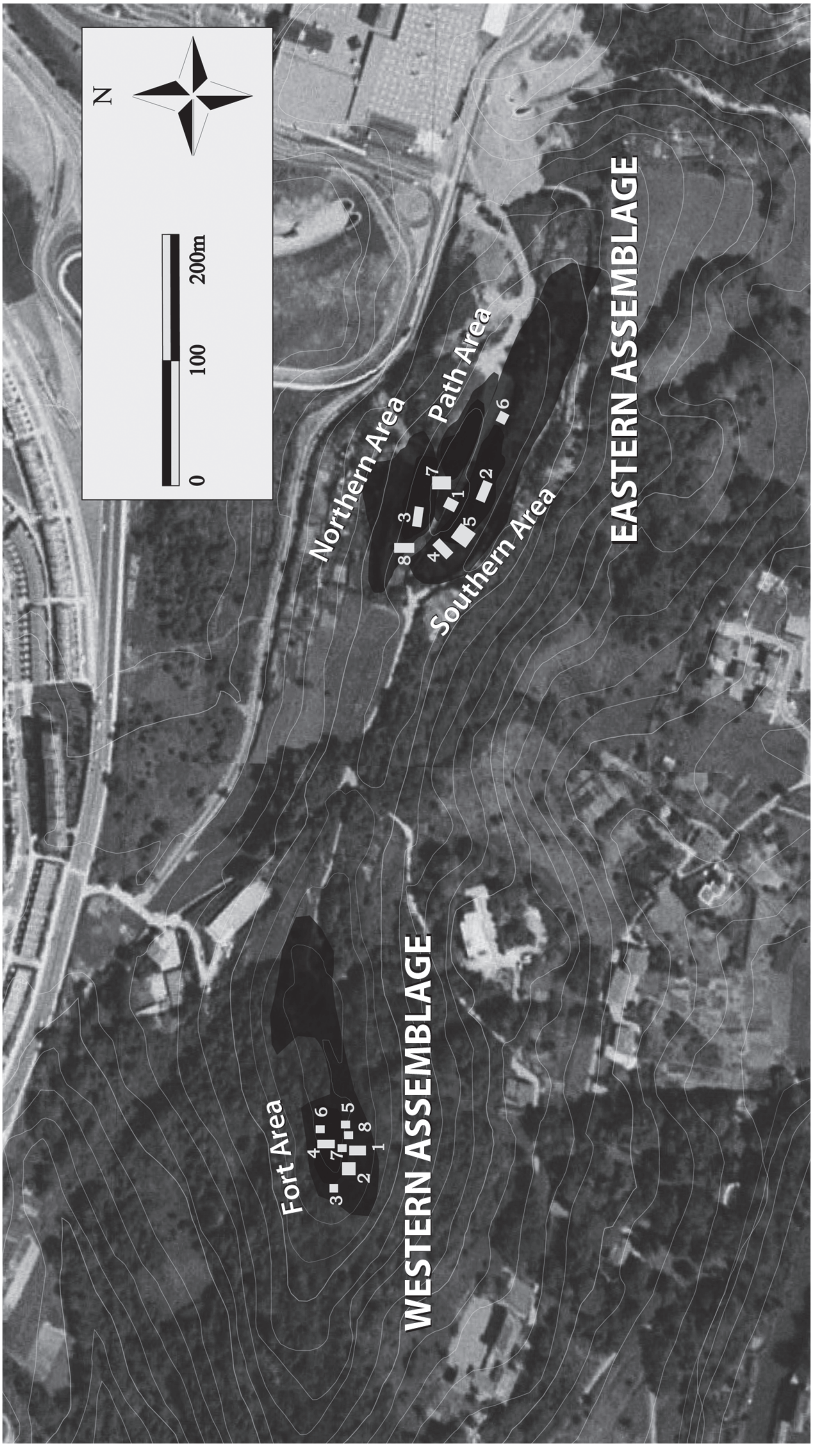

Figure 2. Plan of Ametzagaina showing the location of excavations (soundings) and collection areas: Northern Area (NA), Path Area (PA), Southern Area (SA), Sounding 7 (S7).

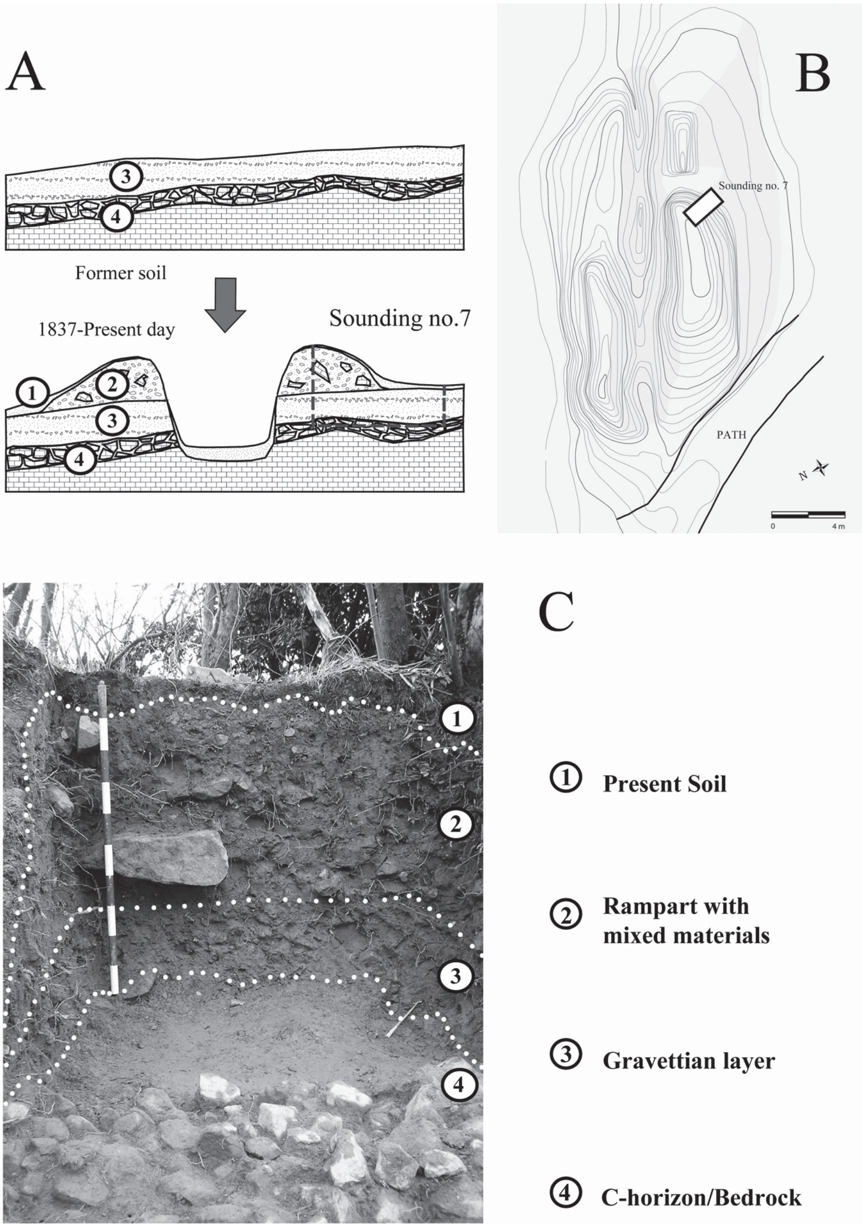

Figure 3. Stratigraphic sequence in Sounding 7 in the eastern sector of the site.

- The absence of retouched types characteristic of earlier or later periods than the Gravettian. For example, the absence of Solutrean foliate points is significant because they coexist with Noailles burins at other sites in the region. Trace quantities of micro-burins (one here) are not unusual in the regional Gravettian, as they are found in the levels in Morin (5) and Alkerdi caves and at the open-air site of Mugarduia Sur (Arrizabalaga and de la Peña 2013). Associated with a micro-laminar fracturing pattern, micro-burins can also be linked with proto-geometric industries such as those described for Aldatxarren Cave, another Gravettian site in Gipuzkoa (Sáenz de Buruaga 2007).
- The homogeneous composition of the assemblages recovered in the different parts of the E Assemblage (Figure 4). By taking into account the distribution of the different forms of retouch (a variable not subject to any selective bias during excavation), clear analogies can be observed. These similarities have been confirmed by a statistical test (χ^2_{16}=24.474; p=0.079). If repeated occupations before and/or after the Gravettian had taken place at this area on Ametzagaina Hill, these distributions would differ to a much greater extent.

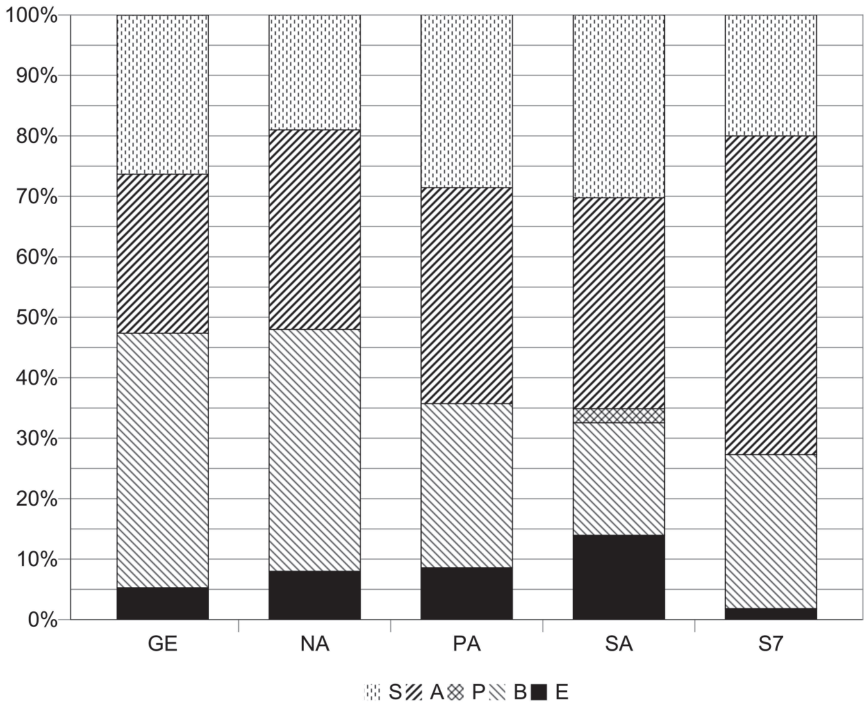

Figure 4. Cumulative percentages of retouch types
(S: Simple; A: Abrupt; P: Flat; B: Burin; E: Splintered) by collection area
(see Figure 2; GE = General collection from eastern knoll).

Consequently, the conclusions reached in the present study (mainly in reference to the E Assemblage) can be extrapolated to such issues as territorial mobility, catchment areas, and the management of lithic resources in the Gravettian period.

MATERIALS AND METHODS

All the flint objects found in the two lithic assemblages at Ametzagaina have been analyzed. They constitute nearly the entire assemblage (2,020 flint objects, or 99.55%, in the E Assemblage; 921 flint objects, or 98.82%, in the W Assemblage), apart from a few hammerstones, cores, and so on, made on other rock types such as schist, sandstone, and limestone. Four thin-sections were made from three nodules of the Gaintxurizketa flint type found at Ametzagaina. These nodules contained no traces of knapping or utilization. The lithic raw materials from both assemblages were identified using a methodology (Tarriño 2006) based on observing the textural characteristics with a conventional stereo microscope and a petrographic microscope (also used to study the thin-sections), followed by comparison with samples from known geological outcrops in the University of the Basque Country comparative collection of flints.

The methodology used in the techno-typological study of the two assemblages at Ametzagaina was based on the principles of Analytical Typology (Laplace 1972). The data were arrayed in contingency tables and compared statistically with the χ^2 test (significance level=0.05) to determine the internal heterogeneity of the assemblages. In the future, we hope to establish a statistical criterion to assess the distance from each flint outcrop as a critical factor in the presence of the flint at the site.

RESULTS

General Composition of the E and W Assemblages

The general composition of the two assemblages found at Ametzagaina is given in Table 1, broken down by the different stages in the lithic *chaîne opératoire*. The percentages of artifact classes in the two assemblages are very similar, which may indicate a functional similarity between the two areas of the site. Whole and fragmented unretouched blanks dominate in both series, followed by retouched tools and small knapping debris in the E Assemblage and the reverse order in the W Assemblage. In both assemblages, cores and core preparation/rejuvenation pieces together amount to nearly 7% of the total, while an element that is usually rare, burin spalls, reaches 4% in the W Assemblage and 6% in the E Assemblage.

Since the site was first published (the E Assemblage, in Tapia et al. 2009), interpretations of the materials have been relatively consistent despite difficulties in dating an open-air site at which many of the artifacts were found in secondary deposits. Several techno-typological factors observed in the E Assemblage from a small primary deposit permit attribution of the site to a series of mainly Gravettian open-air camps. These camps likely focused on initial lithic reduction of materials from the nearby outcrop.

Table 1. Artifact types in the E and W Assemblages.

	E Assemblage		W Assemblage	
	N	%	*N*	%
Manuports	10	0.5	9	1.0
Cores	54	2.7	36	3.9
Core preparation/rejuvenation[a]	74	3.6	28	3.0
Unretouched blanks[b]	1,123	55.3	497	53.3
Retouched tools	355	17.5	142	15.2
Burin spalls	129	6.4	40	4.3
Knapping debris (< 1.5 cm)	284	14.0	173	18.6
Microburins	1	0.04	—	—
Hammerstones	—	—	7	0.8
Total	2,029	100	932	100

a. includes core tables, core trimming elements, and crested blades
b. includes flakes, blades, and bladelets

The main difference between the two assemblages lies in the retouched tools (Calvo 2012; Calvo et al. 2013), which are clearly dominated in the E Assemblage by abrupt retouch (42%), truncations (16%), and backed tools (backed blades, backed blades on truncations, and backed points: 14%). In contrast, the series in the W Assemblage is dominated by burins (34%), which represent the second-most-common modification mode in the E Assemblage (32%). Noailles burins are found in significant proportions in both assemblages, representing more than a third of the total number of burins in each case. Finally, simple retouch is relatively abundant in the W Assemblage (32%), whereas splintered retouch is found in small proportions in both the E and W assemblages (6.5% and 8%, respectively). As we have already detailed, the E Assemblage may be considered entirely Gravettian. However, between a quarter and a third of the W Assemblage may be attributed to earlier occupations, probably Aurignacian, and therefore this western series will be studied in greater detail elsewhere.

Provenance of Flint in the E and W Assemblages

The flint used in the assemblages at Ametzagaina belongs to several types (Figure 5), all of which have been described in earlier studies (Chalard et al. 2010; Normand 2002; Séronie-Vivien et al. 2006; Tarriño 2006; Tarriño et al. 2007a, 2007b):

Flysch flint is the generic name for the flint that outcrops in the Flysch formation throughout the western Pyrenean region. The varieties identified in prehistoric sites include, from west to east, Kurtzia, Gaintxurizketa, Bidache, and Iholdy. At Ametzagaina, the most common varieties are Gaintxurizketa (Figure 5A) and Bidache (Figure 5B). **Bidache** flint contains a large number of bioclasts, especially sponge spicules, that usually form stripes and are particularly visible

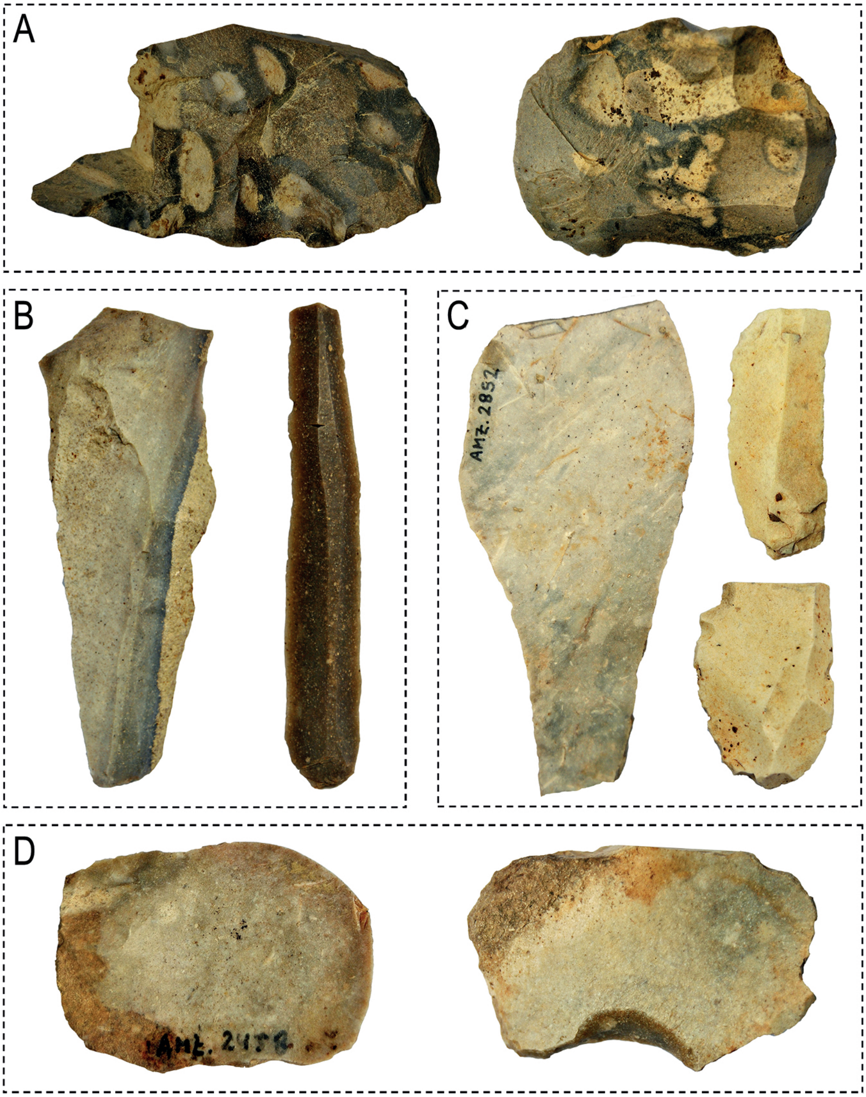

Figure 5. Macroscopic appearance of the main flint varieties identified at Ametzagaina.

A: Gaintxurizketa flint with zoning caused by extensive bioturbation; B: Bidache flint in its patinated state (left), with the characteristics turbiditic lamination clearly visible, and (right) without patina; C: Chalosse flint in its “bioclast” or Audignon variety (left) and patinated or Bastennes-Gaujacq variety (right); D: Urbasa flint, with its typical grayish patina.

when patinated. The natural colors are grayish, becoming white or yellowish when patinated. It also contains detritic quartz fragments, similar in size to fine or very fine sand.

The local (San Sebastián area) **Gaintxurizketa** variety consists of gray flint formed by microquartz (<20 μm) and crypto-quartz, with a large number of relict carbonate impurities and rhombohedral crystals of authigenic dolomite, generally measuring about 20 to 50 μm.[1] In addition, it contains opaque minerals (probably sulphurs). The specimens found at archaeological sites usually display altered carbonates, which are mainly ferrugenized and dissolved, causing superficial microporosity. Bioturbations are also common, and macroscopically they appear as stripes owing to their smaller content of carbonate impurities.

In the W Assemblage, the **Kurtzia** variety of Flysch flint has also been identified in a small quantity (under 1%). This variety is found on the coast of Bizkaia, north of Bilbao, and is easily identified when it is not patinated because it is usually darker when it is fresher. Small concentrations of organic matter (black spots) are characteristic.

Other artifacts of Flysch flint (50% in the E Assemblage and 75% in the W Assemblage) could not be specifically identified because of their poor state of preservation. However, most of them likely belong to the Bidache variety. Cortex was observed on specimens of Flysch flint (12% in the E Assemblage and 3% in the W Assemblage), with signs of abrasion or rounding by water action, probably by the sea. The nearest Bidache outcrops are 30 km from Ametzagaina and the furthest are 50 km away. The main outcrop of Gaintxurizketa flint is 4 km from Ametzagaina. Finally, Kurtzia is 110 km west of Ametzagaina along the coast, and this considerable distance explains its scarcity at the site.

Chalosse flint (Figure 5C) is fine-grained and has bioclasts of bryozoans and macro-foraminifera. Two varieties have been discriminated: a grayish flint with more bioclasts (including *Lepidorbitoides socialis*) (Figure 5C left), called Audignon in the southern part of the French Landes Department, and a yellowish one with fewer bioclasts (Figure 5C right), which is perhaps the Bastennes-Gaujacq type. The outcrops of Chalosse flint are some 110 or 120 km from Ametzagaina.

Urbasa flint (Figure 5D) is dark and and has a homogeneous texture with bioclasts consisting of foraminifera from the marine platform: discocyclinidae (*D. seunesi*) and nummulitidae (*N. heberti*). Ametzagaina is not only far from Urbasa in the Basque Mountain chain (>80 km), it involves crossing the divide between the Atlantic and Mediterranean watersheds. The climb to the plateau of the Sierra de Urbasa, at an elevation of 900 m, where the flint was gathered, is arduous.

An **Indeterminate** flint group includes (*a*) objects that cannot sourced because of their poor state of preservation, such as excessive patina; (*b*) objects affected by other activities, such as thermal alteration; and (*c*) unknown types whose characteristics are identifiable but do not match with any of the known varieties.

The frequencies of the different flint types in the two assemblages at Ametzagaina are shown in Figure 6. In the E Assemblage, Bidache flint is the most common, whereas in the W Assemblage, Gaintxurizketa flint, the nearest type to Ametzagaina, predominates. In both assemblages, the third most common raw material is Chalosse flint, and in the E Assemblage it reaches a proportion of 13%, which is noteworthy given the distance from the outcrop (Figure 7). Based on the number of indeterminate flint types in each assemblage, the W Assemblage is considered to be much less well preserved than the E Assemblage.

Detailed Analysis of the E Assemblage

This section explores the relationship between the petrological and techno-typological data. The W Assemblage is not discussed here because some Aurignacian objects may be mixed with the mostly Gravettian series and because of its smaller size, which would hinder reliable statistical analysis.

This study is based on the correlation between the retouched and unretouched elements and the types of raw material. The χ^2 values for the contingency tables are given in the captions, and the cells that are statistically significant ($p<0.05$), because of either presence or absence, are discussed in the text.

Table 2 shows retouched and unretouched elements (excluding manuports) by material type (Figure 8 portrays the same information as cumulative percentages). The two kinds of elements display many interesting similarities, especially bearing in mind the distances from the raw material outcrops. The local flint (Gaintxurizketa) does not reach 30% of the elements; instead, the Bidache variety predominates in both lithic types (>40%). The third most frequently represented outcrop is the most distant (Chalosse, with 18.5% and 12.3% of the retouched and unretouched elements, respectively). However, the statistically significant results are only found among the retouched elements, as the Bidache flint was used less often to make tools than would be expected from its distribution among the unretouched elements, whereas the Chalosse and, above all, the Urbasa varieties were used for making tools more often than expected.

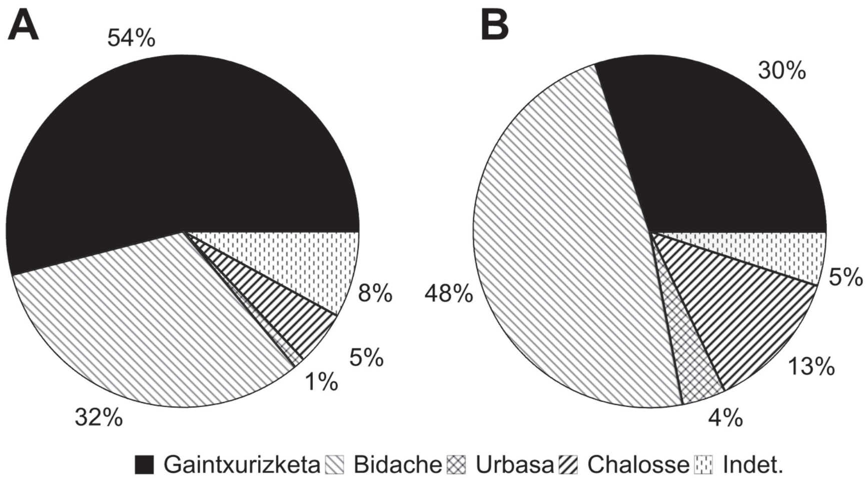

Figure 6. Percentages of the different flint varieties in the (A) West and (B) East Assemblages.

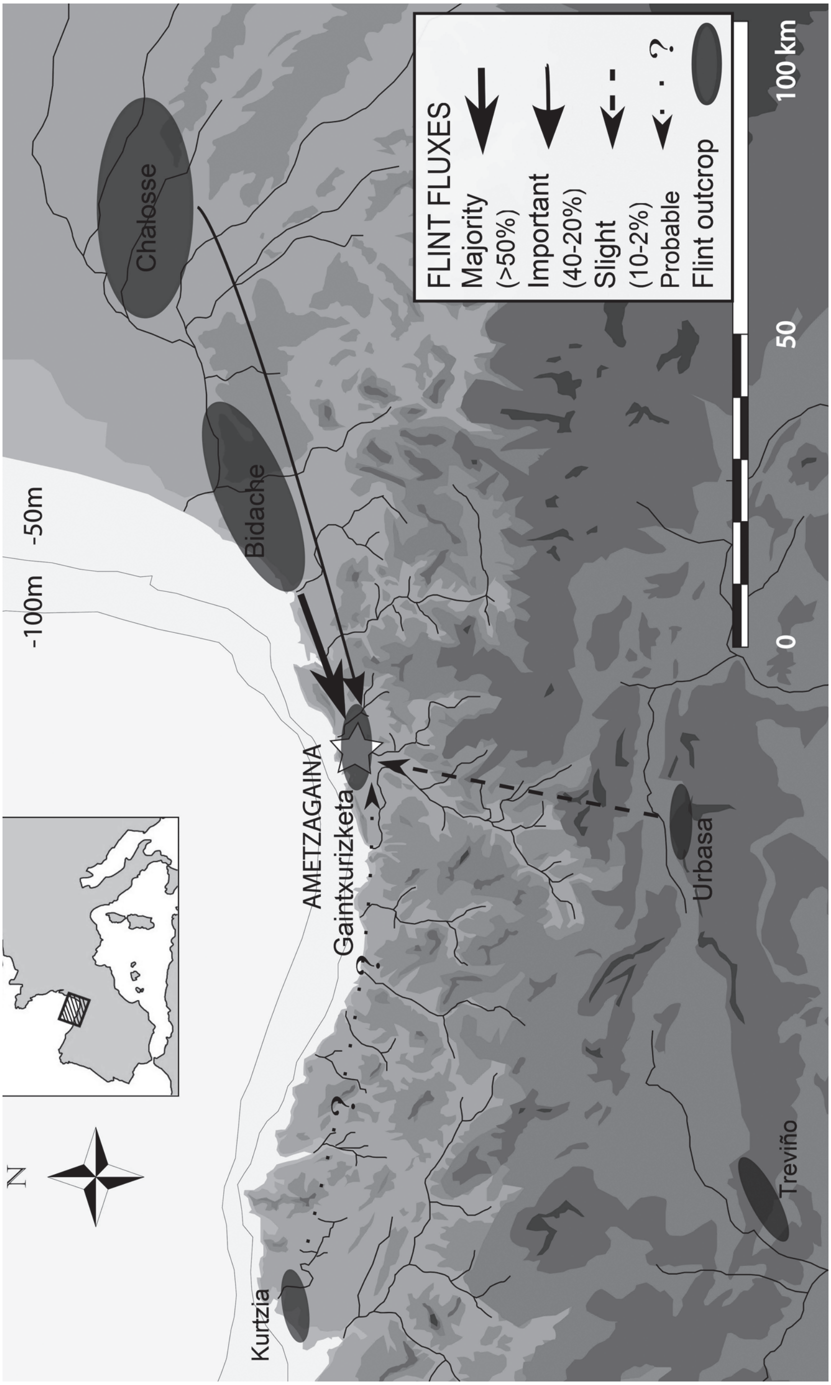

Figure 7. Map showing the source areas for the flint varieties identified at Ametzagaina.

Table 2. Retouched and unretouched flint artifacts by flint type (χ^2_4= 26.513; p=0.0000249).

	Gaintxurizketa	Bidache	Urbasa	Chalosse	Indeterminate	Total
Retouched	104	144	24	66	18	356
Unretouched	491	826	47	204	86	1654
Total	595	970	71	270	104	2010

Therefore, despite the similar frequencies of the different flint types among the retouched and unretouched remains, the chi-square test reveals that the distribution of flint types among the tools is very different. The Gravettian groups who camped at Ametzagaina often brought with them tools that were already prepared, resulting in an overrepresentation (which will be examined below) of Urbasa and Chalosse flint and an underrepresentation of the Bidache variety.

Table 3 relates the flint types with the general techno-typological categories (excluding manuports) (also see Figure 9). Several interesting points can be observed. When the variables are placed in order in terms of the lithic chaîne opératoire, it becomes clear that the strictly local raw material (Gaintxurizketa) loses its relative importance in later stages of the sequence and is only dominant in the category of cores. In contrast, more distant resources (Chalosse and Urbasa—

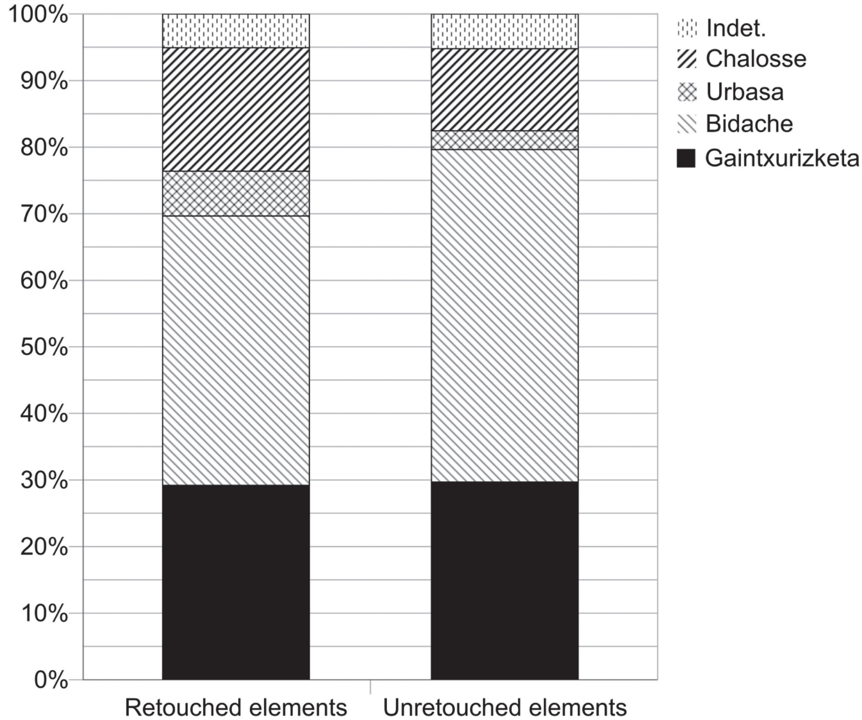

Figure 8. Cumulative percentages of retouched and unretouched flint artifacts by flint type.

Table 3. Artifact types by flint type (χ^2_{20}= 123.267; p=0.705 × 10^{-17}).

	Gaintxurizketa	Bidache	Urbasa	Chalosse	Indeterminate	Total
Cores (CO)	39	13	0	0	1	53
Core preparation/ rejuvenation (PR)	24	38	1	9	2	74
Unretouched blanks (UB)	355	545	37	126	52	1115
Retouched tools (RT)	104	144	24	66	18	356
Burin spalls (BS)	18	77	3	25	5	128
Knapping debris (KD)	55	153	6	44	26	284
Total	595	970	71	270	104	2010

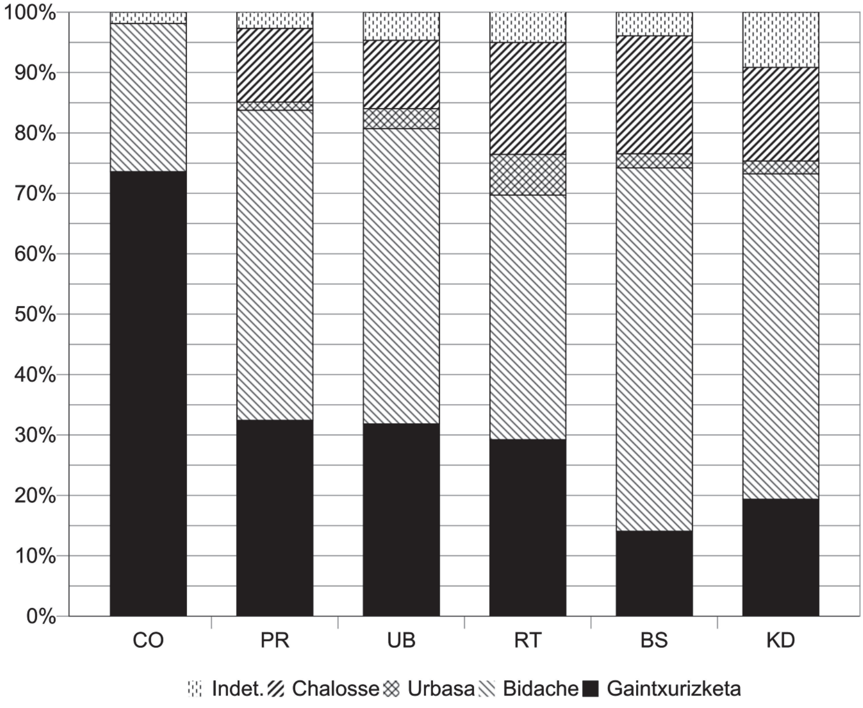

Figure 9. Cumulative percentages of artifact types (see Table 3) by flint type.

located in opposite directions from the site) increase their relative importance in the later stages of the chaîne opératoire. Based on the χ^2 distribution, the most sensitive category is the cores, where the overrepresentation of Gaintxurizketa flint is highly significant, just as the absence of cores in Chalosse flint or the few Bidache cores is also relevant. The occurrence of trimming flakes does not reach significance in any of the flint varieties, similar to the blanks, for which only the relative underrepresentation of Chalosse flint is significant. Again, tools and burin spalls are significantly related to the types of raw material, although inversely. Tools are significantly overrepresented in Urbasa and Chalosse flint and underrepresented in the Bidache variety. Burin spalls are significantly frequent in Bidache and Chalosse flint and rare in Gaintxurizketa flint. Finally, knapping debris reaches a significantly high value in the indeterminate flint type (owing to the small size of the pieces) and a low value in the Gaintxurizketa variety.

Interesting conclusions can be drawn about the functionality of the Gravettian camps at Ametzagaina. The nearest flint is the Gaintxurizketa type, which is found in the vicinity of the site. Despite its proximity, it is not the most abundant type, and its use at Ametzagaina is characteristic more of a secondary knapping site than of one that is in the immediate area of the outcrop: good cores that had been roughly shaped at the outcrop are overrepresented, as are blanks and trimming flakes (although much less significantly). In contrast, knapping debris and burin spalls are found in smaller frequencies than expected. The second-nearest outcrop is at Bidache, the source of most of the lithic material at the site. The significant underrepresentation of cores and tools, compared with the overrepresentation of burin spalls, may be due to this abundance, which makes the artifacts produced from this raw material very sensitive to the difference between observed and expected values. This flint type can be understood as the basic raw material for the groups staying at Ametzagaina, with a few selected cores from which blanks were obtained and used directly to make tools, and which were often transported away from the camp. Only debris, such as burin spalls, was left behind in large amounts.

Because of the greater distance from the outcrops, the other two raw materials, from Chalosse and, above all, from Urbasa, should be considered on a regional scale. The Chalosse variety is more abundant and statistically significant. Its pattern is what might be expected for a distant resource: cores are absent, blanks are relatively scarce, and yet both tools and burin spalls are overrepresented. The Urbasa variety, the least common flint type at Ametzagaina, is less crucial statistically, although again the proportion of tools in this flint is significant.

In short, although there is no direct correlation between distance from the outcrops and abundance at the site, the differential management of the raw materials is observed in a more elaborate statistical analysis. Functionally, the local material (Gaintxurizketa) appears most abundantly in the initial stages of the chaîne opératoire, whereas the more distant types (Chalosse and Urbasa) are found in the most advanced phases in the sequence. In contrast, the flint found at an intermediate distance (Bidache) is the most abundant type at Ametzagaina and exhibits the most ambiguous functional profile.

Table 4 shows the number of artifacts in the main techno-typological categories (excluding some of the less important ones, such as *becs* [short perforators] and undifferentiated abruptly retouched pieces) identified among the retouched tools, according to the five flint varieties (also see Figure 10). Despite first impressions, the distribution of the variables is quite homogeneous; the quantities of the different kinds of tools made from the different raw materials are what would be expected from the frequency of the materials. Backed blades constitute the only exception since the preference for Chalosse flint is highly significant, whereas the Gaintxurizketa variety seems to have been inadequate for this use. Conversely, Gaintxurizketa flint was used for truncations and burins on truncations whereas Chalosse flint appears to be (with weakly statistical signification) unsuitable for this kind of tool. Therefore, it is precisely the two typological elements (backed tools and truncations/burins on truncations) that have been highlighted as most sensitive for the systematization of the Gravettian (Arrizabalaga 1995; Arrizabalaga and de la Peña 2013) that give the most significant results. The systematization of the Gravettian should be understood in the two aspects of the term (chronology and techno-typology). If the first interpretation is accepted, along with the traditional French classification of the Gravettian, the oldest occupations would have been in more frequent contact with the north (Chalosse), whereas in the late Gravettian, movements would have alternated between the south and more local areas. Because of the different concurrent criteria, the techno-typological option seems most likely, as it attributes the preference for making certain tools to the different raw materials, perhaps because of the appearance or dominant characteristics of the raw material in the Gaintxurizketa or Chalosse outcrops.

Table 4. Typological classes by flint types (χ^2_{20}= 41.311; *p*=0.003).

	Gaintxurizketa	Bidache	Urbasa	Chalosse	Indeterminate	Total
Sidescrapers and denticulates (A)	19	29	1	8	4	61
Endscrapers (B)	6	10	3	6	1	26
Truncations and burins on truncations (C)	46	52	11	18	5	132
Dihedral burins and burins on natural surface or fracture (D)	16	18	3	8	2	47
Backed tools (points, blades, and bladelets) (E)	4	18	4	23	2	51
Pièces écaillés (splintered pieces) (F)	4	12	3	3	2	24
Total	95	139	25	66	16	341

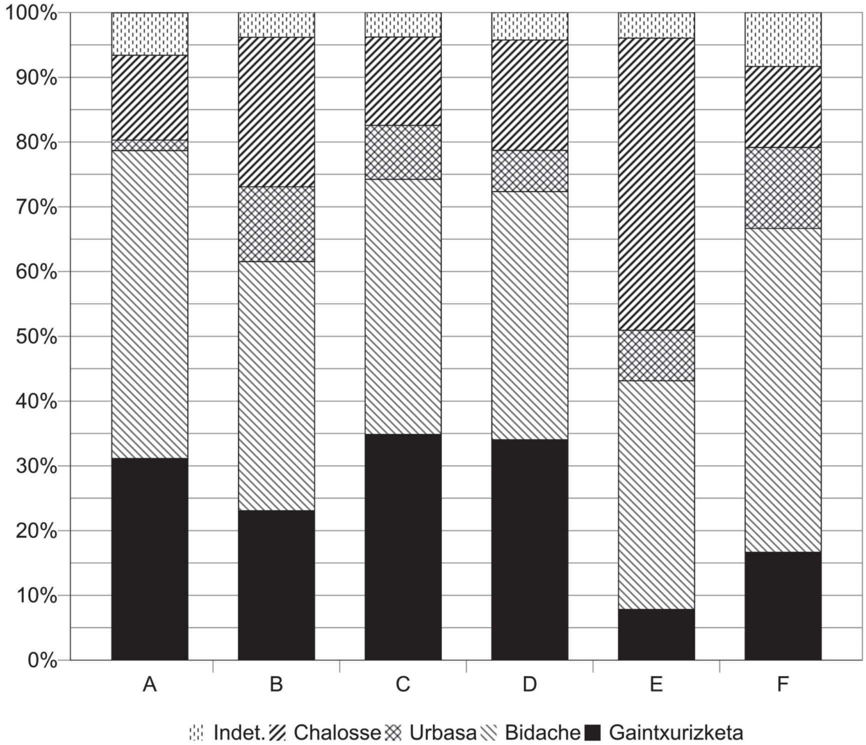

Figure 10. Cumulative percentages of typological classes (see Table 4) by flint type.

DISCUSSION

This preliminary study of the assemblages found at Ametzagaina provides some interesting food for thought. First, in the methodological sphere, an analysis based exclusively on the frequency of the variables would have resulted in a different picture, with less resolution, than the one provided by a simple statistical assessment. Despite its being an open-air site, with many of the objects in a secondary position, the circumstances of the E Assemblage and much of the W Assemblage are consistent with the hypothesis of a series of open-air camps occupied during the Gravettian. The four main flint types at the site (in order of nearest to furthest outcrops: Gaintxurizketa, Bidache, Chalosse, and Urbasa) display significant patterns in their distribution in the chaîne opératoire and typological classes, providing information about the functionality of the camps, the mobility patterns of the Gravettian groups, and their preferences of one flint over another in technological terms.

Such a methodological approach would be more effective if a sufficient number of terms of comparison were described with a similar protocol. This is still not the case. Most of the raw material studies of Basque Paleolithic assemblages have been carried out by the same specialists, although the classification of outcrops used here may not always be applied, the assemblages may not be large enough, or the sample is not analysed statistically. In these circumstances, it is still difficult to obtain a general impression of the Gravettian in the region, although a picture is starting to form thanks to the data obtained in major sequences in the Western Pyrenees.

One example are the flint assemblages from Aitzbitarte III (Errenteria, Guipúzkoa), recently published (Tarriño 2011). The stratigraphic sequence at the cave mouth includes three units clearly assigned to the Gravettian (Levels IV, Va, and upper Vb), with a series of radiocarbon determinations that date them to a quite early phase (ca. 29,500–27,500 BP) (Altuna et al. 2011). Owing to its proximity (less than 7 km in a straight line), this site in principle should exhibit the clearest parallels with Ametzagaina. Similarities do exist, as is inevitable, but there are also some interesting differences. The first of these is that the distribution of raw materials at Aitzbitarte III varies greatly in the Gravettian levels:

- Level IV: Flysch 43.2%; Urbasa 19.8%; Gaintxurizketa 17.7%; Chalosse 8.6%; Urgonian 5%; Saliès de Béarn 0.5%; Treviño 0.5%.
- Level Va: Flysch 39.4%; Gaintxurizketa 19.3%; Chalosse 11.7%; Urbasa 10.9%; Urgonian 7.8%; Saliès de Béarn 4.5%; Treviño 0.6%.
- Upper Level Vb: Gaintxurizketa 43.6%; Flysch 22.4%; Urgonian 13.9%; Urbasa 9.1%; Chalosse 4.2%; Treviño 1.8%.

Three sources of raw materials not identified at Ametzagaina are known at Aitzbitarte III, although their use decreases progressively. One of them is local, the poor-quality Urgonian flint found in the limestone of the same geological facies, and the other two are regional (the Treviño [south of the Basque Mountains in Alava] and Saliès de Béarn [east of Bidache in eastern Pyrénées-Atlantiques Department] varieties). If it is accepted that much of the flint identified as Flysch came from the Bidache outcrops, Level Va most closely resembles Ametzagaina in terms of the sources of lithic raw materials, with reservations. The chronological sequence at Aitzbitarte III (which cannot be studied at Ametzagaina) shows an increase through time in the proportions of Urbasa and, above all, Chalosse flint in the Gravettian levels, both in comparison with the Aurignacian levels and within the Gravettian sequence of levels. The use of Flysch flint also increases, whereas Gaintxurizketa flint is clearly used less through time. In general, the percentage of local raw materials declines and regional flint increases in the Gravettian levels, in parallel with a restriction in the use of regional outcrops which contribute small percentages to the total. Taking the long view, it might be said that the range of movements steadily increased at the same time as the main areas of procurement were narrowed. The low number of objects from Aitzbitarte III advises caution in the functional assessment of each flint type.

Alkerdi Cave (Urdax, westernmost Spanish Navarre) is 36 km from Ametzagaina in a straight line (although Paleolithic groups would have had to travel a considerably longer distance to get around the mountains). The Gravettian level at Alkerdi (Level II) has been dated to 26,470 ± 530/490 BP (GrN-20322) (Cava et al. 2009). A detailed study of the lithic raw materials (Elorrieta 2010) highlights the point made above. The frequencies of the raw materials (Flysch 84.7%; Chalosse 4.5%; Urbasa 1.5%; Saliès de Béarn 0.5%) shows that procurement of lithic resources at this Pyrenean site was radically different from that at Ametzagaina and Aitzbitarte III and was restricted almost exclusively to Flysch outcrops on the northern side of the Pyrenees. The exception is the use of Urbasa flint, which was not used to make tools and is only present in the form of scarce knapping debris. Despite the caution required by the small number of objects, a clear correlation is seen between Chalosse flint and backed tools (the eight tools made from this flint type include five backed blades and two backed points).

Another site to be considered is Antoliñako Koba (Gautegiz-Arteaga, near the coast of central Vizcaya), specifically Levels Lab and upper Lmbk, with the latter level dated to 27,390 ± 320 BP (GrN-23786) (Aguirre 2000). This cave is a little less than 60 km from Ametzagaina, which is close to the real distance that would be traveled on foot between the two sites. As might be expected from its proximity to the famous Soplana-Barrika outcrop near Bilbao, the Kurtzia variety of Flysch flint dominates the assemblage (75%). The long distance from Antoliñako Koba to Urbasa was not an impediment to its use since it represents the second most common flint type (10.3%), followed by two kinds of Treviño flint (the generic type, 4.9%, and the Loza variety, 1.8%). The great quality and apparent availability of Kurtzia flint was not a hindrance to discrete numbers of Urbasa and Treviño flint.

A similar distance away (62 km), but to the north of Ametzagaina, is the extraordinary cave site of Isturitz (Saint-Martin-d'Arberoue, Basse-Navarre [Pyrenées-Atlantiques]), where materials from the Gravettian Level IV/F3 have recently been studied (Lacarrière et al. 2011). The results are similar to those from Alkerdi, except for Chalosse flint. At Isturitz, this flint type is considered local and occurs in greater abundance. The study of cores in the de Saint-Périer collection indicates the following frequencies: Flysch (Iholdy-Bidache) 73%; Chalosse 20%; Urbasa and Treviño approx. 1%; in addition to a few remains of Fumelois-Bergeraçois flint from the far-distant Dordogne. According to Simonet (2010), given the importance of Chalosse flint from the ancient Aurignacian level onwards at Isturitz (14.4%, according to Tarriño and Normand [2002]), this cannot be cited as another example (as Brassempouy, Aitzbitarte III and, as the present study shows, Ametzagaina and Alkerdi) of the increasing use for Chalosse flint in the Gravettian. Isturitz›s nature as an aggregation site would explain the high frequency of this flint type at the site, as well as the varying amounts of "trace" varieties from both the northern (Tercis and Bergeraçois) and the southern(Urbasa and Treviño) sides of the Pyrenees.

Regarding retouched tools, the *armatures* (stone weapon elements) in the Gravettian horizon at Isturitz are interesting. The proportion of this category made on Bidache flint decreases to 57%, while flint types from more distant outcrops increase considerably. This is especially true with Chalosse flint, which reaches a total of 29%. In addition, the different varieties are clearly selected for the different types of armatures in each level. Chalosse, Treviño, and Urbasa flint are associated almost exclusively with backed points, whereas Bidache flint is distributed more homogeneously.

The cave site of Grotte du Pape in Brassempouy (Landes) is a special case in that it is located near the outcrops of two varieties of Chalosse flint (Audignon and Bastennes-Gaujacq) (Simonet 2012). These Brassempouy flint types are considered the most local and accessible to the site. They are also of high quality and large format, and represent the most common raw material types used for Chantier (Locus) I cores and certain armatures. The Audignon variety is used principally for backed points, backed bladelets, and backed bladelets on truncations, whereas the Bastennes-Gaujacq variety is used in large proportions for bladelets with marginal retouch. Similar tendencies of these types of raw material distributions are seen in Levels 2A-2E in the site's Sector GG2 (Grande Galerie).

Further information comes from other open-air knapping sites such as Prado (Sáenz de Buruaga et al. 2005), Pelbarte (Sáenz de Buruaga 2004), and Mugarduia Sur (Barandiarán et al. 2007) on the southern side of the Pyrenees, and Tercis (Normand 1993) to the north. These specialized sites also contain lithic assemblages dominated by locally available raw material from the two Brassempouy outcrops. However, because of their functional bias as knapping sites with no long-term occupational signature, the information these sites can provide regarding procurement models is limited. Nevertheless, some preliminary information is available for other Gravettian sites, such as at Irikaitz (Arrizabalaga and Iriarte 2011).

Other, more distant Gravettian sites such as Gargas, Enléne, La Tuto-de-Camalhot, and La Carane-3 in the central French Pyrenees provide additional data regarding raw material use. All of these sites contain mainly local, high-quality raw materials. However, Chalosse flint is also found in small or noticeable quantities at all these sites, despite their distance to the source. For example, nearly 18% of the Gargas assemblage consists of Chalosse flint even though the site is located 120 km from the main outcrop (Foucher 2005). The same can be said for even more distant transport at other Aurignacian and Gravettian sites located farther north from the Pyrenees in the Périgord (Dordogne) and Quércy (Lot) regions (Chalard et al. 2010). The distribution of Chalosse flint reaches as far as the Magdalenian levels at the site of Las Caldas (Asturias, Spain), 550 km from the outcrop. Its presence has also been described in the Aurignacian levels at Abri Caminade (north Aquitaine [Bordes et al. 2005]) and Le Piage F (Lot [Le Brun-Ricalens and Séronie-Vivien 2004]), 200 km from the source. In the Gravettian, it has been described at Grotte des Fieux (Quercy) and in the Badegoulian occupation at Cuzoul de Vers (Quércy), where between 10% and 15% of the allochthonous flint reached the site in the form of retouched tools made from Chalosse type material. The precise distances between the archaeological deposits and this geological outcrop have been questioned, however, in a recent study (Colonge et al. 2011), which described a new flint outcrop with the

Lepidorbitoides fossil similar to Chalosse flint in the Gers region further east along the Pyrenees. Nonetheless, the Chalosse flint type is still considered a true marker for the Aurignacian and Gravettian in southwest France. When its distribution and technological application are taken into consideration, it appears to be a particularly suitable material for manufacturing large blades and creating the preforms for large endscrapers, burins, and backed elements during the EUP.

Similar remarks can be made regarding the use of Urbasa flint. This material was already in widespread use during the Aurignacian, as at Labeko Koba (central Guipúzcoa) where it represents nearly 50% of the lithic assemblage. At that site it was also the nearest flint outcrop, albeit more than 40 km away (Tarriño 2000). Similarly, at Ekain in coastal Guipúzcoa not far west of our site (Ríos 2011), Urbasa flint is the most common type in Level IXb, followed by the Bidache type. Some Gravettian knapping sites are also associated with the exploitation of this raw material, such as Mugarduia Sur and Pelbarte. However, the Urbasa flint is only found in small percentages across all of northern Spain, such as at the sites of Las Caldas (M. S. Corchón, personal communication) and possibly El Mirón in eastern Cantabria (personal communication from A.Tarriño to L. G. Straus, July 2013).

In contrast to the long-distance movements of flint types is the scarce presence of Flysch flint varieties, such as Gaintxurizketa and Bidache, outside the immediate surroundings of their outcrop. Despite the latter being of better technical quality, it is rarely found outside its region from the Mousterian (Unikoté II) (Dachary 2000) to the Magdalenian (Dachary 1999; Straus 1995) and Azilian (Straus 1995), based on work by the Séronie-Viviens. It is assumed that the presence of other, better-quality flint types (Chalosse, Urbasa, and Treviño) did not justify transporting these materials long distances.

Little supplementary information can be added about the functional attributes of each flint type given the current state of our knowledge. Only two variables have been cross-referenced in other cases (Ekain, Aitzbitarte III), and the number of objects examined does not allow for statistically significant conclusions. We hope that this aspect of the lithic record will be analyzed in future studies.

Despite the paucity of available data, it can be seen that allochthonous raw materials, especially Chalosse flint, circulated more widely in the western Pyrenees in the Gravettian than in the Aurignacian. This impression is difficult to interpret, and indeed needs confirmation by future research. Several possible explanations exist: changes in mobility patterns of the human groups (Binford 1980, 1982; Kelly 1983, 1992); development of social networks for the exchange of resources (Whallon 2006)—perhaps as a consequence of population growth (Bocquet-Appel et al. 2005); better knowledge of the sources of raw materials, and so on. To be able to test these hypotheses it will be necessary to carry out further research because the number of sites is currently very small for such a large area. At the current rate of new discoveries (De las Heras et al. 2013), in a couple of decades we may be able to assess more precisely whether the apparent increase in the number of sites in the Gravettian, in parallel with a wider circulation of allochthonous resources, is a result of a change in the mobility patterns of groups or of an enlargement in their exchange networks.

CONCLUSIONS

Conclusions can be drawn from the contents of this study on three different levels. The first is methodological. We have advanced greatly in our understanding of lithic raw materials and their origin since the last regional overview of Gravettian lithic assemblages in the Iberian Basque Country (Arrizabalaga 1995) and since the first publication of an assemblage from this perspective (Tarriño 2000). The main sources of the flint used in this area have been determined, and it has also become possible (as far as is allowed by legal limitations on destructive tests on archaeological objects) to identify small lithic remains that are often patinated and/or altered. As the title of this paper indicates, the challenge now is to determine mobility patterns for each archaeological level and to identify the value that prehistoric groups gave to each raw material type (what they most used it for). The territories that contain these raw materials should also be determined, and the movements in search of such flints should be estimated (and compared with a suitable statistical protocol).

Second, some of the authors (e.g., Arrizabalaga 2007) have proposed that the Pyrenees disrupted the distribution of territories in the Paleolithic, and the route at the end of the Western Pyrenees tended to be focused on the lower Bidasoa Valley where movement is easiest(keeping in mind as well that most of the chain experienced maximum glaciation at this time, making the narrow passage near the Bay of Biscay coast all the more vital). This means that the Paleolithic catchment areas, which on open ground tend to take regular shapes, look more like an hourglass in this region. The narrowest part is in the Basque territory near the modern Txingudi estuary, on both sides of the mountains. We have seen that the sites in this region, except Ametzagaina and Aitzbitarte III (the nearest ones to the bottleneck), exhibit an overrepresentation of the closest high-quality flint: Bidache flint at Alkerdi and Isturitz; Chalosse at Brassempouy, to the north of the Pyrenees; and Kurtzia Flysch flint at Antoliñako Koba, to the south. These patterns shape two different territories. Only archaeological deposits in northeast Guipúzkoa and presumably in the southeast of Labourd and Basse-Navarre (the westernmost districts of the French Department of Pyrénées-Atlantiques) reflect both territories, as each one contributes small amounts of local flint. Thus, based on the current state of knowledge, sites in the Iberian Basque Country and the continental Basque Country maintained their own pattern and were supplied with the nearest high-quality resources. The exceptions are the sites located in the narrowest parts of the hourglass, as they tended to share the good-quality raw material available on both sides of the Pyrenees.

The third point relates to how the mixed profile of lithic procurement at Ametzagaina influences the meaning of mobility to and from the site. The flint from the nearest outcrop (Gaintxurizketa) was roughly trimmed at the outcrops and taken to the secondary knapping site (Ametzagaina) as shaped cores (which are overrepresented in the assemblage) and further reduced. Primarily, these cores produced most of the tools, except for backed tools, with a certain preference for truncations and burins on truncations.

The flint used most often is the Bidache type. This material was also brought into Ametzagaina as shaped cores and used to produce blade blanks and retouched tools. The raw materials from more distant sources (Chalosse and Urbasa) are not found as cores and only rarely as trimming flakes and flake blanks. However, they are abundant among the blade blanks and retouched tools (except for the most basic types), and proportionally among the knapping debris. Repeating the usual pattern at Gravettian sites to the north of the Pyrenees, Chalosse flint is used in significant amounts to make blade blanks and backed elements. Urbasa flint is used above all for end-scrapers and scaled pieces, with the latter often found as various tool types in the stage of reuse or recycling.

From this perspective, Chalosse flint in this region was used for blade and/or microblade tools, but above all for backed elements. This can be seen in the E Assemblage at Ametzagaina (backed blades), Alkerdi (mainly backed blades), and Isturitz (almost exclusively backed points), and also at Brassempouy (mainly backed blades) where Chalosse flint is the most local and abundant type at this site. Although it is still too early to reach conclusions about raw material use in temporal sequences, a general picture can be constructed for the principal deposits, with the Aurignacian appearing to be marked by the procurement of local resources whose role decreases as the outcrops of high-quality flint gain importance during the Gravettian.

Finally, it is clear that no linear correlation exists between distance from the outcrop and the frequency of the flint type in a deposit. Therefore, this variable cannot be interpreted in a simplistic way, and the archaeological interpretation of Upper Paleolithic hunter-gatherer behavior should bear in mind the circumstances of each deposit and level.

NOTES

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1. The petrographic characterization, described here for the first time, is based on the analysis of four thin sections carried out in the course of this and other related studies.

REFERENCES CITED

Aguirre, Mikel. 2000. El paleolítico de Antoliñako Koba (Gautegiz-Arteaga, Bizkaia): Secuencia estratigráfica y dinámica industrial. Avance de las campañas de excavación 1995–2000. *Illunzar* 4:39–81.

Altuna, J., K. Mariezkurrena, and J. Ríos, eds. 2011. *Ocupaciones humanas en Aitzbitarte III (País Vasco) 33.600–18,400 BP.* Gobierno Vasco, Vitoria-Gasteiz.

Arrizabalaga, Alvaro. 1995. *La industria lítica del Paleolítico Superior Inicial en el Oriente Cantábrico*. Unpublished doctoral thesis, Universidad del País Vasco, Vitoria.

———. 2007. "Frontières naturelles, administratives et épistémologiques: L'unité d'analyse dans l'archéologie du Paléolithique (dans le cas basque)," in *Frontières naturelles et frontières culturelles dans les Pyrénées préhistoriques*. Edited by Natalie Cazals, Jesús González, and Xavier Terradas, pp. 27–37. Santander.

Arrizabalaga, Alvaro, and María-José Iriarte-Chiapusso. 2010a. "El Gravetiense en la encrucijada: Actualización de la información y propuesta de relectura para el caso vasco," in *Cuaternario y Arqueología: Homenaje a Francisco Giles Pacheco*. Pp. 133–46. Cádiz.

———. 2010b. "El Paleolítico superior inicial en el siglo XXI: Dos décadas de avances en la encrucijada vasca," in *El Paleolítico superior en la Península Ibérica: novedades del siglo XXI.* Edited by J. M. Fullola, X. Mangado and M. Tejero, pp. 311–35. Barcelona.

———. 2011. "Les gisements archéologiques gravettiens de plein air dans le Pays Basque péninsulaire: Un phénomène émergent," in À la recherche des identités gravettiens: *Actualités, questionnements et perspectives*, Edited by N. Goutas, L. Klaric, D. Pesesse, and P. Guillermin, pp. 197–206. Paris: Mémoire 52 de la Société Préhistorique Française.

Arrizabalaga, Alvaro, and Paloma de la Peña. 2013. "El registro de la industria lítica como base para una organización del Gravetiense cantábrico," in *Pensando el Gravetiense: Nuevos datos para la región cantábrica en su contexto peninsular y pirenáico.* Edited by C. de las Heras, J. A. Lasheras, A. Arrizabalaga, and M. de la Rasilla, pp. 347–69. Monografías del Museo Nacional y Centro de Investigación de Altamira 23. Madrid: Ministerio de Educación y Cultura.

Barandiarán, Ignacio, Pedro Benéitez, Ana Cava, and María-Asunción Millán. 2007. El taller gravetiense de Mugarduia sur (Navarra): Identificación y cronología. *Zephyrus* 60:15–26.

Binford, Lewis. 1980. Willow smoke and dogs' tails: Hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45:4–20. http://dx.doi.org/10.2307/279653

———. 1982. The archaeology of place. *Journal of Anthropological Archaeology* 1:5–31. http://dx.doi.org/10.1016/0278-4165(82)90006-X

Bocquet-Appel, Jean-Pierre, Pierre-Yves Demars, Lorette Noiret, and Dmitry Dobrowsky. 2005. Estimates of Upper Paleolithic meta-population size in Europe from archaeological data. *Journal of Archaeological Science* 32:1656–68. http://dx.doi.org/10.1016/j.jas.2005.05.006

Bordes, Jean-Guillaume, François Bon, and Foni Le Brun-Ricalens. 2005. "Le transport des matières premières lithiques à l'Aurignacien entre le Nord et le Sud de l'Aquitaine: Faits attendus, faits nouveaux," in *Territoires, déplacements, mobilité, échanges durant la Préhistoire*. Edited by Jacques Jaubert and Michel Barbaza, pp. 185–98. Paris: CTHS.

Calvo, Aitor. 2012. El yacimiento gravetiense al aire libre de Ametzagaina (Donostia, País Vasco). Los tecno-complejos líticos del Conjunto Oeste. *CQK 2*:17–34. Available online.

Calvo, Aitor; Jesús Tapia, Alvaro Arrizabalaga, and María-José Iriarte-Chiapusso. 2013. "El yacimiento de Ametzagaina (Donostia, País Vasco). Un campamento gravetiense al aire libre en el Cantábrico," in *Pensando el Gravetiense: Nuevos datos para la región cantábrica en su contexto peninsular y pirenáico.* Edited by C. de las Heras, J. A. Lasheras, A. Arrizabalaga, and M. de la Rasilla, pp. 229–41. Monografías del Museo Nacional y Centro de Investigación de Altamira 23. Madrid: Ministerio de Educación y Cultura.

Cava, Ana, Irantzu Elorrieta, and Ignacio Barandiarán. 2009. El Gravetiense de la cueva de Alkerdi (Urdax, Navarra): Análisis y contexto de su industria lítica. *Munibe* 60:51–80.

Chalard, Pierre, François Bon, Laurent Bruxelles, Sylvain Ducasse, Nicolas Teyssandier, Caroline Renard, Philippe Gardere, Patricia Guillermin, Sebastian Lacombe, Mattieu Langlais, Romain Mensan, Christian Normand, Robert Simonnet, and Andoni Tarriño. 2010. "Chalosse type flint: Exploitation and distribution of a lithologic tracer during the Upper Paleolithic, southern France," in *Ancient mines and quarries: A Trans-Atlantic perspective.* Edited by M. Brewer-Laporta, A. Burke and D. Field, pp. 13–22. Oxford: Oxbow Books.

Colonge, David, Pierre Chalard, Michel Bilotte, Sylvain Ducasse, and J.-P. Platel. 2011. Nouvelle découverte d'un gîte à silex à Lepidorbitoides dans le Sud-Ouest de la France (Saint-Aubin, Gers) et implications archéologiques. *Bulletin de la Société Préhistorique Française* 108 (3):561–78.

Dachary, Morgane. 1999. "L'industrie lithique: Premières résultats," in *L'habitat magdalénien de la grotte du Bourrouilla à Arancou (Pyrénées-Atlantiques)*. Edited by Claude Chauchat, pp. 12–36. Paris: CNRS

———. 2000. Étude du matériel lithique recueilli à Unikoté (Iholdy, Pyrénées Atlantiques): Campagnes 1995 à 1998. *Archéologie des Pyrénées Occidentales et des Landes* 19:65–76.

De las Heras, C., J. A. Lasheras, A. Arrizabalaga, and M. de la Rasilla, eds. 2013. *Pensando el Gravetiense: Nuevos datos para la región cantábrica en su contexto peninsular y pirenaico*, Monografías del Museo Nacional y Centro de Investigación de Altamira 23. Madrid: Ministerio de Educación y Cultura.

Elorrieta, Irantzu. 2010. *El aprovechamiento y disponibilidad de las materias primas silíceas durante el Paleolítico Superior en el Pirineo Occidental: El caso de Alkerdi como paradigma*. Unpublished DEA, Universidad del País Vasco, Vitoria.

Foucher, Pascal. 2005. Gargas et l' Atlantique: Les relations transpyrénéennes au cours du Gravettien. *Munibe* 57:131–47.

Kelly, Robert. 1983. Hunter-gatherer mobility strategies. *Journal of Anthropological Research* 39(3):277–306.

———. 1992. Mobility/Sedentism: Concepts, archaeological measures, and effects. *Annual Review of Anthropology* 21:43–66. http://dx.doi.org/10.1146/annurev.an.21.100192.000355

Lacarrière, Jessica, Nejma Goutas, Christian Normand, and Aurelien Simonet. 2011. "Vers une redéfinition des occupations gravettiennes de la grotte d'Isturitz (Pyrénées-Atlantiques, France): Révision critique des collections «anciennes» par l'approche intégrée des données lithiques, fauniques et de l'industrie osseuse," in *À la recherche des identités gravettiens: actualités, questionnements et perspectives.* Edited by N.

Goutas, L. Klaric, D. Pesesse, and P. Guillermin, pp. 67–83. Paris: Mémoire 52 de la Société Préhistorique Française.

Laplace, Georges. 1972. La typologie analytique et structurale: Base rationnelle d'étude des industries lithiques et osseuses. *Banques des données archéologiques* 932:91–143. Paris: CNRS.

Le Brun-Ricalens, Foni, and Marie-Roger Séronie-Vivien. 2004. Présence d'un silex d'origine nord-pyrénéenne (Chalosse?) en Haut-Quercy dans l'Aurignacien du Piage (Lot, France) et implications. *Paléo* 16:129–36.

Normand, Christian. 1993. Un atelier de taille de pièces à dos à Tercis (Landes). *Archéologie des Pyrénées Occidentales et des Landes* 12:27–51.

———. 2002. "Les ressources en matières premières siliceuses dans la basse vallée de l'Adour et de ses affluents. Quelques donnés sur leur utilisation au Paléolithique Supérieur," in *Comportements techniques et économiques des sociétés du Paléolithique supérieur dans le contexte pyrénéen*. Dir. by N. Cazals, pp. 26–47. Projet Collectif de Recherche, Service Régional de l'Archéologie de Midi-Pyrénées.

Ríos-Garaizar, Joseba. 2011. El nivel IXb de Ekain (Deba, Gipuzkoa, Región Cantábrica): Una ocupación efímera del Auriñaciense Antiguo. *Munibe* 62:87–100.

Sáenz de Buruaga, Andoni. 2004. Las primeras manifestaciones del Paleolítico superior antiguo en Araba y la explotación de las materias primas silíceas: Algunas reflexiones. *Estudios de Arqueología Alavesa* 21:1–16.

———. 2007. Cueva de Aldatxarren (Mendaro). *Arkeoikuska* 2006:168–75.

Sáenz de Buruaga, Andoni, Maite García-Rojas, and Ismene Retolaza. 2005. Aproximación a la interpretación tecno-tipológica del conjunto industrial de tradición gravetiense de Prado (Burgeta, Araba). *Estudios de Arqueología Alavesa* 22:51–68.

Séronie-Vivien, Micheline, Marie-Roger Séronie-Vivien, and Pascal Foucher. 2006. L'économie du silex au Paléolithique supérieur dans le Bassin d'Aquitaine. Le cas des silex à lépidorbitoïdes des Pyrénées centrales. Caractérisation et implications méthodologiques. *Paléo* 18:193–216.

Simonet, Aurélien. 2010. *Typologie des armatures lithiques gravettiennes de la grotte d'Isturitz (Pyrénées-Atlantiques, France)*. Oxford: BAR International.

———. 2012. *Brassempouy (Landes, France) ou la matrice gravettienne de l'Europe*. Liège: ERAUL 133.

Straus, Lawrence. 1995. *Les derniers chasseurs de rennes du monde pyrénéen: L'Abri Dufaure, un gisement Tardiglaciaire en Gascogne (fouilles 1980-1984)*. Mémoires de la Societé Préhistorique Française 22.

Straus, Lawrence, and Geoffrey Clark. 1986. *La Riera Cave: Stone Age hunter-gatherer adaptations in northern Spain*. Anthropological Papers 36. Tempe: Department of Anthropology, Arizona State University.

Tapia, Jesús, Alvaro Arrizabalaga, María-José Iriarte-Chiapusso, and Aitor Calvo. 2009. El campamento gravetiense de Ametzagaina (Donostia, País Vasco). Un avance a su estudio arqueológico. *Munibe* 60:99–115.

Tarriño, Andoni. 2000. "Estudio de la procedencia de los sílex recuperados en el yacimiento de Labeko Koba (Arrasate, País Vasco)," in *Labeko Koba (País Vasco): Hienas y Humanos en los albores del Paleolítico superior*. Edited by Alvaro Arrizabalaga and Jesús Altuna, pp. 345–54. *Munibe* 52.

———. 2006. *El sílex en la Cuenca Vasco-Cantábrica y el Pirineo navarro: caracterización y su aprovechamiento en la Prehistoria*. Monografía del Museo Nacional y Centro de Investigación de Altamira 21. Madrid: Ministerio de Educación y Cultura.

———. 2011. “Procedencia de los sílex de la cueva de Aitzbitarte-III (Rentería, Gipuzkoa),” in *Ocupaciones humanas en Aitzbitarte III (País Vasco) 33.600–18.400 BP*. Edited by J. Altuna, K. Mariezkurrena, and J. Rios, pp. 353–73. Vitoria: EKOB 5. Available online.

Tarriño, Andoni, François Bon, and Christian Normand. 2007a. “Disponibilidad de sílex como materia prima en la Prehistoria del Pirineo occidental,” in *Frontières culturelles dans les Pyrénées préhistoriques*. Edited by Natalie Cazals, Jesús González, and Xavier Terradas, pp. 103–22. Santander.

Tarriño, Andoni, and Irantzu Elorrieta. 2013. “La explotación de los recursos abióticos durante el Gravetiense Cantábrico. Primeros datos sobre la explotación de los recursos abióticos en el Pirineo Occidental y Cuenca Vasco-Cantábrica,” in *Pensando el Gravetiense: Nuevos datos para la región cantábrica en su contexto peninsular y pirenáico.* Edited by C. de las Heras, J. A. Lasheras, A. Arrizabalaga, and M. de la Rasilla, pp. 330–47. Monografías del Museo Nacional y Centro de Investigación de Altamira 23. Madrid: Ministerio de Educación y Cultura.

Tarriño, Andoni, and Christian Normand. 2002. Procedencia de los restos líticos en el Auriñaciense antiguo (C4b1) de Isturitz (Pyrénées-Atlantiques, Francia). *Espacio, Tiempo y Forma* (serie I) 15:135–43.

Tarriño, Andoni, Maitane Olivares, Nestor Etxebarria, Juan Baceta, Jesús Larrasoaña, Iñaki Yusta, José Pizarro, Ana Cava, Ignacio Barandiarán, and Xabier Murelaga. 2007b. El sílex de tipo “Urbasa”: Caracterización petrológica y geoquímica de un marcador litológico en yacimientos arqueológicos del Suroeste europeo durante el Pleistoceno superior y Holoceno inicial. *Geogaceta* 43:127–30.

Whallon, Robert. 2006. Social networks and information: Non-“utilitarian” mobility among hunter-gatherers. *Journal of Anthropological Archaeology* 25:259–70. http://dx.doi.org/10.1016/j.jaa.2005.11.004