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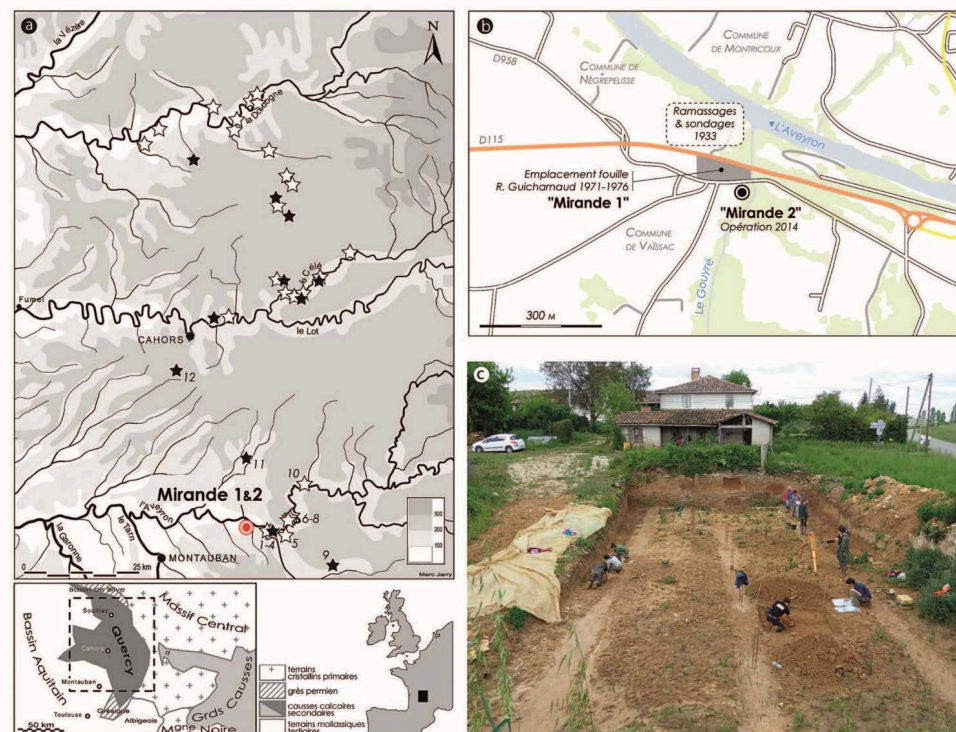
This operation was made possible thanks to the authorization of the owner, J.-F. Henri, whom we thank very much. A big thank you also, besides the authors, to the colleagues who came to lend a hand during this "commando" operation: J.-Ch. Castel, C. Fat Cheung, M. Grubert, E. Ladier and M. Paillé. We also thank V. Laroulandie and A. Royer for their determining of the intrusive faunal remains of Mirande 2 and B. Gravina for the translation. We would like to thank G. Bosinski, K. Mussfeldt, E. Ladier, A. Bergeret and E. Pignol for their warm welcome at Saint-Antonin-Noble-Val and Montauban during the study of the Mirande 1 material. Finally we thank the two reviewers for their constructive remarks.

Introduction

- 1 The Southern margins of the Bas-Quercy region is a well-known area for its caves and rockshelters of the late Palaeolithic (fig. 1a). The lower valley of the Aveyron River is indeed marked by sites among which the famous Magdalenian shelters of Bruniquel - Plantade, Lafaye, Gandil, Montastruc - (Tarn-et-Garonne), the Courbet cave (Penne, Tarn) or the rockshelter of Fontalès (Saint-Antonin-Noble-Val, Tarn-et-Garonne) (e.g. Pajot 1969). Although the Late Glacial of the Montalbanais region is thus abundantly documented - but in the form of incomplete series (old excavations of V. Brun, M. Chaillot or B. Bétirac in particular) - there is a very small number of occupations contemporary of the end of the last Pleniglacial. This documentary vacuum was partly filled by the discovery in the 1990s of an assemblage attributed to the Lower

Magdalenian (circa 21-19 ka cal. BP) within the lower stratigraphy of the Gandil rockshelter (Ladier 1995, 2000; Langlais *et al.* 2007; Ladier *dir.* 2014). On the other hand, the Badegoulian (circa 23-21 ka cal. BP), although well documented in the catchment area of the Lot River (e.g. Abri du Cuzoul in Vers: Clottes, Giraud, Chalarid *dir.* 2012; Les Peyrugues in Orniac: Allard 2009; Pégourié cave in Caniac-du-Causse: Séronie-Vivien *dir.* 1995; Le Petit Cloup Barrat in Cabrerets: Castel *et al.* 2005) was only known in the Bas-Quercy region through rare surface series (e.g., Lasgardes-Haut at Granejoul: fig. 1a, No. 12; Coucounès at Lapenche: No. 11, and even the Plaine d'Esandérou at the Verdier: No. 9; Le Brun-Ricalens 1988; Morala 2013)¹. Within this meager corpus, the Mirande open-air site (Nègrepelisse, Tarn-et-Garonne) differs not only by the abundance of the material and the quality of the information it supplied (excavations by R. Guicharnaud), but also for the debates it generates around its chronocultural attribution (see below). In 2014, rescue work carried out on a plot close to that explored by R. Guicharnaud in the early 1970s yielded a lithic assemblage that can be attributed in all likelihood to the Badegoulian (Langlais *org.* 2014). This discovery, the preliminary results of which are the subject of this article, makes it possible to discuss the attribution of the Mirande industry nearly 90 years after its discovery, and in doing so, sheds new light on the question of the human occupation in the Bas-Quercy region at the end of the last Pleniglacial.

Figure 1 – Regional and local context of Mirande.



a: Location of the main Upper Pleniglacial (black stars) and Late Glacial (white stars) sites in the Quercy region.

N°1 to 4: Plantade, Lafaye, Gandil and Montastruc.

N°5: Abri du Cambou.

N°6 à 8: Pénoval, Le Courbet, La Madeleine-des-Albis.

N°9: Plaine d'Esandérou.

N°10: Fontalès.

N°11: Coucougnès.

N°12: Lasgardes-Haut (map M. Jarry, INRAP).

b: Site context and location of the different sectors and test-pits carried out between 1933 and 2014 (map modified after Géoportail).

c: General view of the site during excavations (photo P. C.).

1 - The site of Mirande 1: factual background

- 2 Discovered in 1928 during surface collecting and surveyed in the 1930s (Bergougnoux and Chaillot 1933), the site, first called "Montricoux," has yielded several collections of which the greater part is lost today². Following new surveying (Pajot 1968) that resulted in a nearly 60 m² extensive excavation led by R. Guicharnaud in the 1970s, the site took the name of "Mirande" - named after the nearest locality - and the excavated area, located between roads D958 and D115 (fig. 1b) became "Mirande 1" (Guicharnaud 1971-1974, 1976a, 1976b). Several hypotheses of cultural attribution have been proposed for this rich assemblage composed almost exclusively of lithic remains, and for which no reliable ¹⁴C dating could be obtained³. While the first excavators mentioned the "lower" Aurignacian (see Chatelperronian) and the Mousterian, B. Pajot proposed to attribute the series to the Gravettian on the basis of now questionable typological criteria (Pajot 1968: p. 288- 291: ratio of the proportions between burins and endscrapers, frequency of burins on truncation and the presence of flat-faced burins

reminiscent of the "Raysse burins"; for a detailed discussion see Millet-Conte 1994 - p. 46-49). From the product of his excavations at Mirande 1, R. Guicharnaud connected the assemblage with the final Magdalenian, which was supported by the existence of a tool interpreted as a parrot beak burin (Guicharnaud 1971-1974 - p. 6). While refuting this last typological attribution, this chronocultural diagnosis was used and completed in a technological study carried out in the context of a university dissertation (Millet-Conte 1994). This author, based on a sample of this very rich industry, relied on the abundance of the backed bladelets, the preponderance of dihedral burins over burins on truncation, the presence of objects interpreted as Magdalenian shouldered points, but also on the large number of rather short endscrapers that would announce, according to him, the Azilian (*op cit.*, p. 53-57).

- 3 It took more than ten years for new studies to emerge under the leadership of G. Bosinski, who began a re-evaluation of the entire Guicharnaud collection in the early 2000s. After the analysis of the quartz - very abundant in Mirande 1 - that led him to propose the implementation of a bipolar debitage on anvil (Bosinski and Guicharnaud 2008), a detailed study of the very numerous microliths collected during the excavation and of the production modes of their blanks, led to a review of the attribution of this assemblage and, by comparison with several series with backed microbladelets described from Cantabria to the French Southwest (e.g. Cazals 2000; Ladier 2000; Langlais 2007), proposed to attribute the industry to the Lower Magdalenian (Bosinski 2013).

2 - The contribution of Mirande 2

- 4 In April 2014, thanks to the vigilance of Edmée Ladier, the Midi-Pyrenees Regional Archeology Service was informed of the presence of lithic artefacts on the surface and in a section at a building plot in front of Mirande 1, on the other side of the D958 road (fig. 1b). This time located in the municipality of Vaïssac, this archaeological evidence was then recorded under the name of "Mirande 2." Assuming that these remains materialized the continuity of the same site, this discovery offered at least the opportunity to better contextualize the human occupations of Mirande. A rescue excavation was therefore carried out several weeks after the discovery (Langlais org. 2014, 2015). The site was located within the rectangular hole dug by the owner to build a house with linear foundations already in place (fig. 1c). In addition to surface collecting, the work was carried out on three main and disjoint areas, corresponding to the different sections cleared for a total of about 15 m² (fig. 2: "South Trench", "North Section" and "Test-pit"). The sieving tests carried out during the excavation proved to be too time-consuming due to the very clayey nature of the sediment and the time/man planned for the operation⁴. For each sector, we have favored the 3D recording of as many objects as possible, while "mass" samples per 2 to 5 cm thick "slices" were done within a test column set up at the level of the Test-pit in order to sieve them in the laboratory.
- 5 The following lines are presenting the main contributions of this work, both on the contextual level (geology and stratigraphy, degree of preservation of the archaeological level) and on the nature, homogeneity and chronocultural attribution of the unearthed elements.

Figure 2 – Orthophoto of Mirande 2, the three excavated sectors and horizontal projection of piece-plotted artefacts. Note the correlation with the Lambert 93 system (in blue, relation established using DGPS) and grid system for projection of archaeological material.

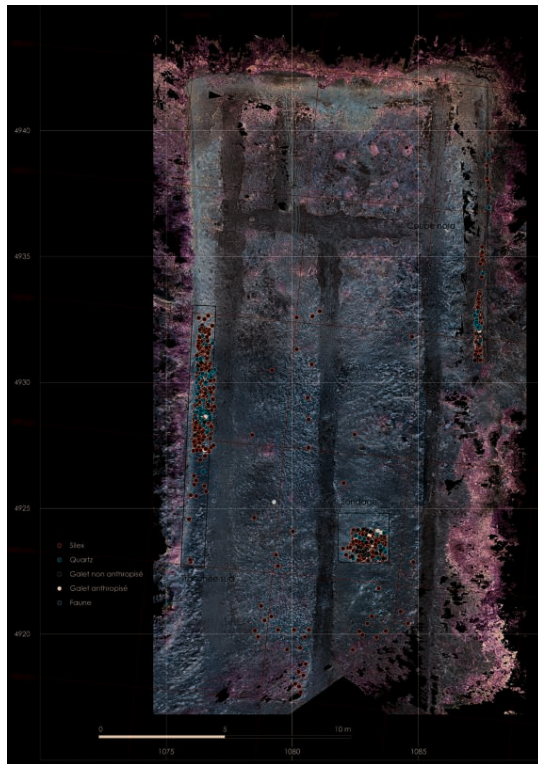


Illustration Get In Situ

Figure 3 – a: The geological context of Mirande 2 within the terrace system of the Aveyron River (scale 1/50000, Nègrepelisse map section; modified after Astruc et al., 2000) / b: Schematic geological section.

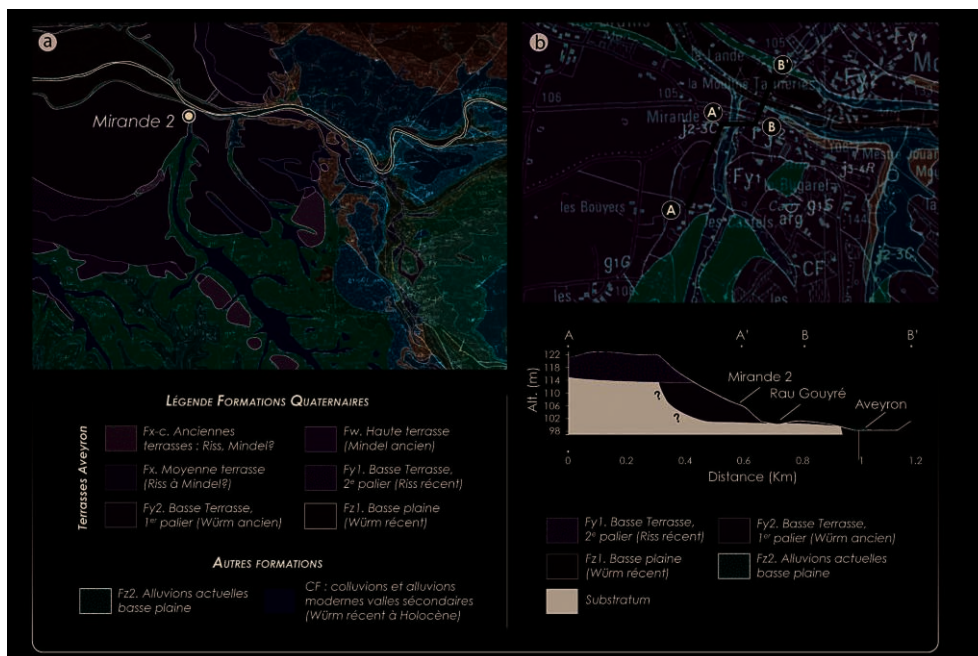


Figure 4 – General stratigraphy of the western section.

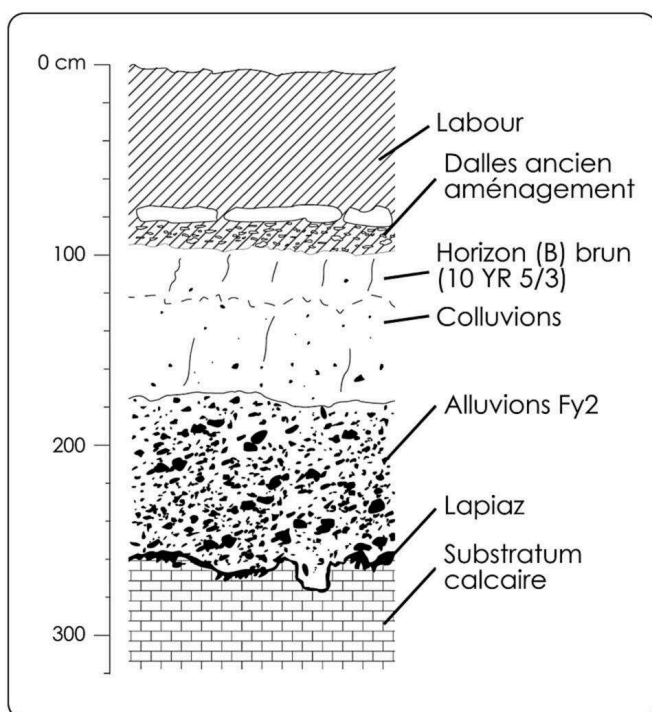


Figure 5 – a, N°1: Stratigraphic sequence of the west portion of the northern section (see Log 3 of figure 6A); N°2: Close-up of the gravels resting on the limestone pavement. Note the altered clays overlying the intact limestone / b, N°1: Stratigraphic sequence in the middle of the northern section (see Log 6 of figure 6A); N°2 and 3: Note the erosion interface between the colluvium and decanted clays at the base of the photo; N°4: Close-up of the base of the sequence with the gravels and overlying decanted clays.

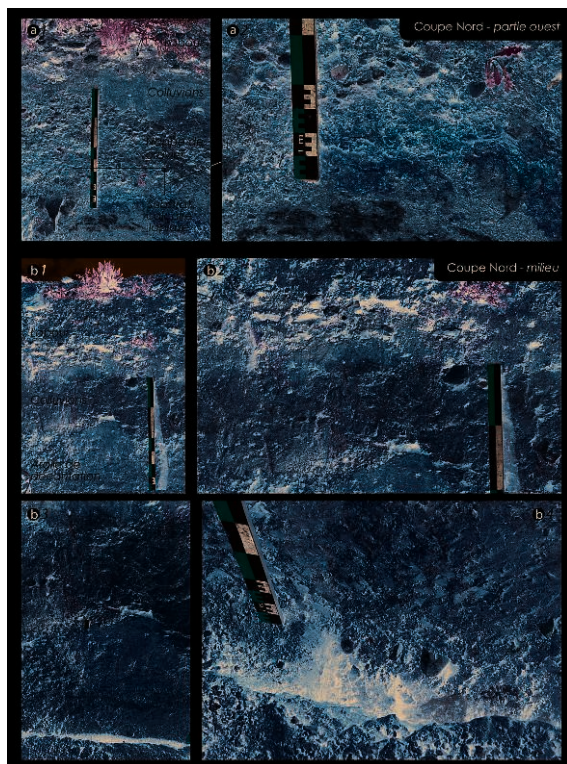
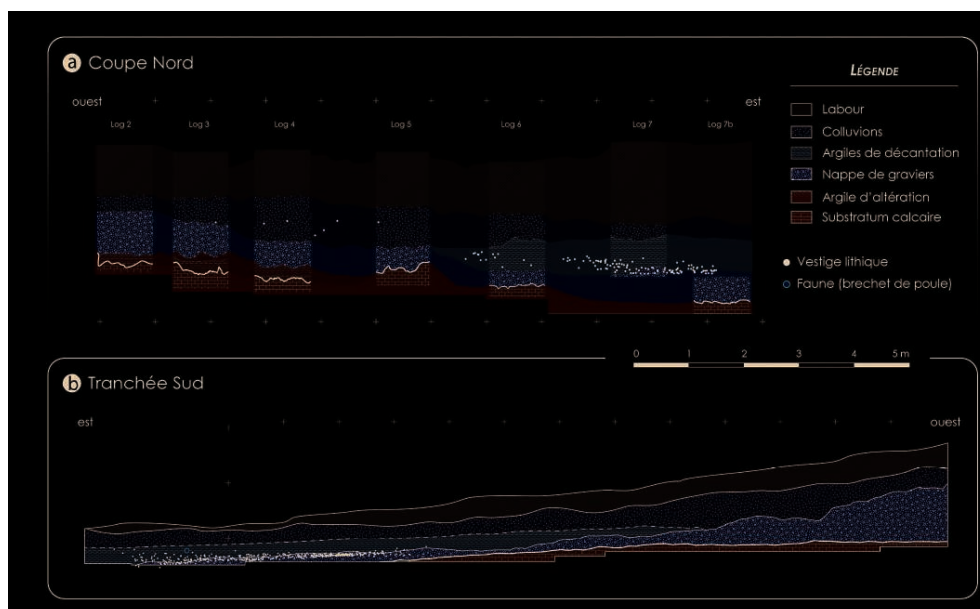


Figure 6 – General northern (a) and southern (b) sections.



2.1 - Geological context and stratigraphy of deposits and taphonomy

- 6 Situated on the left bank of the Aveyron River, Mirande 2 is located on a gentle incline that rises about 6 m above the current bed of the river. According to the geological map, this incline corresponds to the lowest terrace of the Aveyron (Fy2) whose age would be early Würm (fig.3a; Astruc *et al.* 2000). In the area, the terrace system structures the landscape while, a few kilometers upstream, the valley narrows sharply and the terraces remain only in the form of highly localized fragments. The widening of the Aveyron valley corresponds to the transition between the Jurassic limestone and the Oligocene molasses. At the local scale, the site is located on the lower part of a gentle slope forming the junction between the terraces Fy1 and Fy2 (fig. 3b). Approximately 50 m east of the site, the Fy2 terrace is cut into by the Gouyré stream, a small tributary of the Aveyron River oriented N-S along which the Jurassic limestone of the Cajarc Formation is exposed. The earthworks of the site made it possible to obtain two long sections oriented East-West (E-W) and one North-South (N-S) oriented section (fig. 1c). From top to bottom, the succession of the deposits of the Western Section (N-S) is as follows (fig. 4):
- At the top (0-95 cm): backfill related to the development of the plot. The lower part (50-95 cm) consists of concrete slabs corresponding to a modern layout;
 - Between 95 and 175 cm: brown (10YR 5/3) to light brown clay loam associated with small size gravel. Bioturbation can be seen to the base of the unit. A horizon B of little marked brown soil is visible on the first 30 cm of the unit. Towards its base, the unit is enriched in coarse fraction (gravel, small gravel and small pebbles). This unit is intersected by a small network of cracks of sub-metric spacing that extend locally into the lower unit;
 - Between 175 and 260 cm: unit of gravel, small gravel and rounded pebbles (<10 cm) whose mineralogical composition is dominated by quartz, gneiss and various types of granites. The support is clastic and the matrix silty-clayey. The contact with the underlying unit is erosive;
 - Finally, between 260 and 320 cm: limestone pavement substrate marked by a thin layer of alteration clays at the interface between the gravel unit and the unaltered limestone.
- 7 The unit in contact with the limestone substratum results from the setting up of the Aveyron River terrace Fy2 (fig. 3b). On the other hand, the diamictic aspect of the overlying unit suggests that the formations situated upstream of the site (terrace Fy1) are colluvium. In their western half, the E-W oriented sections show the same stratigraphic succession as the section previously described (example of the North section: fig. 5a). Further to the east, an additional unit appears between the colluvium and the top of the gravel unit (fig. 5b). They are silty clays with rounded polyhedral structure, with rare gravels. The presence of gravels is probably the result of the migration of small gravels along the network of cracks associated with the brown soil or the dispersion of small gravels from the underlying gravel layer associated with clay withdrawal/swelling cycles (e.g. Poesen and Lavee 1994; Moeyerson *et al.* 2006). Overall, bedding within this unit is not preserved because of the bioturbation associated with the current brown soil, but locally we have observed preserved clay beds of millimetric thickness. The unit is truncated at the top by the colluviums.

Figure 7 – Vertical projection of the archaeological material and piece-plotted pebbles in the southern trench (a) and northern section (b) on the orthophoto.

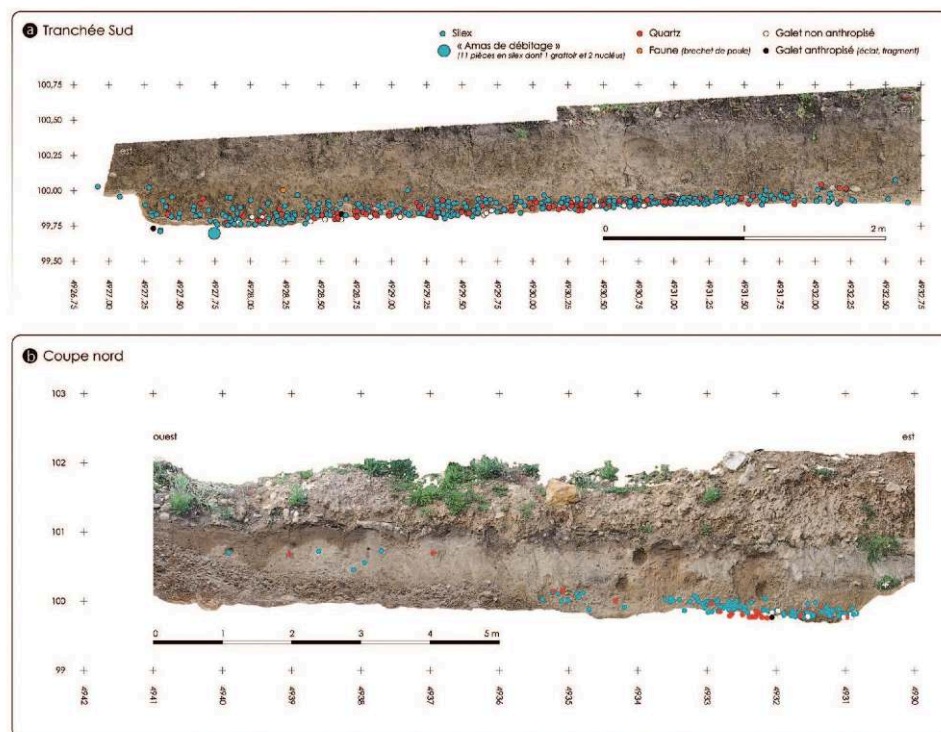


Illustration Get In Situ

Figure 8 – Test-pit: horizontal (a) and vertical (b) projections of archaeological material and piece-plotted terrace pebbles on the orthophoto (Illustration Get In Situ).

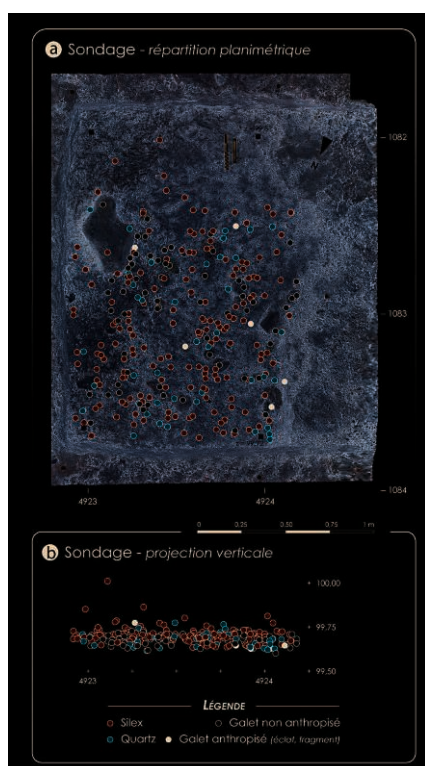


Illustration Get In Situ

2.1.1 - Geometry of deposits and stratigraphic localization of the anthropogenic remains

- 8 The geometry of deposits on the north and south sections was reconstructed using stratigraphic logs and field observations (fig. 6). The gravel unit always rests on the limestone pavement substratum and its thickness decreases rapidly from west to east. Clays appear from the middle of both sections and gradually thicken to the east. The thickness of the colluviums of the slope decreases from west to east (fig. 6b). They first intersect with the top of the gravel unit (western half) and then the top of the clayey unit. While in the western part of the South section some scattered remains have been collected in the colluviums (in particular associated with modern intrusive elements: remains of domestic hen and rat), the archaeological remains are located at the top of the pebble layer.

2.1.2 - A unique level geologically *in situ*

- 9 The vertical projections carried out below the excavation (fig. 7 and 8) and the projection of the remains on the geological section (fig. 6) show that the majority of the remains are dispersed over a thickness of 20 cm. In figure 9, it is clear that the number of remains by excavated layer follows a normal distribution, a criterion used to support the hypothesis of a unique archaeological level (e.g. Delagnes *et al.* 2006). However, this hypothesis will have to be specified by a systematic test of lithic refitting. The few water-screening tests carried out in the field and in the laboratory (test column, "mass"

sampling: see above) confirmed the presence, at least in the tested sectors, of microremains within the level, materialized by splinters and/or microwastes (<5 mm) of flint and quartz (fig. 9 and table 1). Microcharcoals associated with the lithic remains should be considered with caution since some of them, subjected to ^{14}C dating under the SaM Collective Research Program (Ducasse and Renard org. 2013) gave an aberrant measurement (OxA 33217: 300 ± 25 BP). In conclusion, although at present the degree of preservation of the site cannot be estimated, we can at least conclude that it is geologically in situ, that is to say it is the same age as the deposits in which it is contained.

2.2 - Technical equipment: synthetic view

- 10 Given the conditions of the field work and the constraints associated with it, let us specify above all that the collected assemblage corresponds to a study corpus biased by the spatial representativeness of the exploited window (three disjointed areas for a total of 15 m², or less than 1% of the minimum surface area estimated at about 0.2 ha), but also by the diversity of approaches applied according to the sectors (i.e., section cleaning, planimetric excavation; non-systematic sieving: see above). The archeological remains studied, composed exclusively of lithic remains, number 891 and are divided into 675 flint pieces (tables 2 and 3), 212 quartz elements (table 4) and 4 artifacts made of other rocks. In spite of the separation of the excavated sectors and the biases related to the constitution of the different groups, the analysis showed a homogeneity of the petrographic and technotypological features of this assemblage. The nature of the unearthed industries is quite compatible with an attribution to the Badegoulian.

Figure 9 – “Test column” of the test-pit: counts of flint and quartz artefacts by spit.

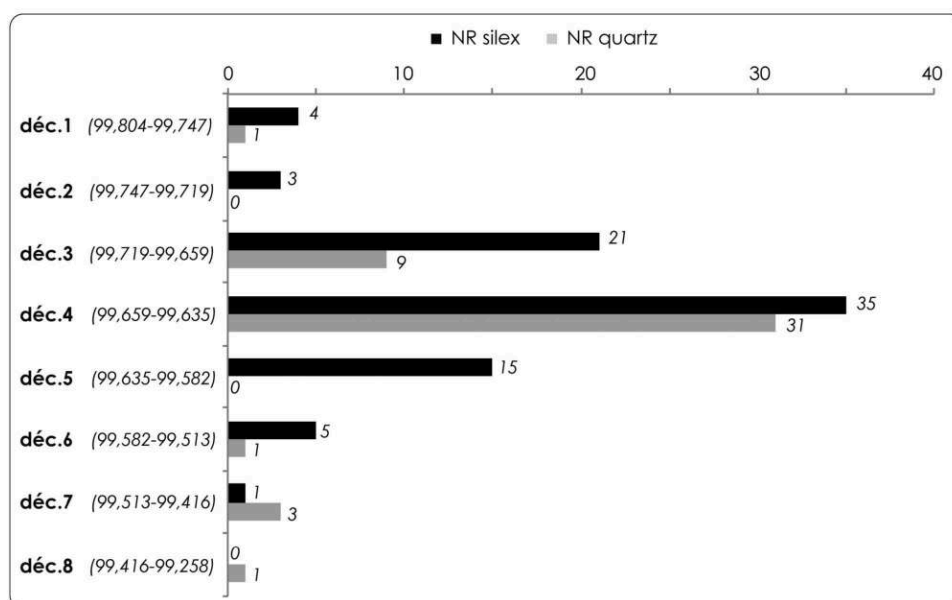


Table 1- Flint and quartz blanks from the test column of the test-pit by spit.

SILEX	esquille	ELL	II	éclat	fgt	NR
<i>dec1</i>	1	2	1			4
<i>dec2</i>	1	1	1			3
<i>dec3</i>	12	2	2	2	3	21
<i>dec4</i>	15	9	4	7		35
<i>dec5</i>	9	6				15
<i>dec6</i>	5					5
<i>dec7</i>	1					1
<i>dec8</i>						0
Total	44	14	8	6	2	84

QUARTZ	microdébris	débris	éclat	fgt	fgt galet	NR
<i>dec1</i>		1				1
<i>dec2</i>						0
<i>dec3</i>	6		1	2		9
<i>dec4</i>	21	7	2		1	31
<i>dec5</i>						0
<i>dec6</i>	1					1
<i>dec7</i>	2	1				3
<i>dec8</i>	1					1
Total	31	9	3	2	1	46

Table 2- Siliceous raw materials (from three sectors excepted surface collecting, sieve residues and Test-pit).

Matière première	Nombre	% det	% total
Tertiaire	531	88,8	78,7
<i>dont type Verdier</i>	63		
Silex Jaspéroïdes	33	5,5	0,8
<i>dont jurassique</i>	1		
<i>dont tertiaire</i>	21		
Sénonien	20	3,3	3,0
<i>dont blond</i>	4		
Fumélois	8	1,3	1,2
Bergeracois	3	0,5	0,4
Silex à <i>Lepidorbitoides sp.</i>	3	0,5	0,4
sous-total dét.	598	100,0	84,5
Indét	55		8,1
Indét allochtone	22		3,3
<i>dont possible Flysch</i>	5		
sous-total indét.	77		
TOTAL	675		

Table 3- Technological & typological counts of flints by raw material (from three sectors excepted surface collecting, sieve residues and Test-pit).

	TER	JASP	JASP tertiaire	JASP jurassique	SENO	FUM	BGC	CHA	Ind.	Ind.	ALL	TOTAL
Produits/sous-produits bruts												
éclat	155	5	5		3	2	1		16	2		189
dont mince	4											4
dont cortical	29								2			31
dont semi-cortical	12								1			13
éclat laminaire	55		1		3				4	2		65
dont cortical	2											2
dont semi-cortical	17		1		1				2			21
éclat lamellaire	80	3	1		5	1			8	2		100
dont cortical	1											1
dont semi-cortical	8											8
Lame	2	1	1		3						1	8
dont semi-cortical					1							1
Lamelle	52	1	3		2	1			5	2		66
dont semi-cortical	2								1			3
fragment indét.	129		6		1				14	6		156
esquille	18	1							2	1		22
indéterminé	2					1						3
nucléus	21		3			2			1	1		28
dont à éclats	5											5
dont à éclats laminaires	1											1
dont à lamelles	14		2			1			1	1		19
rognon	2											2
sous-total	516	11	20		17	7	1	0	50	17		639
Équipement retouché												
Outils de transformation	12		1	1	3		2	2	2	5		28
Armatures	3					1		1	3			8
sous-total	15		1	1	3	1	2	3	5	5		36
TOTAL	531	11	21	1	20	8	3	3	55	22		675

2.2.1 - Flint industries

Raw materials origin and economics

- 11 All quartz and other rocks are probably of local origin (see below). The analysis of the origin of the flint used at Mirande 2, based on the micropalaeontological content diagnosis and the sedimentary structure of the pieces (binocular microscope; x 7.5 to x 50), indicates a great geographical diversity of the places of supply (fig. 10a). Within the studied corpus, the origin of nearly 85% (N = 598) of the flint was determined and several types were identified (table 2):

- Tertiary flints are generally characterized by the presence of charophyceae and oogonia (fig. 10b No. 1) or continental gastropods, especially of the *Lymnaea* type (Morala 1980; Mouline 1983; Chalard *et al.* 1996; Turq 2000; Turq and Morala 2013). Although some of them, showing cortical areas with little or no erosion, may well have originated from the Verdier outcrops located some 20 km south-east of the site (fig. 10b, No. 2)⁵, the high frequency of alluvial cortex suggests a more strictly local supply, on the beaches of Vère or the Aveyron Rivers.
- Jasperoid flints form a heterogeneous group, to which it is generally difficult to assign a precise geological and geographical origin, for lack of structural characteristics or specific micropalaeontological markers. Among them, jasperoid flints of tertiary age are characterized by a greasy and glossy appearance as well as by the presence of charophyceae, although their exact origin cannot be determined. We can note the existence of at least one piece with an oolitic structure that can be connected with the known Jurassic formations on the edge of the Massif Central, that is to say at least 60 km north-east of the site (fig. 10a No. 2; Séronie-Vivien 1987; Turq and Morala 2013).

- Flints of the Senonian *sensu lato*, whether gray-black or yellow, are available in the same area within a radius of 65 to 100 km north of the site (fig. 10a, No. 3 and 5; Turq 2000; Fernandès 2012; Turq and Morala 2013).
 - Fumel flints from the Lower Turonian formations near Fumel (Morala 1980; Turq and Morala 2013) are available at least 65 km north of the site (fig. 10a No. 4).
 - Three artefacts unambiguously indicate the contribution of flint from the Bergerac area (fig. 10b No. 4), representing a movement of material over nearly 120 km from the north of the site (fig. 10a No. 6).
 - The presence of *Lepidorbitoides* flint (fig. 10b No. 3), sometimes associated with siderolites and without orbitoides media, indicates the use of materials whose sources are located either in the Chalosse (fig. 10a No. 7a; Bon *et al.* 2002; Séronie-Vivien *et al.* 2006; Chalard *et al.* 2010) or in the Gers regions (fig. 10a No. 7b; Colonge *et al.* 2011). In the current state of knowledge, the primary or sub-primary deposits are situated more than 120 km as the crow flies southwest of the site.
- 12 In addition to these different types, and apart from the indeterminate flint *stricto sensu* (N=55, or about 8% of the total), a number of objects originating from marine formations but without the characteristics allowing precise petrographic and geographical attribution can be added. Insofar as their structure is often close to that observed for the flint of the Senonian, and has no equivalent in locally or regionally available materials, we have decided to consider these various elements as non-local materials of indeterminate origin (table 2). Finally, several pieces have characteristics similar to the flints of the Pyrenean Flysch (N=5). If this attribution was confirmed, the procurement of this material required travelling more than 200 km between the sources and the Mirande 2 site.
- 13 Taking into account the nature of the objects and the form they had when brought to the site (i.e. fragmentation of the *chaînes opératoires*), three cases could be identified: 1) local tertiary flints, an *in situ* implementation of the various identified productions (flakes, blades and bladelets); 2) non-local materials introduced in the form of tools and volumes for bladelet knapping (Bergerac and Fumel flint); 3) non-local flints documented only in the form of "ready-to-use" tools or raw materials (flint with *Lepidorbitoides* and possible Flysch: fig. 11 N°1).

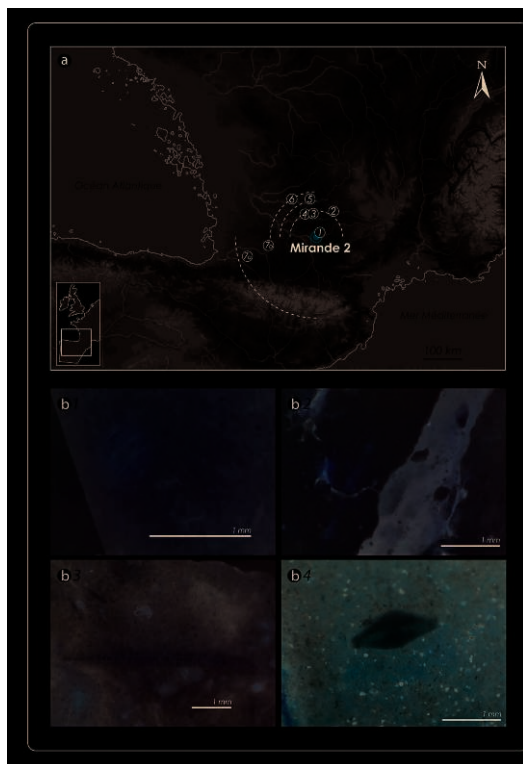
Table 4- Tools and Microliths blanks.

	lame	EL	lamelle	éclat	fgt indét	indét	TOTAL
Outillage de transformation							
Grattoir	2	1					3
Grattoir sur lame retouchée	1						1
Grattoir-bec		1		1			2
Burin sur troncature					1		1
Perçoir/bec		1					1
Encoche				1			1
Troncature		1					1
Lame retouchée	2						2
Pièce esquillée		1		1	1		3
Raclette				8			8
Racloir				1			1
Pièces à retouches et ébréchures lat.				2	1	1	4
sous-total	5	5		14	3	1	28
Equipement cynégétique							
Lamelle à dos simple			3				3
Lamelle à dos et ret. opp			2				2
Pointe à dos et ret. opp			1				1
Microlamelle à dos appointée			1				1
Ebauche de lamelle à dos			1				1
Sous-total			8				8
TOTAL							36

Table 5- Technological & typological counts of quartz (from three sectors excepted surface collecting, sieve residues and Test-pit).

	Débitage bipolaire sur enclume			Percussion lancée tangentielle possible	Modalité de fracturation indéterminée	Percuteur	TOTAL
	certain	probable	possible				
éclat	41	5		3	15		64
dont cortical	19				2		21
dont semi-cortical	14	3			1		18
micro-éclat					2		2
fragments	16	1	3		24		44
dont cortical	4		1		7		12
dont semi-cortical	1						1
débris					49		49
micro-débris					10		10
galet et frag. de galets	7	1	1		8	1	18
nucléus et frag. de nucléus	18			1	1		20
dont recyclage percuteur	1						1
indéterminé					4		4
racloir					1		1
TOTAL	82	7	4	4	114	1	212

Figure 10 – a : Provenience of different siliceous raw materials documented at Mirande 2 (distance radii : 200 km, 120 km, 90 km and 65 km) ; N°1 : Tertiary, N°2 : Jurassic, N°3 : Blond Senonian, N°4 : Fumelois, N°5 : Black-grey Senonian, N°6 : Bergeracois, N°7a and b : Flint with *Lepidorbitoides* sp. / b : Micropalaeontological and/or characteristic internal structures, N°1 : example of an oogonium, Tertiary flint ; N°2 : typical structure of Verdier flint ; N°3 : *Lepidorbitoides* sp., Chaillosse flint *sensu lato* ; N°4 : *Orbitoides media*, Bergeracois flint.



Nature of equipment and technological characteristics

- 14 The retouched equipment comprises 36 elements divided into 28 domestic tools made from products and by-products of laminar production (N=10 blades and laminar flakes) and from flakes from essentially autonomous debitage (N=14 flakes).), as well as 8 microliths, potential lamellar projectile insets elements (table 4).
- 15 Marked by endscrapers (fig. 11 Nos. 1, 4, 5 and 8), often imported and sometimes associated with other active parts (No. 6), the processing toolkit is characterised by the presence of several *raclettes* (N=8: fig. 12 Nos. 1 to 7). Discovered in all the excavated sectors, these pieces respond without significant difference to the Badegoulian “standards.” Although the use of thin flakes refers to the setting up of a dedicated and autonomous production, widely described elsewhere (e.g. Bracco *et al.* 2003; fig. 12 No. 9), one object documents joint but discrete selection of laminar blanks (No. 5). Apart from the objects produced *in situ* from local resources (Nos. 1 and 3), this category of tools is characterized, like that of the endscrapers, by the use of non-local materials, without it being possible, with regard to the constituent biases of the series, to demonstrate definitively the postponed nature of their production (Nos. 2, 6 and 7). Apart from the retouched blades (N=2), a single scraper (fig. 13 No. 2) and pieces with lateral retouching and chipping (N=4, see knives), some splintered pieces complete the inventory of the main tools collected at Mirande 2 (fig. 13, Nos. 1 and 3). It should be noted that some evidence suggest the introduction of bipolar debitage on anvil (fig. 15

- No. 1?), a method of production that is part of the technical background of Badegoulian groups; this is evidenced at the scale of the site in terms of the quartz exploitation modes (see below) but also, on a larger scale, by the examination of the "classical" sites in the Quercy and Aquitaine regions (Cuzoul de Vers: Ducasse 2010; Cassegros: Ducasse and Le Tensorer *dir.* 2016).
- 16 In the state of the analysis and in spite of the absence of cores, the examination of the few laminar products integrated or not with the equipment (N=13) makes it possible to propose two production operating schemes related to the search for blanks with distinct morphometric characteristics: (1) a bent laminar production generating rather narrow products (e.g. fig. 11 N° 3 and 4), accompanied by (2) a debitage of flat and invading blanks on large face (e.g. fig. 11 N°1). The implementation in the Badegoulian of an operating scheme for the production of blades and elongated products from flat surfaces has already been reported (e.g., Parrain Nord, Dordogne: Fourloubey 1998; Oisy, Nièvre: Bodu, Chehmana, Debout 2007; Seyresse, Landes: Ducasse 2010). Its relation with some facial productions of large-sized thin flakes is worth discussing (fig. 11 N° 2?) in Mirande, as elsewhere, from a more substantial corpus and the help of physical refits. Finally, it should be noted that local materials are also used in the hammerstone production of laminar flakes (or even blades) in a relatively flexible mode, allowing the knappers to take advantage of pebbles of suitable dimensions and morphologies (virtually non-existent conformation phase of volumes, taking advantage of natural convexities, production on narrow faces).
- 17 As for the hunting register, it is essentially documented through the presence of microliths (N=8: fig.14 Nos.1 to 7) and products and by-products linked to the production of their blanks, which are exclusively lamellar (tables 3 and 5 and fig. 15). Although most of these elements correspond to the use of local materials, other pieces show the use of non-local flints (in particular Senonian and Fumel flints), suggesting the import (still hafted?) of finished products or volumes to be knapped (cores and/or by-products). In addition to a rough-out fragment in *Lepidorbitoides* flint, the Mirande 2 microliths include bladelets with simple and invasive backs (fig. 14, Nos. 2, 5 and 6), bladelets with invasive back and retouch opposed to the cutting edge (fig. 14, Nos. 3 and 4) - one of which can be considered as a point with respect to the proximal convergence of its edges (No. 1) - and a microbladelet with slender back (No. 7). Although they come from the various screening tests carried out in the South Trench and in the test column, three fragments of microbladelets with a semi-abrupt inverse right back (fig. 14, nos. 8-10) are to be noted. This morphotype, which is undoubtedly under-represented due to the collecting methods of the material, recalls not only some of the elements described in Mirande 1 (Bosinski 2013 - p 159 and ML and SD personal observations), but also some microliths types pointed out within several lithic assemblages in the European south west attributed to the Badegoulian (Lassac, Aude: Sacchi 1986 and Ducasse 2010 - p.159) and to the Lower Magdalenian (Fontgrasse, Gard: Bazile 1989 and Langlais, 2010, p.90; lower units of Saint-Germain-la-Rivière, Gironde: Lenoir, Marmier, Trécolle 1991 and Langlais *et al.* 2015; Montlleo, Spain: Langlais 2010).

Figure 11 – Tools on blades and elongated blanks.



N°1: end-scraper on a wide, retouched blank, soft-stone hammer percussion (undetermined non-local flint, possibly Flysch flint).

N°2: fragment of a laterally retouched blank (Jasper-like Tertiary flint).

N°3: fragment of a laterally retouched blade (reworked end-scraper? Bergeracois flint).

N°4 : endscraper on a blade (Bergeracois flint).

N°5 : endscraper on a blade (local Tertiary flint).

N°6 : endscraper/alternately retouched bec on a secondary crest (note the installation of the bec from the previous burin removal; Chalosse flint sensu lato).

N°7 : burin on an elongated blank, hard-hammer percussion (possible core on the edge of a notch; local Tertiary flint).

N°8 : end-scraper on a retouched blade (surface-find, Fumelois flint).

Drawings C. Fat Cheung, photos and illustration S. D.

Figure 12 – Raclettes from the different excavation sectors.



N°1 and 3: local Tertiary flint.

N°2 and 6: undetermined non-local marine flint.

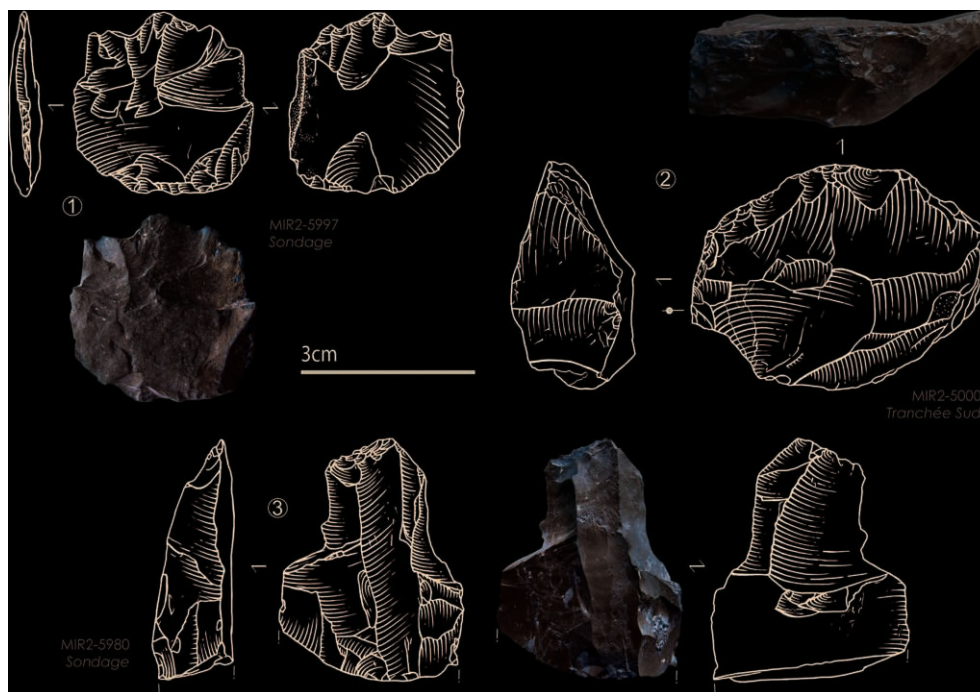
N°4 and 5: undetermined flint.

N°7: Senonian flint

Endscrapers on flakes (N°8, undetermined non-local marine flint) and flake core (N°9 and 10, surface-finds, local Tertiary flint.)

Drawings C. Fat Cheung, photos and illustration S. D.

Figure 13 – Splintered pieces (N°1: Senonian flint; N°3: local Tertiary flint) and a scraper (N°2; local Tertiary flint).



Drawings C. Fat Cheung, photos and illustration S. D.

- 18 Different methods of lamellar production have been documented, in particular on the basis of the analysis of the 19 discovered cores. These include enveloping debitage on blocks with a more or less bent and convergent debitage surface (fig. 15, Nos. 2 and 3), but also productions on flakes (fig. 15, Nos. 4-8). These are expressed in various modes. If the best represented, which is likely to be the source of the inverse-backed microbladelets blanks, corresponds to "dorsal-front" debitage (Nos. 4-7), the implementation of production "on slice", more or less enveloping, is documented by means of rare cores (fig.15 Nos. 1 and 8) and a number of characteristic by-products (i.e. lamellar flakes with reversed facet, or even twice overflowing, indicating in some cases the implementation of an "overflowing preferential" debitage: Ducasse and Langlais 2007; Ducasse 2010).

2.2.2 - The exploitation of quartz

- 19 All the quartz probably originate from the palaeo-terrace on which the human groups settled. Examination of the pieces collected during the excavation led to the rejection of several whole or fragmented pebbles bearing no definite anthropogenic traces. On the whole, clear evidence of a knapping process and fragments and (micro)waste, possibly resulting from anthropogenic action, constitute a corpus of 212 remains (table 5).
- 20 Several products (pebbles, cores, flakes), whole or fractured, show the implementation of a debitage by bipolar percussion on anvil (fig. 16). This method, documented by several refits (fig. 17), is the main fracturing mode of the pebbles with hard hammer (numerous Siret type accidents: fig.16 No. 2) in order to obtain blanks. Two pebbles have traces of use as a hammer and two of them have been re-worked by debitage on

anvil (figure 18, No. 1). The hypothesis of recycling macro-tools as volumes to be knapped can thus be considered. Of the 18 pieces considered as cores knapped on anvil, some correspond to matrix-flakes resulting themselves from such debitage. It can therefore be considered that some large pebbles were first fractured on anvil in order to create surfaces favorable to further debitage at the expense of the pebble, but also to produce large blanks intended to be themselves used as volumes to be knapped. The bipolar debitage on anvil is generally carried out in the thickness of the pebble and can then be continued at the expense of a new surface adjacent to the first. Examination of the butts and that of the core overhangs shows the absence of preparation of the striking platforms before extracting of the products.

- 21 Together with this dominant mode of fracturing, only three flakes as well as one fragment of core could testify to the implementation of a second debitage process, this time involving a tangential percussion (fig. 18, Nos. 3 and 4). It seems therefore that we are dealing with an imbrication of technical gestures (bipolar percussion on anvil or tangential) that participate in the fracturing of quartz pebbles from the palaeo-terrace. The economic objective seems to be the production of cutting blanks probably to use in butchery (Bracco and Morel 1998), although this hypothesis cannot be substantiated here for lack of clearly used objects and in the absence of a functional study. In addition, the single piece with clear lateral retouches, comparable to an active side scraper part (fig. 18 No. 2) corresponds to a fragment whose technological origin remains indeterminate.

Figure 14 – Bladelets and backed micro-bladelets from the different excavated sectors (N°2, 5, 7 and 8: Tertiary flint; N°3: Fumelois flint; N°1, 6, 9 and 10: undetermined raw materials).



Drawings C. Fat Cheung, photos and illustration S. D.

2.2.3 – The other rocks

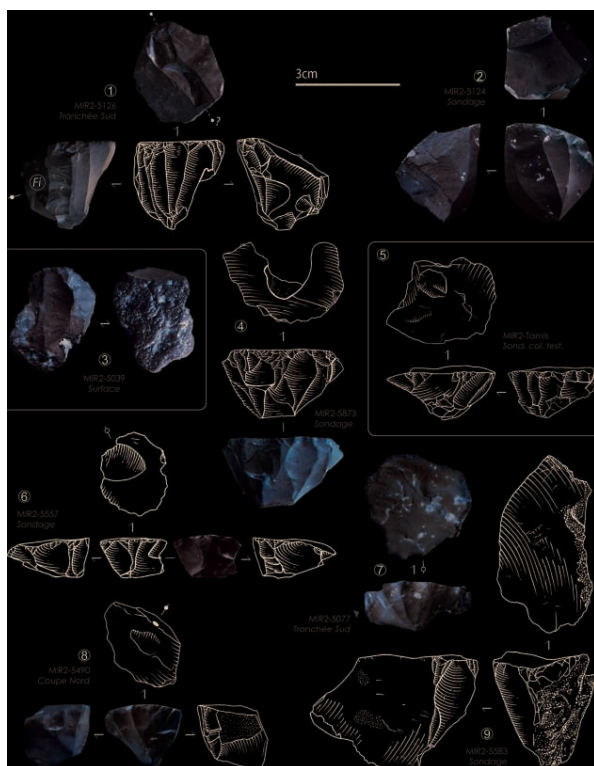
- 22 Among the other rocks (N=4), we can note the presence of three remains related to the trachyte family and that testify to a use as macro-tools or an exploitation of the flakes as volumes to be knapped. If, in the absence of clear objectives, this last hypothesis remains difficult to consider, the organization of the negatives visible on some objects

makes it possible to propose the hypothesis of volumes calibrated by peripheral removals, and this for a function that eludes us (dormant tools?), note there are no traces of use as an anvil. Finally, the presence of a limestone plaque with traces compatible with use as a retoucher or small hammer, can be pointed out.

3 - Synthesis and discussion

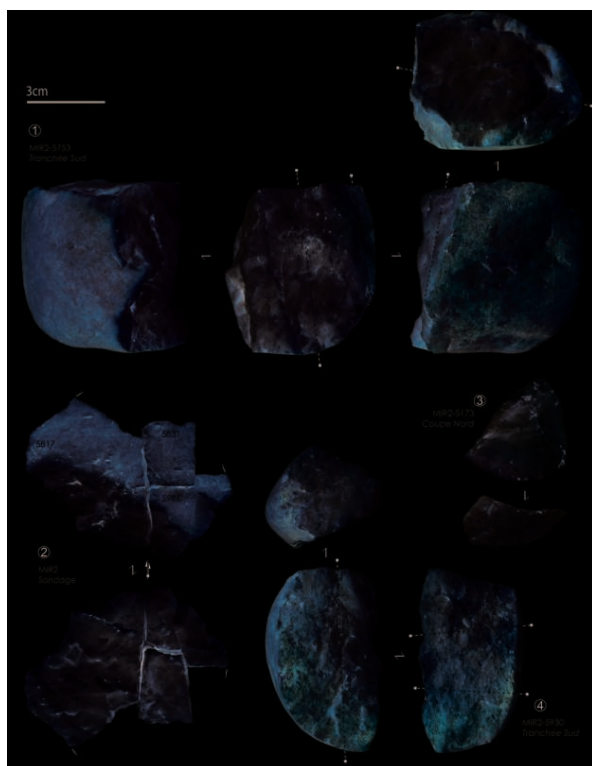
- 23 The field operation conducted at Mirande 2 brings several new information at different spatial and temporal scales.

Figure 15 – Bladelets and micro-bladelet cores (Tertiary flint excepted N°4: undetermined). Note the blank of core on flake N°1, possibly extracted on anvil).



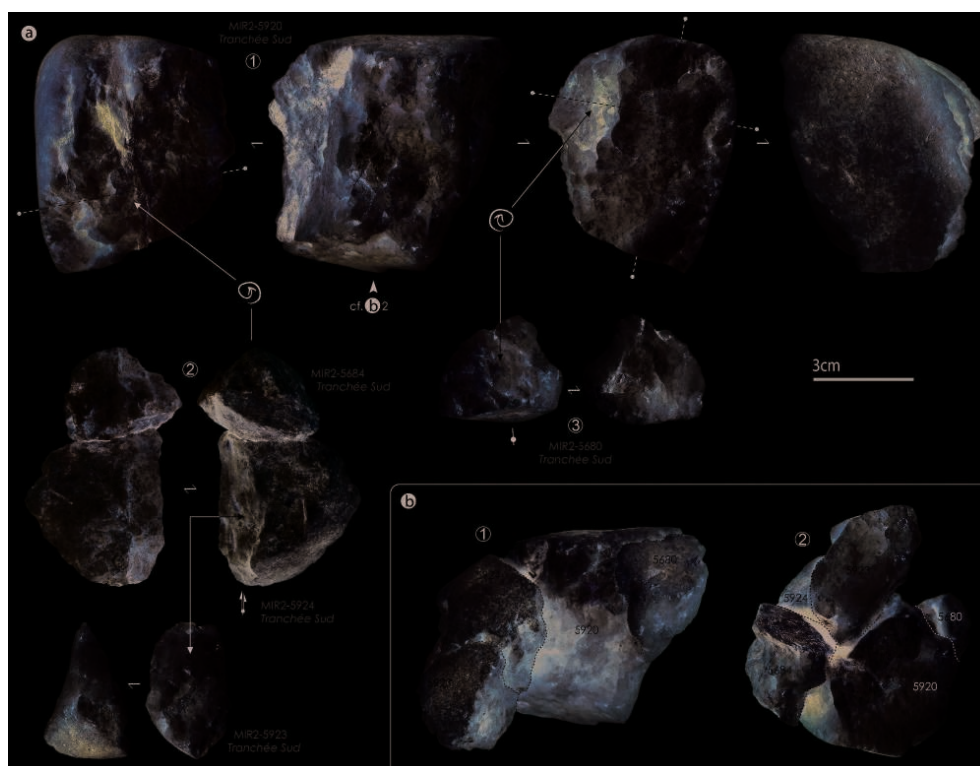
Drawings C. Fat Cheung, illustration S. D.

Figure 16 - Cores and products from bipolar percussion of quartz from the palaeo-terrace (N° 1 and: cores; N°2 conjoin of a semi-cortical flake with a crushed/splintered butt to a Siret fracture; N°3 flake with a cortical butt; the dashed line indicates the main percussion axes).



Photos M.L., Layout S.D.

Figure 17 - Partial refit of a bipolar percussion reduction sequence of a quartz pebble from the South Trench (a: before refitting, b, different views of the refit elements; dashed lines indicate the main percussion axes).

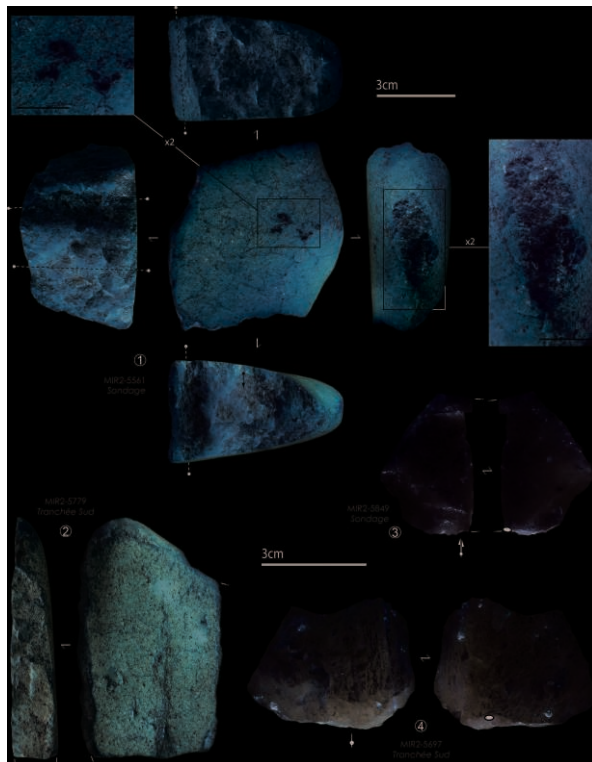


Photos M.L., Layout S.D.

- 24 From the point of view of local geology, it allows to propose a chronological calibration of the lower terrace of the Aveyron (Fy2) that converges with the results obtained by J.-P. Texier (2014) in his geological study of the Gandil rockshelter, located about ten kilometers to the east. At Mirande 2, most of the archaeological remains come from a gravelly unit interpreted as resulting from the setting up of the Fy2 terrace. Given the age range that can be given to the objects attributed to the Badegoulian (circa 23-21 ka cal. BP), the final phase of setting up this terrace could therefore be the end of the upper Pleniglacial.
- 25 From the archaeological point of view, the Mirande 2 site bears witness to one (or more) Badegoulian occupation(s) on an old Aveyron River terrace, near its confluence with the Gouyré stream. New in this geographical area, the lithic assemblage discovered is characterized by the marked use of local materials (flint and quartz) but also by the import of flint coming from territories sometimes distant, connecting Mirande 2 with the north and the southwest of the Aquitaine Basin. The flint productions are materialized by a variety of objectives and technical modes (laminar and lamellar debitage, flake productions). On the other hand, the corpus of lamellar microliths recalls the results obtained on other Badegoulian open-air sites such as Lassac (Sacchi 1986; Ducasse 2010) or Oisy (Bodu, Chehmana, Debout 2007). The exploitation of the quartz makes it possible to produce flakes or secondary blocks by means of a bipolar fracturing on anvil of pebbles coming from the palaeo-terrace. This technical behavior strongly recalls what could be described in Mirande 1 (Bosinski and Guicharnaud 2008). If the sites of the Upper Palaeolithic where these quartz

productions have been accurately documented remain rare (Bracco 1996, 1997), the Badegoulian site of La Roche in Tavernat (Chanteuges, Haute-Loire) holds a special place there. This site has indeed yielded an abundant series of quartz whose analysis has made it possible to document the existence of a *chaîne opératoire* of flake production by percussion on anvil, in order to divide some large blocks into core blanks (Bracco 1993; Bracco and Slimak 1997). Although this method of fracturing pebbles on anvil to obtain volumes to be knapped is also known in other contexts (e.g. Soriano *et al.* 2009), these first comparisons lead us to re-examine the Mirande 1 site.

Figure 18 - N°1 heavy-duty tool (hammerstone) probably recycled as a core (bipolar percussion on an anvil; the dashed lines indicate the main percussion axes, $\frac{3}{4}$ scale), N°2= fragment with continuous retouch (scraper), Nos 3 and 4 : flakes probably detached by freehand percussion with a tangential blow.



Photos M.L. Layout, S.D.

- 26 The lithic assemblage of Mirande 2 has strong similarities with its neighbor Mirande 1 but also with the basal layers (c.23-25) of the Gandil rockshelter, both attributed to the lower Magdalenian (Langlais *et al.* 2007; Ladier dir. 2014). It is also the absence of certain lamellar operative modes (i.e. productions “on *déjeté* ventral front:” Ducasse and Langlais 2007; Langlais and Ducasse 2013) together with the presence of *raclettes* that make it possible to distinguish the Badegoulian from Mirande 2 from the Lower Magdalenian of neighboring sites. For Mirande 1, initially, the reading of B. Pajot's thesis (1968) revealed the possible existence of *raclettes* at Mirande among the Bergougnoux / Chaillot and Pajot surface finds collections - pieces classified as “blades and truncated flakes”(ibid . fig. 146, p. 297, N°4 and 5). However, the recent examination of a group of tools from the Guicharnaud collections did not allow us to confirm this conclusion. Several questions arise as to the relationships between the two “sites” and, in so doing, the meaning to be given to the absence of *raclettes* at Mirande 1

(diagnosis problem? division of activities for the same Badegoulian occupation? chrono-cultural distinction? Etc.). On the other hand, the diversity of lamellar production modes expressed in Mirande 1 (Bosinski, Guicharnaud, Morala in press) and, in particular, the presence of numerous elements indicative of a (micro)lamellar debitage on flake slices of the “preferential overflowing” type (Ducasse and Langlais 2007; Ducasse 2010) accentuates once again the technical connections between the Badegoulian and the Lower Magdalenian (*ibid.*).

- 27 Thus, all the data acquired during the rescue operation conducted at Mirande 2 not only allows us to re-examine the original Mirande 1 site and its chronocultural attribution, but also to feed, beyond the strictly regional context, our reflections on the Badegoulo-Magdalenian transition.

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NOTES

1. The reviewing of the lithic collection of the site of Pénovaire (Penne, Tarn, MNHN of Toulouse, ML and SD personal observation), for which B. Pajot indicated the presence of "very typical" *raclettes* while attributing the assemblage to the Middle Magdalenian (1968 - page 88), allowed to rule out any possibility of Badegoulian on this site, the "raclettes" observed probably corresponding only to simple retouched flakes.
2. Only the pieces collected by M. de Maulde, bought by Colonel Vésinié and then bequeathed to the Institute of Human Palaeontology, are now available for studying. It seems, on the other hand, that the series collected by Bergougnoux and Chaillot are lost (Millet-Conte 1994 - p.21).
3. After an unsuccessful attempt in collaboration with Gif-sur-Yvette (Millet-Conte 1994 - p. 52-53), two bones were submitted to the Lyon laboratory (CDRC-Artemis) for AMS dating in the context of the SaM Collective Research Program (Ducasse and Renard *org.* 2013). In 2015, a test on charcoals recorded in the level, conducted by the Oxford laboratory (ORAU), yielded an aberrant result (OxA-33216: 45,300 ± 1900 BP).
4. The fieldwork took place over three days, from 28 to 30 April 2014, mobilizing a total of 36 man-days.
5. Distances between the sources/sites expressed correspond to orthodromic distances. These values remain indicative and therefore do not take into account the potential diversity of the methods of procurement and movement of these materials.

ABSTRACTS

The recently discovered open-air site of Mirande 2 (Vaïssac, Tarn-et Garonne) lies on a gentle incline of the left bank of the Aveyron River approximately 100 metres from the site of Mirande 1 (Nègrepelisse, Tarn-et-Garonne), which was excavated between 1971 and 1976 by R. Guicharnaud. A test-pit carried out during rescue work evaluated the site's potential, provided important geological data and produced diagnostic archaeological material. The three excavated sectors (South Trench, North Section and Test-Pit) preserved only lithic material (flint and quartz), whose typo-technological composition evinces a chrono-culturally coherent assemblage. Initial archaeo-stratigraphic information indicates a single concentration of archaeological material that varies in thickness by sector. Attributable to the Badegoulian, the lithic assemblage comprises various blanks and multiple types of raw materials. Several shaped trachyte blocks and quartz pebbles, exploited for the production of heavy-duty tools and flakes, likely derive from the palaeo-terrace occupied by the human groups. While the majority of the flint artefacts come from the terraces of the Vère and Aveyron Rivers, a limited quantity of non-local raw materials were introduced from sources some 100 km to the north. These latter artefacts are found uniquely as tools that were likely discarded at the end of their use-lives. Two types of domestic tool blanks were identified; endscrapers, combination tools and laterally retouched pieces on blades and elongated flakes alongside scrapers and raclettes on flakes produced according to different, sometimes independent *chaînes opératoires*. In terms of the blade and elongated flake component, our preliminary analysis suggests blanks to have been detached from either a wide surface or from wedge-shaped cores. Finally, microliths are represented by different types of backed micro-bladelets on blanks produced from nodules and flakes. In addition to Mirande 2 being a new open-air occupation on the palaeo-terraces of the Aveyron River near its confluence with the Gouyré, it is also amongst the first evidence for the Badegoulian between the Lanquedoc and Quercy regions in an area where this culture remained poorly documented.

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Keywords: Badegoulian, open air site, Quercy, Petroarchaeology, Lithic Technology, Flint, Quartz

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