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La conquête de la montagne : des premières occupations humaines à l'anthropisation du milieu

Éditions du Comité des travaux historiques et scientifiques

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DOI: 10.4000/books.cths.6362

Publisher: Éditions du Comité des travaux historiques et scientifiques

Place of publication: Éditions du Comité des travaux historiques et scientifiques

Year of publication: 2019

Published on OpenEdition Books: 20 December 2019

Serie: Actes des congrès nationaux des sociétés historiques et scientifiques

Electronic ISBN: 9782735508846



<http://books.openedition.org>

Electronic reference

RASILLA VIVES, Marco de la ; et al. *The Llonin Cave (Peñamellera Alta, Asturias, Spain), level III (Galería): techno-typological characterisation of the Badegoulian lithic and bone assemblages* In: *La conquête de la montagne : des premières occupations humaines à l'anthropisation du milieu* [online]. Paris: Éditions du Comité des travaux historiques et scientifiques, 2019 (generated 20 novembre 2020). Available on the Internet: <<http://books.openedition.org/cths/6362>>. ISBN: 9782735508846. DOI: <https://doi.org/10.4000/books.cths.6362>.

This text was automatically generated on 20 November 2020.

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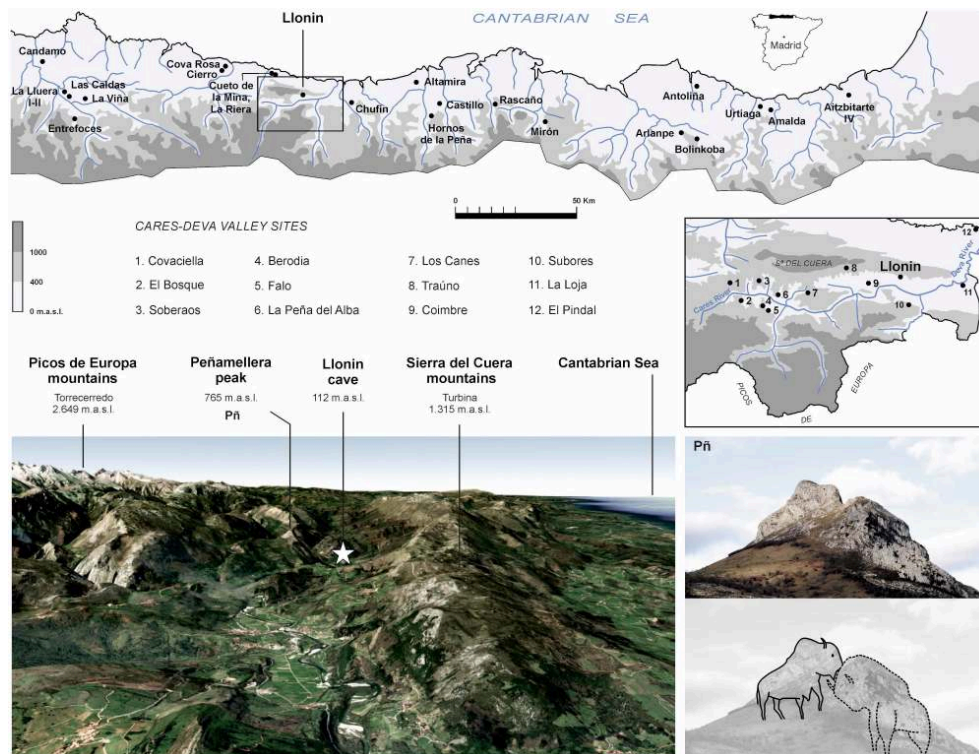
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To Gregorio Gil Álvarez (1926-2014), rural medicine doctor and humanist. To Manuel Hoyos Gómez (1944-1999) and Javier Fortea Pérez (1946-2009), *in memoriam*.

Aknowledgements to the Llonin excavation and research team, to María Borao (Universidad de Valencia), Jesús F. Jordá (UNED), Marc Tiffagom and to the editors and reviewers for their constructive critics.

- 1 Llonin cave is located in the Cares-Deva basin, at 112 m.a.s.l. and with ENE orientation. It is ~23 m above the closest drainage basin (La Molinuca stream) and ~18 km away from the Cantabrian Sea. The Cares-Deva valley is delimited by a mountainous relief with several mineral outcrops (i.e. iron, manganese and copper) and contains 13 other rock art caves or rock shelters from headwaters to estuary. El Pindal cave is in the coastline, close to the Deva River estuary. Situated on the Deva's right bank (Cantabria), Cueva Áurea's recently discovered art must also be added (Fig. 1).

Fig. 1. – Asturias, Cantabria and Basque Country mentioned sites distribution and specific sites of the Cares-Deva basin.

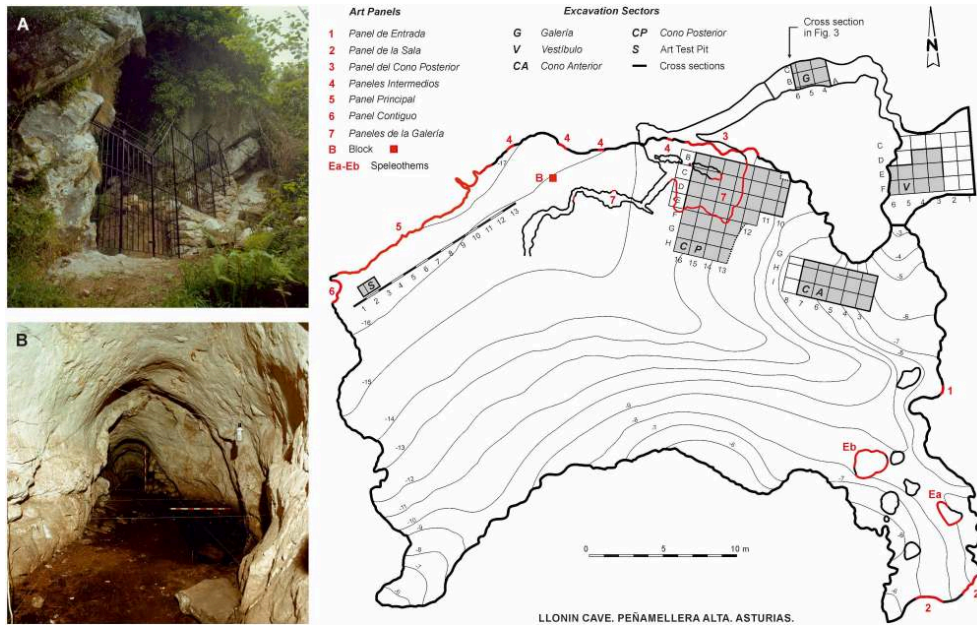


Left below: Llonin landscape with the main relief structures (east to west view). Right below: Peñamellera Peak bison forms.

Photo Elsa Duarte. Left below © Digital Globe, 2017, Google, IGN.

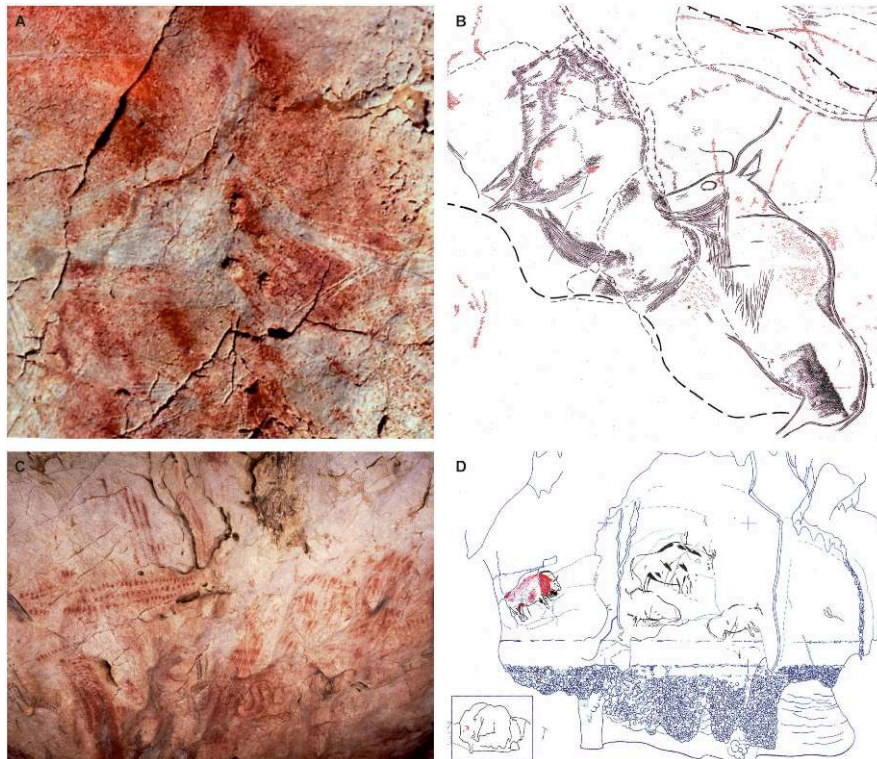
- 2 Llonin's surrounding landscape is closed by mid-altitude mountains and the Peñamellera peak that constitutes a prominent relief feature, showing a singular form of two bisons when faced from the east (Fig. 1). The left bison's "head" points to La Molinuca valley and the cave. Undoubtedly this great "visual point", like for example the nearby Peña Tú rock or El Castillo Mountain in Cantabria, played an important role in the territory organization and also in the emotional/symbolic thinking (Rasilla and Duarte 2018).
- 3 The cave entrance was practically blocked by archeological deposits and calcite formations, but in 1957 it started being used for local cheese fermentation, which caused a partial destruction of the archeological layers. In 1971, its rock art was publicly presented and further research revealed a rich archeological sequence that included evidence of Middle and Upper Paleolithic (Gravettian, Upper Solutrean, Badegoulian, Middle Magdalenian, Upper Magdalenian), and to a lesser extent, Azilian and Bronze Age. This long-chronology parietal art is made up of several painting and engraving superimpositions, with a prominent use of multiple and striated lines engraving technique; there is a reasonable correlation between the artistic and cultural records (Forkea *et al.* 1995, 1999 and 2004, Rasilla 2014, Rasilla *et al.* 2014) (Figs. 2 and 3).

Fig. 2. – Llonin Cave (Peñamellera Alta, Asturias, Spain): fence and vestibule (A). Galería excavation area (B). Plan of the cave with the excavation sectors and cave art panels (C).



(Fortea *et al.* 2004).

Fig. 3. – Llonin Cave (Peñamellera Alta, Asturias, Spain): examples of rock art.



A: Panel Principal, engraved hind made by multiple and striate technique. **B:** Panel Principal, painted and engraved bisons, right bison overlapping a previous red deer. **C:** Panel Principal, overview of meters 3 to 5 with a red colour anthropomorphic feminine figure and several painted signs. **D:** Panel de la Sala, engraved bisons with fine lines and one partially painted.

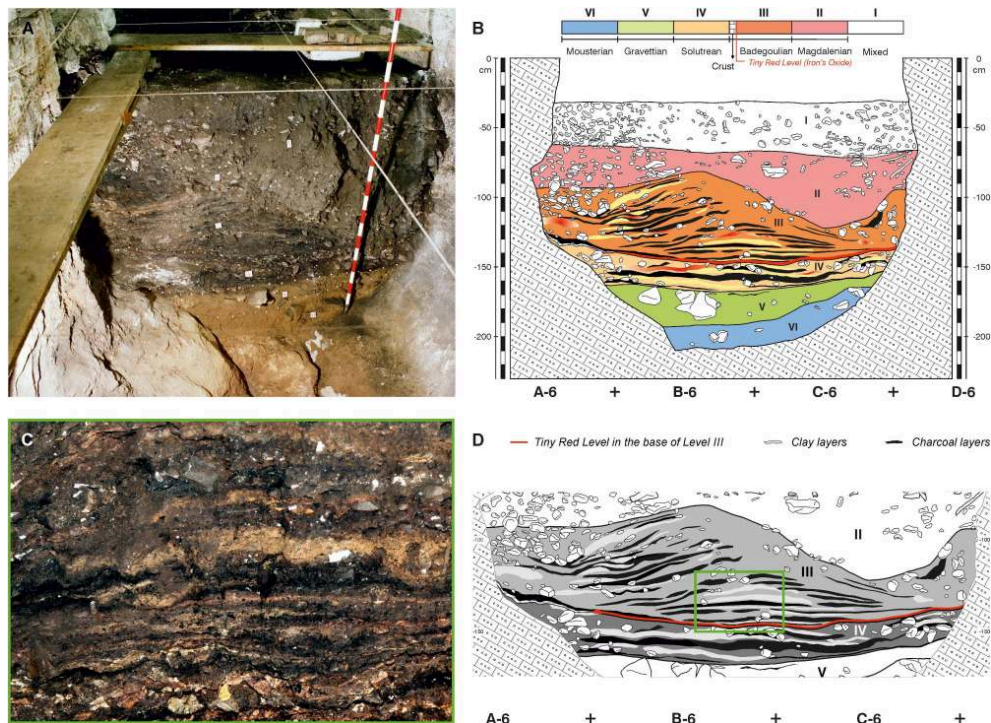
Drawings : B : Alba Fernández Rey, D : Andrea Miranda. Photos Javier Fortea. Scales in Fortea *et al.* 2004.

Archeological data

Stratigraphy

- 4 During the excavation works, we realized that a very thin red level delimited level III (Badegoulian) from level IV (Solutrean). It was constituted by fine-grained iron oxides and it filled up the whole excavated surface. Its importance is critical because it seals the top of level IV and we haven't noticed relevant taphonomical processes between levels III and IV. It also seems that iron oxides particles were sprinkled by the first individuals who arrived at the cave at the beginning of level III's formation. It could have involved a practical function directly related to the fire tasks documented in this level such as waterproofing, refractory base, etc., but it may also have been symbolic (Fig. 4).

Fig. 4. – Llonin Cave (Peñamellera Alta, Asturias, Spain): Galería. Stratigraphy (A); stratigraphic cross-section showing the different cultural units (B); level III detail (C, D).



Photos Javier Fortea. Drawings Elsa Duarte.

- 5 Level III is 30 to 50 cm thick and it shows a central tumulus shape. It consists of clayey-sandy sediment with black (charcoal, ashes) and yellow (clay) lenticular beds alternations (Fig. 4C, 4D). These clayey beds are highly compacted by fire action and they are usually beneath black lenses; they were in place before making fire. Sometimes there are sorts of "pits" full of ashes, charcoal and burnt and broken bones and lithics, beside a great quantity of broken and burnt Ordovician quartz-arenite and Devonian sandstone pebbles. There are also specific red (iron oxide) patches. Therefore, this level is mainly anthropic, without erosive discordances between levels III and IV.

Fauna and charcoal

- 6 The preliminary faunal study indicates a predominance of chamois over red deer and Spanish ibex while horse and aurochs are occasional. The faunal record is in primary position, trampling evidence is scarce and no carnivore marks have been identified until now. On the contrary, bones have been highly transformed by humans. Incisions are more common than scraping and longitudinal incisions are more numerous than oblique or transversal ones. Defleshing traces are more common than disarticulation ones. Moreover, there is a strong fragmentation for marrow extraction and a high exploitation of large, short and flat bones.
- 7 Although wood charcoal analysis is still ongoing, the preliminary results reveal the presence of legume and heather (*Ericaceae*) species. Even though these families include a large number of genera and species of diverse ecological conditions, this combination is characteristic of the Eurosiberian cold moorlands and points to the existence of cold conditions and open, shrub-like landscapes, with a low arboreal component (only a fragment of *Juniperus* has been identified).

Lithic assemblage

- 8 It is formed of knapped materials, macro-lithic artifacts and partly modified rocks carried to the site (Table 1). Over an estimated total of ~17,000 knapped pieces, we are presenting here a sample of 31.90% (n = 5,423). For the estimate and analysis, we have not taken into account the first centimeters of the level's top layer, nor sub-squares 1/4/7 from C/D-5/6 (Fig. 2), just to avoid possible archeological mix-ups.

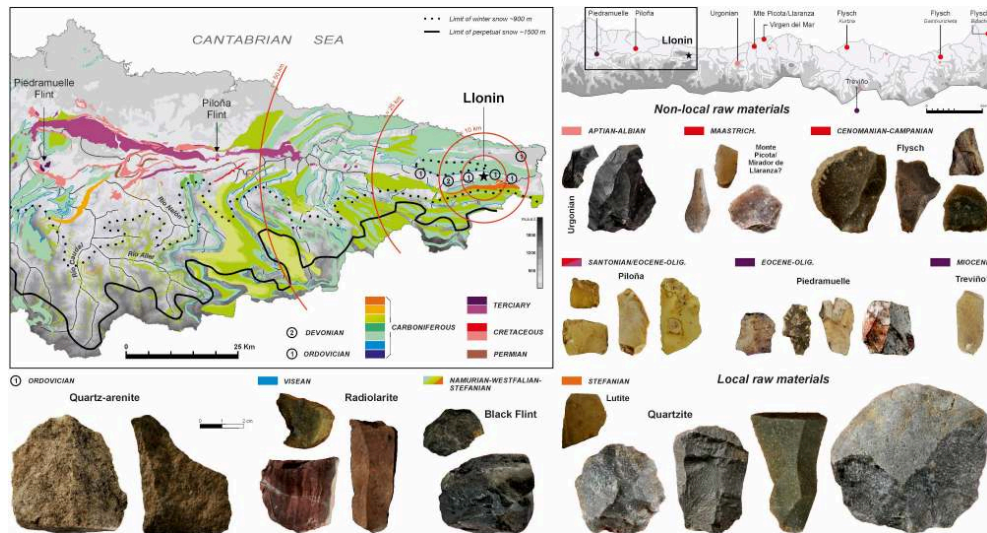
Table 1. – Llonin Cave (Peñamellera Alta, Asturias, Spain), Galería, level III: general composition of the lithic assemblage.

Lithic assemblage	Quartzite		Flint		Lutite		Subtotal		Qa + S		Total	
	n	kg	n	kg	n	kg	n	kg	n	kg	n	kg
Flakes	4,149	25.93	1,159	4.85	115	0.89	5,423	31.69	314	7.94	5,737	39.63
<i>Estimated total</i>	13,000	82.00	3,600	15.20	400	2.80	17,000	100.00	1,000	26.00	18,000	126.00
Pebbles >5 cm									220	39.88	220	39.88
<i>Estimated total</i>									750	150.00	750	150.00
Hammers/retouchers	2	0.65			3	1.53	5	2.18			5	2.18
Anvils									1	0.77	1	0.77
Total	4,151	26.58	1,159	4.85	118	2.42	5,428	33.87	535	48.59	5,963	82.46
<i>Estimated total</i>	13,000	82.00	3,600	15.20	400	2.80	17,000	100.00	1,750	176.00	18,750	276.00

Sample of 31.90% (n = 5,423) over an estimated total of ~17,000 knapped pieces. Qa + S: quartz-arenite + sandstone? (studies in progress).

- 9 Quartz-arenite and sandstone make up parallel macro-lithic *chaînes opératoires*, and they consist of pebbles, anvils, hammers and few “large” flakes aimed at fire activity. They probably come from the stream and the outcrops just in front of the cave (<100 m distance) (Fig. 5).

Fig. 5. – Llonin Cave (Peñamellera Alta, Asturias, Spain): raw materials.



Left: local/semi-local (<10 km radius) and non-local origin. Right and above: main flint sources in the Cantabrian Region. Some flint identifications need further petrological analysis (cf. question marks). Map, photos and PAO Elsa Duarte.

Sample

- 10 The sample is made up of all the tools, cores and blades/bladelets from squares C-4/5/6 (13.65% of the total sample), with a random sample for the flakes and shatter (49.23% of the total sample). All sediments have been water-sieved in 2.38 and 1.41 mm mesh screens.
- 11 In addition, we have used a random sample for the rest of the excavated surface A-6, B-4/5/6 and D-5. We have studied all the pieces in each square/layer selected (37.12% of the total sample). There are no significant differences regarding surface distribution between these two large groups, except for a higher material density in the sub-squares next to the walls.

Assemblage composition and preservation

- 12 It is formed by a majority of unretouched blanks (~50%) over shatter, tools and cores (Table 2). For the technological groups, the shatter makes ~40% and the blanks ~60% (Table 3). This is a reverse proportion in comparison to a complete experimental and/or archeological reduction sequence (Geneste 1988, Santamaría 2012).

Table 2. – Llonin Cave (Peñamellera Alta, Asturias, Spain): general knapping groups frequencies.

Knapping group	n	%
Blanks	2,430	44.81
Shatter	1,937	35.72
Cores	43	0.79
Tool-cores	16	0.30
Tools	997	18.38
Total	5,423	100.00

BLANKS: flakes (complete/fragments ≥ 20 mm), blades-bladelets (complete/fragments), indeterminate fragments (≥ 20 mm); **SHATTER:** flakes (complete/fragments < 20 mm), indeterminate fragments (< 20 mm).

Table 3. – Llonin Cave (Peñamellera Alta, Asturias, Spain): technological group frequencies of cores and retouched/unretouched artefacts.

		Unretouched	Tools	Tools/cores	Cores	Total	
		n	n	n	n	n	%
Blanks	Flakes	1,879	647	3	4	2,533	46.71
	Blades	182	50			232	4.28
	Bladelets	221	33			254	4.68
	Indet.fragments	148	106	13	12	279	5.14
Shatter		1,937	161			2,098	38.69
Pebbles					27	27	0.50
Total		4,367	997	16	43	5,423	100.00

- 13 The already published levels V (Gravettian) and VI (Mousterian) from Llonin Galería are different from level III because of the lower object density in both levels (< 300) and a lower ($\sim 13\%$) representation of tools (Martínez 2015, Rasilla and Santamaría 2011-12). These early occupations appear more episodic than levels IV-II, but the Solutrean and Magdalenian level analyses are still ongoing.
- 14 The Minimum Number of Blanks for the studied sample is $n = 2,144$ (Hiscock 2002, Santamaría 2012) and in comparison to the number of studied blanks ($n = 3,012$, Table 3), the assemblage is relatively fragmented. We have assessed the stratigraphic integrity by comparing fragmentation rates between unretouched and retouched blanks (excluding tools under 20 mm), and also between blank categories (excluding indeterminate fragments) and raw material categories (excluding lutite) by unretouched and retouched blanks (Santamaría 2012). The global fragmentation state is “moderate/tending to be moderate” in the evaluated cases and thus shows an internal coherence (Table 4).

Table 4. – Llonin Cave (Peñamellera Alta, Asturias, Spain): blanks fragmentation and levels' conservation.

Groups	Complete + marginal	LL/LR + TP/TD + LT	Minimum number of blanks (MNB)	Fragmented blanks (FB)	Total number of blanks (TNB)	Representation index	Fragmentation index	Fragmentation index interpretation
Unretouched/retouched: n = 2,93								
Unretouched	1,010	523	1,533	1,201	2,211	0.69	0.54	Moderate
Retouched	404	150	554	317	721	0.77	0.44	Moderate
Total	1,414	673	2,087	1,518	2,932	0.73	0.49	Moderate
Unretouched/blanks: n = 2,211								
Flakes	856	421	1,277	954	1,810	0.71	0.53	Moderate
Blades/bladelets	154	102	256	247	401	0.64	0.62	Strong
Total	1,010	523	1,533	1,201	2,211	0.68	0.58	Moderate
Unretouched/raw material: n = 2,211								
Quartzite	776	436	1,212	1,004	1,780	0.68	0.56	Moderate
Flint	234	87	321	197	431	0.74	0.46	Moderate
Total	1,010	523	1,533	1,201	2,211	0.71	0.51	Moderate
Retouched/blanks: n = 721								
Flakes	366	124	490	271	637	0.77	0.43	Moderate
Blades/bladelets	38	26	64	46	84	0.76	0.55	Moderate
Total	404	150	554	317	721	0.77	0.49	Moderate
Retouched/raw material: n = 721								
Quartzite	276	122	398	249	525	0.76	0.47	Moderate
Flint	128	30	158	68	196	0.81	0.35	Weak
Total	404	152	556	317	721	0.79	0.41	Moderate

LL/LR+TD/TP+LT: LL Longitudinal left, LR Longitudinal right, TD Transversal distal, TP Transversal proximal, LT Longitudinal and transversal LIP/LDT/LID/LDD (morphological classification *sensu* Santamaría 2012). **MINIMUM NUMBER OF BLANKS:** *sensu* Santamaría 2012. **REPRESENTATION INDEX:** *sensu* Santamaría 2012: MNB/TNB. **FRAGMENTATION INDEX:** *sensu* Santamaría 2012: FB/TNB. Statistical differences are only significant (*moderate* according to V's Cramer test) when comparing flake/laminar blanks. **UNRETOUCHED/RETOUCHED:** $X^2(4) = 33.792$, $p < 0.000$, Cramer's $V = 0.107$, *independent*. **UNRETOUCHED/BLANK:** $X^2(4) = 393.024$, $p < 0.000$, Cramer's $V = 0.422$, *moderate*. **UNRETOUCHED/RAW MATERIAL:** $X^2(4) = 40.792$, $p < 0.000$, Cramer's $V = 0.136$, *independent*. **RETOUCHED/BLANK:** $X^2(4) = 54.234$, $p < 0.000$, Cramer's $V = 0.274$, *moderate*. **RETOUCHED/RAW MATERIAL:** $X^2(4) = 19.785$, $p < 0.001$, Cramer's $V = 0.166$, *independent*.

- 15 In general, unretouched blanks are more fragmented (fragmentation index) than tools and both follow a similar fragments' distribution (complete > transversal > longitudinal > complex longitudinal), except for unretouched flakes among which longitudinal fragments are only 1% more than transversal ones. Laminar blanks are more fragmented than flakes and quartzites are more fragmented than flints.
- 16 These slight differences should be explained as intrinsic to the archeological level context:
- Laminar blanks break more than flakes due to their morphological and metrical features;
 - Quartzite is highly related to splintered pieces and bipolar technique involves abundant and highly diverse fractures;
 - Complex longitudinal fragments are over 2% in the five studied cases (~8 % of the studied sample) and they do not result from flaking activity but from others, such as trampling (Santamaría 2012) or more likely splintering and intentional fractures ("anvil type", $n = 73$ and ~60% of them). So in the absence of direct refits we reject inter-stratigraphic artifact flows and therefore archeological contamination.

Raw materials

- 17 The local knapped raw materials are of Carboniferous age: quartzite, lutite and different types of flint (mainly radiolarite and black flint). Up to date, Cretaceous and Tertiary flint sources are non-local and they are found to the east of Llonin (40-85 km: Urgonian, Virgen del Mar and Monte Picota/Mirador de Llaranza: Risetto 2009, Fontes *et al.* 2016, Tarrío *et al.* 2015, Tarrío 2016) or to the west (60-100 km: Piloña and Piedramuelle: Fortea *et al.* 2010, Santamaría 2012, Tarrío *et al.* 2013, Rasilla *et al.* 2015, Duarte *et al.* 2016). Nonetheless, some of them involve macroscopic identification problems: Monte Picota/Mirador de Llaranza is a chalcedony-type flint similar to Piloña flint (*Infiesto facies*) and Piedramuelle (*chalcedony facies*). We are analyzing these features (Rasilla *et al.* 2018), but for the moment we have grouped them as a raw material unit called chalcedony. Urgonian flint (Tarrío 2016) and Kurtzia-Flysch flint (Flysch flint from now on) crop out 40 km and 120 km to the east respectively, and they also macroscopically resemble different varieties of black local flints (Fig. 5). We haven't identified local Pendueles-Flysch flint (~8 km distant) in the assemblage, but further studies are ongoing.
- 18 Quartzite is the most knapped raw material (76.5%), followed by carboniferous flint varieties and mainly radiolarite (10.43%) (Table 5).

Table 5. – Llonin Cave (Peñamellera Alta, Asturias, Spain): raw materials and number of pieces frequencies.

Quartzite	Radiolarite	Black flint	Urgonian flint	Piloña flint	Chalcedony	Piedramuelle flint	Flysch flint	Jasper and Treviño flints	Altered and indeterminate flints	Lutite and quartz
4,149	566	155	11	42	22	17	201	4	140	116

- 19 The rest of the flint types are scarce (~10%). Within them, Flysch flint is more abundant (3.70%) than other flints from the neighborhood such as black flint (2.85%). We have tentatively identified 2 blades and 1 flake as Treviño flint (0.05%). The indeterminate and altered flints are scarce: 2.58%. Heat alteration is spread all over the level but, as seen in the bone industry, few pieces have reached calcination state, so this doesn't distort the general macroscopic classification. On the contrary, this partial thermal change makes determining flint's features such as fossils or impurities stand out. Jaspers and quartz are poorly represented (1 flake and 1 shatter respectively) and lutite is 2.12%.
- 20 Compared to weight data, quartzite and radiolarite are similar, but flint groups show an opposite ratio regarding Number of Specimens/Weight (Fig. 6A). Flysch flint contains the highest ratio and it is expressed by shorter module blanks, and therefore makes the largest bladelet assemblage production. Black flint is an outlier because its catchment area is similar to non-local flints, but it is found today in the Cares River alluviums.
- 21 Manuports or partially tested cores are nearly absent and cores tend to be highly reduced. They usually keep a cortical surface and pebble morphology, especially the centripetal ones (~70%). Their dimensions are small (n = 59; medium length 49.85 mm – smaller dimension 12.89; medium width 40.57 mm – smaller dimension 10.88; medium thickness 26.98 mm – smaller dimension 7.88) and irregular flake-type negatives are common. The largest complete flake is a semi-cortical quartzite (denticulate) and its maximum measurement (95.78 × 79.49 × 23.45 mm) is 200% larger than cores' measurements. It is also the heaviest flake in the assemblage (165.13 g) and only a

quartzite core is heavier (178.95 g). But this maximal module is smaller than some of the pebbles we collected in nearby alluviums (they can reach 300 mm in their longest axis). Cortical blanks make 23.45% of the total. They are larger in local raw materials, but quartzite is at intermediate level, as it presents a tendency to low cortex index (Fig. 6B). Blade-bladelet production and retouch is more common in distant-sources flints (Table 6, Fig. 6C).

Table 6. – Llonin Cave (Peñamellera Alta, Asturias, Spain): relative proportion of raw materials and blanks.

	Flakes	Blades	Bladelets	Indeterminate fragments	Total	
	n	n	n	n	n	%
Quartzite	2,050	171	152	183	2,372	75.06
Radiolarite	257	27	38	47	322	10.19
Black flint	70	4	7	14	81	2.56
Urgonian flint	6			2	6	0.19
Piloña flint	21	5	6	3	32	1.01
Chalcedony	9		5	1	14	0.44
Piedramuelle flint	12	1	2		15	0.47
Flysch flint	102	17	28	10	147	4.65
Other flints	2	2			4	0.13
Indeterminate flint	65	4	17	12	86	2.72
Lutite	78	2		11	80	2.53
Total	2,672	233	255	283	3,160	100.00
%	84.56	7.37	8.07	8.96	100	

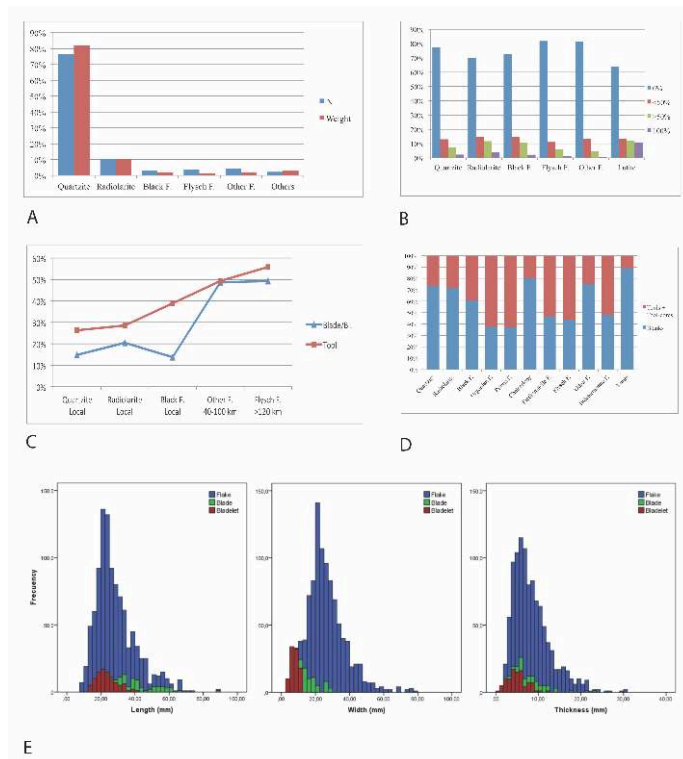
OTHER FLINTS: jasper and Treviño. Indeterminate flints: altered and indeterminate.

- 22 In general, flints are more retouched than quartzite (56% versus 24%) but there are two exceptions: radiolarite and chalcedony (Fig. 6D). Lutite shows marginal dynamics with a low number of flakes, higher cortex index and very few tools.

Technology of blank production

- 23 Unretouched complete blanks (n = 1,038) make 30.2% of the all the blanks. Their dimensions are the most accurate approach to core reduction strategies, since cores are exhausted. Complete flakes (n = 883) average dimensions are:
- Medium length: 28.08 mm – smaller dimension 11.53;
 - Medium width: 28.09 mm – smaller dimension 10.62;
 - Medium thickness: 8.98 mm – smaller dimension 6.15;
 - Elongation index (L/W) 1.00;
 - Careening index (W/T) 3.12.
- 24 Blade-bladelet (metric division: 12 mm wide) production shows a length and width *continuum* that ranges from ~13-55 mm long and ~2-20 mm wide and an elongation index of ~3 (Fig. 6E).

Fig. 6. – Llonin Cave (Peñamellera Alta, Asturias, Spain): lithic assemblage.



A: raw materials and number of pieces/weight proportion. Other F. (= flints): urgonian, chalcedony, Piloña, Piedramuelle, altered, indeterminate, jasper, Treviño. **B:** relative proportion of blanks' cortex and raw materials. **C:** intensity of laminar production/tools by raw material group. It increases in distant flints and is higher for tools. Laminar production: linear regression (except outlier black flint), $Y = 4.14 + 9.71 x$, R^2 (corrected) = 91.9%. Tools: linear regression (except black flint), $Y = 16.03 + 7.98 x$, R^2 (corrected) = 95.6%. Other F. (= flints): jasper and Treviño. **D:** relative proportion of raw materials, blanks and tools/tool-cores. Indeterminate F. (= flints): altered and indeterminate. **E:** complete unretouched blanks measures and frequencies.

- 25 For raw materials, there are different flake modules (length or width) depending on their type: quartzite ~29 mm, local flints ~26 mm, non-local flints 22 mm, Flysch 21 mm. Standard deviation is higher in local raw materials (~10) than in non-local ones (~5). Blades over 21 mm wide are outliers because they are scarce ($n = 13$), mainly on quartzite ($n = 11$) and their elongation index is next to 2, so they seem to belong to the large flake reduction phase. On the contrary, we have identified 10% quartzite bladelets as by-products from splintered pieces' use. Although they keep an inferior face, their dorsal face is slightly irregular and their proximal/distal edges are splintered. Their use as backed bladelets and also as *bâtonnets*-type indeterminate fragments will be assessed (Roda *et al.* 2015). Flysch flint would be the only raw material unit aimed at on-site bladelet production, since blanks are abundant and there are several types of flakes (such as cortical ones), blades-bladelets and two bladelet cores. They could be introduced as already prepared cores and/or tools. The rest of non-local flint knapping units are more fragmented; for example there are two Urganian flint bladelet cores, but no bladelets.
- 26 In general, dorsal negatives are between 1 and 3 and they are unidirectional ($n = 431$ over a sample of $n = 868$) both in flakes and blades/bladelets, although centripetal negatives increase in flakes under 30 mm. Moreover, technological features for arching and careening, such as ridges and backs, are quantitatively similar in flakes and

bladelets (~22%, sample n = 3,437) but they are comparatively more abundant in bladelets under 12 mm wide. These bladelets range between 9 and 12 mm wide and 6 to 9 mm thick, and these measurements match up burin's thicknesses (Table 7) so some bladelets could be related to burin manufacture.

Table 7. – Llonin Cave (Peñamellera Alta, Asturias, Spain): frequencies of tools and raw materials.

	Quartzite		Flint		Lutite		Total		Flint variability	
	n	%	n	%	n	%	n	%	Local	Non-local
Endscrapers	47	4.71	24	2.41	1	0.10	72	7.22	II	III
Borers	11	1.10	7	0.70			18	1.81	II	I
Burins	11	1.10	45	4.51	2	0.20	58	5.82	II	V
Truncated pieces	21	2.11	15	1.50			36	3.61	I	IV
Retouched blades	14	1.40	5	0.50			19	1.91	I	II
Retouched flakes/ indeterminate fragments	87	8.73	28	2.81	1	0.10	116	11.63	II	III
Notches	53	5.32	10	1.00	2	0.20	65	6.52	II	II
Denticulates	39	3.91	5	0.50			44	4.41	I	I
Splintered pieces	339	34.00	132	13.24	2	0.20	473	47.44	II	IV
Sidescrapers	42	4.21	3	0.30	2	0.20	47	4.71	I	I
Raclettes			26	2.61			26	2.61	II	III
Abrupt retouched flakes/ indeterminate fragments	6	0.60	12	1.20			18	1.81	II	II
Retouched bladelets			5	0.50			5	0.50	I	I
Total	670	67.40	317	31.62	10	0.10	997	100.00		

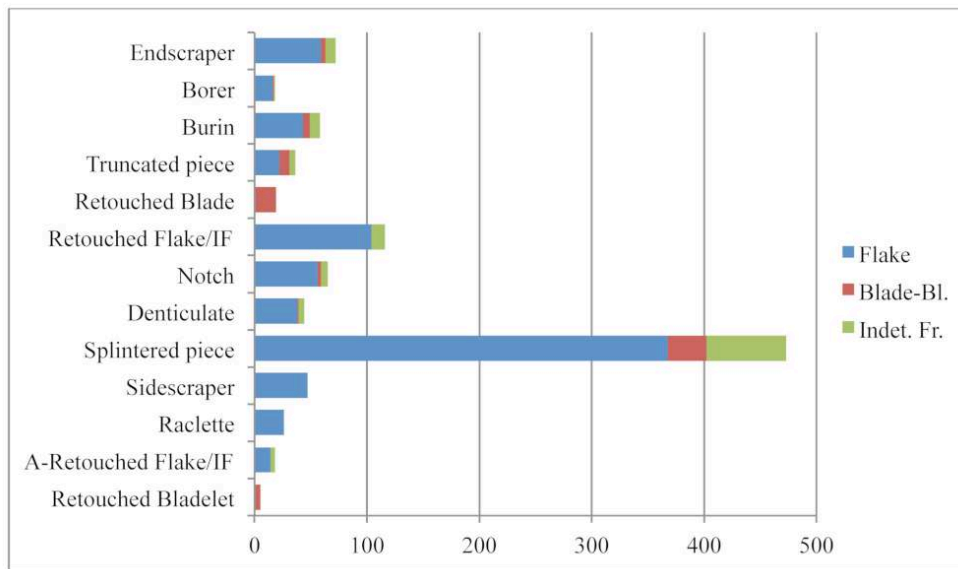
Roman numbers: amount of flint types (radiolarite, black flint, Urgonian, calcedonic, Piloña, Piedramuelle, Treviño). Tool-cores are not taken into account.

- 27 Cores are scarce and are exhausted. Their negatives' morphology is mainly small flakes, and they are centripetal (n = 30), orthogonal (n = 5) and indeterminate (n = 2). We have identified 16 pieces as tool-cores, which are pieces with a morphology that fits in the typological primary groups, but their thicknesses, negative series and negative dimensions make them susceptible to be cores. 3 denticulate tool-cores join the centripetal group and the rest are aimed at bladelet production such as thick endscrapers/*sur front* (n = 6) or thick burins/*sur tranche* (n = 5) (Ducasse and Langlais 2007, Santamaría 2012) or splintered pieces (n = 2), with a predominance of quartzite over flint. This raw material difference is similar to laminar prismatic cores, with bladelet (n = 3) or blade (n = 3) negatives.

Tool production

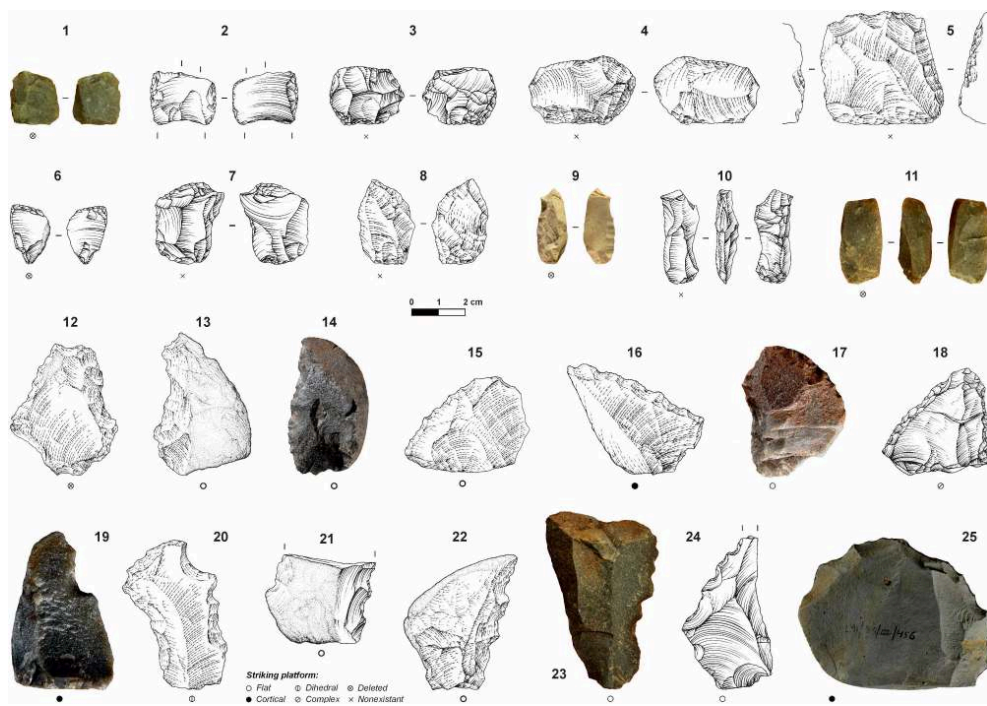
- 28 The tool transformation rate (i.e. percentage of blanks transformed into tools) is 29.1%. Tools made on shatter are included here since they are scarce (16.06%) and quite broken. *Substratum* tools (retouched flakes, notches, denticulates, sidescrapers and mainly splintered pieces) predominate (74.72%), followed by endscrapers, burins (angle burins dominate over dihedral ones) and truncated pieces (Table 7, Figs. 7, 8 and 9).

Fig. 7. – Llonin Cave (Peñamellera Alta, Asturias, Spain): tools and tool blanks frequencies.



IF : indeterminate fragments.

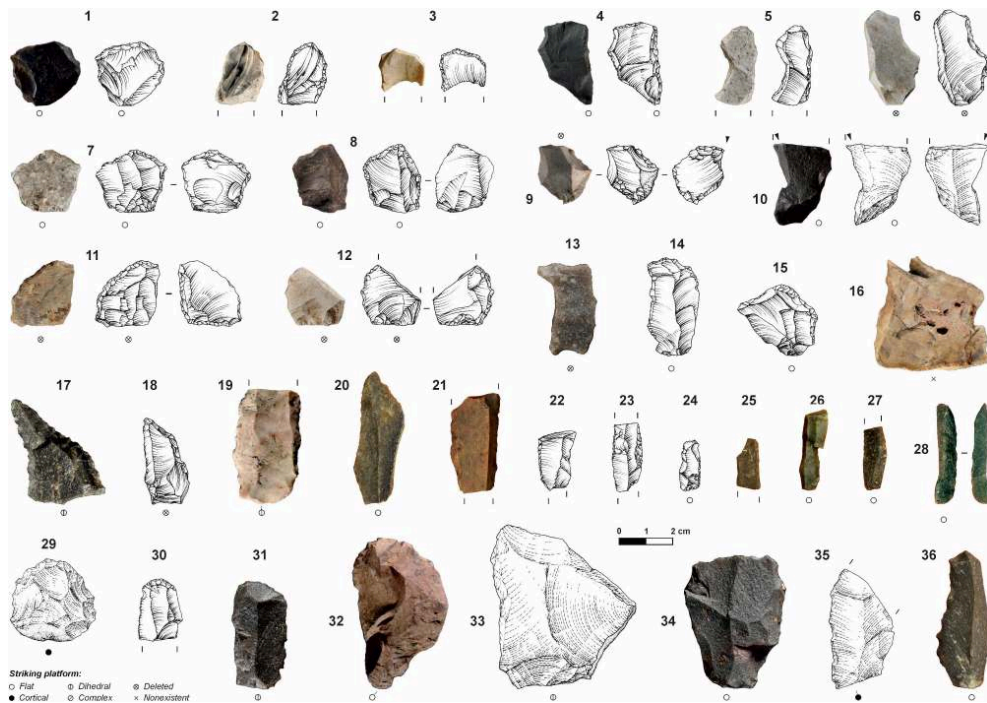
Fig. 8. – Llonin Cave (Peñamellera Alta, Asturias, Spain): lithic toolkit.



1-11: splintered pieces. **12-18:** sidescrapers. **19-20:** notches. **21-25:** denticulates. Quartzite: 1, 4, 5, 8, 11, 12, 13, 14, 15, 16, 17, 19, 20, 22; radiolarite: 10, 18, 24; lutite: 25; Piloña flint: 2, 3, 9; black flint: 21; Piedramuelle flint: 7; indeterminate: 6.

Photos and drawings Elsa Duarte.

Fig. 9. – Llonin Cave (Peñamellera Alta, Asturias, Spain): lithic toolkit and laminar blanks.



1, 2, 3, 4, 5, 6: raclettes. **7, 8, 11, 12:** raclettes and splintered pieces. **9, 10:** burins. **13:** abrupt retouch and splintered piece. **16:** abrupt retouch. **14, 15:** truncated pieces. **17, 18:** borers. **19, 35, 36:** retouched blades. **20, 21:** blades. **22, 23, 24:** retouched bladelets. **25, 26:** bladelets. **27, 28:** bladelets resulting from splintering. **29, 31, 32:** Endscrapers. **33, 34:** retouched flakes. *Quartzite:* 10, 17, 27, 28, 29, 31, 33, 34, 35, 36; *radiolarite:* 4, 8, 11, 14-15, 21, 23, 25, 32; *Piloña flint:* 3, 16, 19, 22; *Urgonian flint:* 1; *Flysch:* 5, 6, 9, 13, 18, 20, 30; *indeterminate/altered:* 2, 7, 12, 24, 26.

- 29 This transformation rate is biased by the predominance of splintered pieces (47.44% out of the total tools). So if we exclude them, the rate becomes 17.3%. Given the abundance and high knapping quality of quartzite, main raw material used for these pieces (Table 7), we tend to consider splintered pieces as wedges instead of cores. For us negatives on these pieces reflect bipolar action but not a blank production. In fact, hypothetical blanks would be small and they wouldn't fit metrically for other tools (Table 8). However, by-products could be used again as wedges. Further studies are in progress in order to evaluate their on-site techno-functional implications.

Table 8. – Llonin Cave (Peñamellera Alta, Asturias, Spain): mean and standard deviation of length, width and thickness for complete tools.

	Fragmented tools	Complete tools	Complete tools measures					
	n	n	Length (mm)		Width (mm)		Thickness (mm)	
			Mean	Standard	Mean	Standard	Mean	Standard
Endscrapers	42	30	36.47	12.74	34.95	11.84	13.00	5.01
Borers	6	12	39.63	13.00	30.00	11.41	10.31	4.46
Burins	33	25	26.26	9.99	18.86	8.98	8.72	7.73
Truncated pieces	21	15	26.52	9.72	20.83	8.04	8.13	11.04
Retouched blades	14	5	46.78	15.76	19.39	5.65	7.43	16.47
Retouched flakes/ indeterminate fragments	81	35	38.21	13.11	33.84	10.24	10.89	4.07
Notches	36	29	38.14	14.57	36.79	13.55	12.40	5.07
Denticulates	28	16	49.07	18.89	39.98	14.19	15.12	4.35
Splintered pieces	225	248	28.15	10.11	22.90	10.08	9.40	26.43
Sidescrapers	16	31	50.70	12.21	39.46	8.66	10.92	4.20
Raclettes	10	17	18.88	5.22	17.74	5.24	5.73	1.42
Abrupt retouched flakes/ indeterminate fragments	11	6	25.65	8.74	15.99	7.53	5.75	2.88
Retouched bladelets	4	1	25.80		9.73		1.80	
Total	527	470						

- 30 *Raclettes* are few and some abrupt retouched flakes/indeterminate fragments could likewise be *raclettes* being manufactured or fragmented. Moreover, *raclettes* are made of flint and show regular transverse sections and few negatives. Their thicknesses and type of retouch coincide with those from truncated pieces (Table 8), so it is probable that *raclettes* come from reduction and/or intentional fracture of truncated pieces (Fig. 9 No. 14). As for the rest of the tools, they show a high formal variability and combination, thus 35% of *raclettes* show splintered edges (Fig. 9 Nos 7, 8, 11, 12). Almost 20% of the tools show several retouched edges, maybe as a result of recycling and/or improving prehension without hafting.
- 31 Tools are mainly made on quartzite and flint predominates only in burins, *raclettes*, abrupt retouched flakes/ indeterminate fragments and retouched bladelets, and several types of flint are used for this purpose. Burins join the highest flint variability of the assemblage and almost all the raw materials have been splintered (Table 7). Flint is almost never used for large tools such as sidescrapers, denticulates or notches. On the contrary, quartzite is not used for small tools such as retouched bladelets or *raclettes* and it is very little used in burins and abrupt retouched flakes (Table 8 and Fig. 7). Cortex index (~32%) is similar to unretouched blanks and it is only absent in retouched bladelets. There is a statistical association between tools and blanks ($X^2(3) = 68,307, p < 0.000$) as they concentrate on flakes (79.43%), and indeterminate fragments are the most retouched group (45.22%, Fig. 7).
- 32 Definitely, the raw material procurement area is basically local under 5 km (92%) and it is focused on quartzite (77%) collected from the main river stream, the Cares River, less than 1 km away. Its knapping quality is very good, given the fact that it is possible to guide the knapping process and obtain large to small flakes and blades whereas local flints contain more natural fractures and impurities, and so a higher random breakage pattern. Moreover, the intensity of the production in local flint is lower, because these raw materials are rarer in the main alluvial catchment area. Non-local flints make mobile toolkits, and bladelets production increases as a way of technological investment. Flaking schemes are simple and focused on square flakes that are randomly converted into tools. Only measurements discriminate between tools: biggest flakes for common tool types and blades/smaller flakes for the rest. Splintered pieces are *broad spectrum* tools because they cover all the sizes and raw materials. Given the general low

amount of shatter and the fact that splintering generates high shatter density, we hypothesize that flaking and retouching must have been done in another area of the site.

Bone industry assemblage

- 33 The bone industry assemblage consists of 108 pieces. Antler (50%) dominates over bone (~30%) and animal teeth (~15%) as raw materials. There are more typological (~70%) than technological pieces and this could be due to the fact that we have based the present study on the bone industry selected in the field and inventory lists. A preview in B-6 has delivered 5 new antler technological pieces included here, so the whole faunal assemblage still has to be re-examined (Table 9).

Table 9. – Llonin Cave (Peñamellera Alta, Asturias, Spain), Galería, level II: bone assemblage general composition.

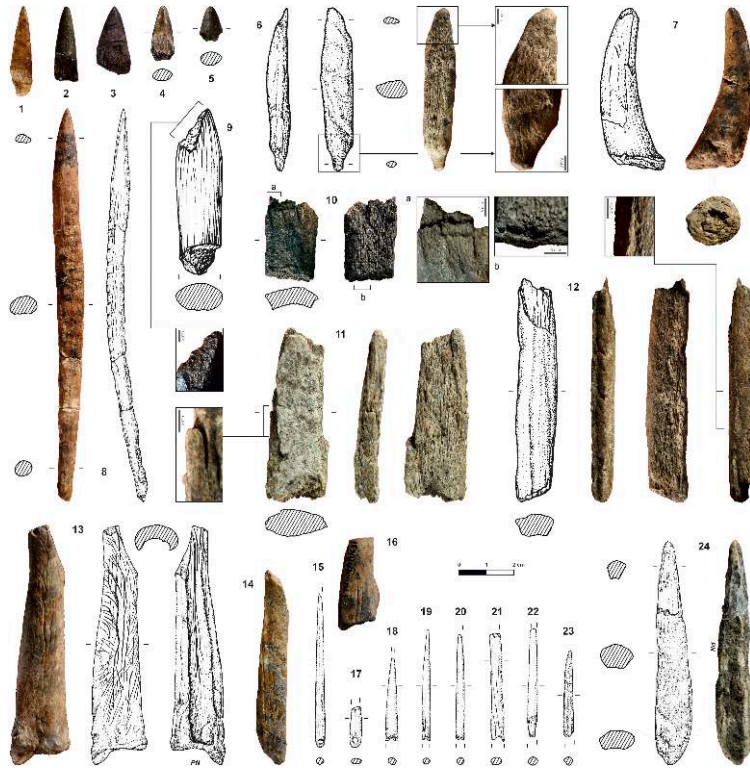
	Antler	Bone	Antler or bone	Tooth	Total
Unworked technological pieces					
Waste products	5				5
Scraped pieces		4	1		5
Tines	4				4
Partially worked splinters					
Point preforms		1			1
Indeterminate preforms	3	3			6
Finished objects					
Projectile points	38		1		39
Rods	2				2
Needles		6			6
Awls	2	1			3
Ellipse	1				1
Pendants		2		16	18
Engraved pieces					
Non-figurative engravings		6			6
Technical engravings		12			12
Total	55	36	1	16	108

Assemblage composition and preservation

- 34 Bone objects are distributed all over the level, with a slight concentration in the intermediate and final layers, as is the case for the outstanding pieces. On the contrary, the surface distribution shows a high number of objects in B-6 ($n = 15.5$ pieces/sub-square on average) in comparison with the rest (2 pieces/sub-square on average).
- 35 The assemblage is highly broken (91%): 12 pieces show post-depositional or dry fractures, 8 projectile points show tongued fractures, 10 awls and pendants are broken in their active zones (use) and the rest (excluding the indeterminate fractures) are intentional. These ones are related to the technological knapping process, the reuse of the points and the general bone breakage pattern exposed above. We have only refitted

2 point fragments (saw-tooth fracture), which come from the same square, sub-square, and layer (-135 m, B-4). The distance between them was under 30 cm (Fig. 10 No. 8).

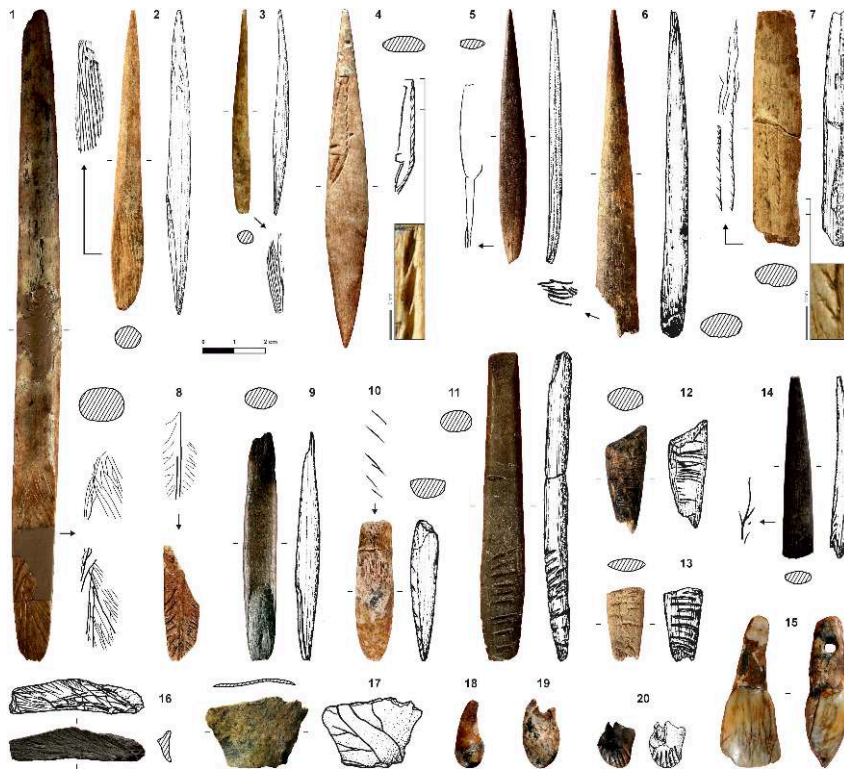
Fig. 10. – Llonin Cave (Peñamellera Alta, Asturias, Spain): bone toolkit and technology.



1, 2, 3, 4, 5: Projectile points' distal fragments. **6:** Antler splinter with lateral scraping, *base raccourcie* and flattened distal end. **7:** Tine with transversal detaching marks. **8:** Point-based point with rectilinear proximal end. **9:** Rod with truncated distal end. **10:** Antler waste product with bifacial splintered fractures. **11:** Antler waste product with long lateral crack. **12:** Antler splinter with partial lateral scraping. **13:** Decorated bone, possibly recycled from a needle/awl matrix. **14, 16:** Bones with parallel lines, possible needle/awl matrix. **15, 17, 18, 19, 20, 21, 22, 23:** Needles. **24:** Bone splinter for projectile point/awl. *PN:* percussion notch.

- 36 The average preservation is good, but most of the pieces show alterations related to fire activities, such as colorations, ash coatings, fissures and thermal cracks. Anyway, very few seem to have reached calcination (Stiner *et al.* 1995, Lebon 2010) (Figs. 10 and 11).

Fig. 11. – Llonin Cave (Peñamellera Alta, Asturias, Spain): bone toolkit and decorative/use engravings, pendants and portable art.



PROJECTILE POINTS, PLACARD TYPE: **2, 3, 9:** single-beveled points with technical lines/scraping (No. 9 recycled). **4, 5:** rhomboidal-type point-based points with *pseudoexcisa* decoration (No. 5 probable). **6:** distal fragment point with fine transversal fine lines. **10:** single-beveled point with oblique line. **11, 13:** flattened proximal end point with transversal incisions. **12:** proximal end point with transversal fine lines. **14:** point with carenated distal end and sharp edges with ramiforme engraving. **ROD:** **7:** rod with *pectiniform* engraving. **PENDANTS:** **15:** Herbivore incisive; **18, 19, 20:** Red deer canines. **DECORATED BONES:** **16:** Multiple lines engraving. **17:** ramiform engraving.

Photos Javier Fortea for Nos 1, 2, 5, 6, 7, 11, 13; Elsa Duarte for Nos 3, 4, 6, 8, 9, 10, 12, 14, 15-20. Drawings Elsa Duarte, except No 4: Alba Fernández Rey.

- 37 The differential burning is not focused on a typo/technological group or any raw material category, so we explain this as a random abandon of the pieces in the Gallery where fireplaces are placed all around the ground. Moreover, root etching and microfauna gnawing are very rare, apart from dissolution pits, desquamations, roundings and concretions that concentrate in the wall areas. This is further evidence in favor of the level's good preservation.

Blank production

- 38 Concerning the manufacturing process, antler dominates over bone and teeth (Table 9). There are no beams or defining anatomical parts to distinguish red deer from reindeer. Given the existence of red deer bones and canines at the site and the limited number of identified reindeer specimens in the Solutrean-Badegoulian-Magdalenian sites in the Cantabrian Region (Gómez-Olivencia *et al.* 2013), we suppose it is *Cervus elaphus* antler. The compact tissue ranges between 4 and 6.5 mm in the case of waste products and preforms, with little modification in cortical tissue. Nevertheless, it is more variable for the final products despite a higher concentration around 5 to 6.5 mm, because some pieces are thinner (~4 mm) and others (n = 5) are very thick (7-10 mm).

- 39 There is a lack of technological pieces (splinters) longer than the complete antler finished objects, and partially worked blanks are again shorter than finished objects. Within these preforms and waste products, there are 8 pieces obtained by knapping and 2 of them show diffuse notches. The other 6 objects show both lateral edges in oblique position, with a burr that runs along these edges next to the cortical tissue and a layered profile (Fig. 10 Nos. 10, 11, 12). In one piece (Fig. 10 No. 11), a crack runs along one of the steps that form the layered profile. It seems to be the result of applying hard force in order to split the blank, following the long axis of the antler, and not the result of scraping. So we tend to interpret these features as the use of splintered pieces in the knapping process (Rigaud 2004) such as *coin-fente* (David 2004). The large number of lithic splintered pieces and the variety of forms and measurements reinforce this possibility and it seems to be in relation with other type of actions such as *coin-éclat*, *coin-éclat-fente* and *cassure sur enclume* (David 2004). Moreover, even detaching and flattening could have been carried out by using splintered pieces. For example, a waste product resembles a lithic splinter and bears transverse fractures with a bifacially layered form and a medial salient area between both faces. It seems to have been laterally reduced with the aid of splintered pieces (or thick flakes resulting from the use of splintered pieces) and detached by bending (Fig. 10 No. 10). Moreover, a tine shows deep and short incisions with V section, serrated profile and saw-tooth fracture, as a result of using splintered pieces for transversal detaching by knapping (Fig. 10 No. 7). There are four small tine fragments with tongue fractures.
- 40 Once the blanks obtained, the cortical and inner parts would be flattened by scraping, maybe starting by the lateral edges as we can see in two pieces, one unfinished (Fig. 10 No. 12) and another reconverted into a tool (Fig. 10 No. 6). It bears scraped lateral edges, and the distal long bending fracture seems to have been rectified and maybe used as spatula, whereas the proximal end is *raccourci* and was maybe used as it has been proposed for Cuzoul de Vers (Le Guillou 2012). Antler finished objects usually bear spongy areas and scraped long sides with barely rounded sections so there is a lack of straightening of the edges, profiles and surfaces. Moreover, final polishing is barely used. Nevertheless, bone objects such as needles are highly worked and polished. Recycling process abounds and for example four points' distal ends show renewed oblique scrapings and another point shows a broken distal end in the process of being flattened and resharpened/pointed (Fig. 11 No. 9).
- 41 The bone products cover a large morphological variety (Table 9), but the whole *chaîne opératoire* lacks. We have ruled out 42 bones with short and fine engraved marks as possible cut marks. These are ribs, scapulae and long bone fragments, between 20 and 60 mm in maximum length. Taking this as a small sample, does it represent a measurement template in bone breakage pattern intended for combustion tasks?
- 42 A selection of twelve long bones fragments (3-6 mm thick) show parallel lines (separated by 1.7 to 5 mm); they could be outlines or fragments of awl/needle production (Fig. 10 Nos. 14, 16). Thus, needles are 2 to 4 mm thick and 3 to 5 mm wide and two bone fragments would fit perfectly, whereas other tightly lined bones could be related to meat filleting (Castel 2012). Moreover, there is a metatarsus fragment split by percussion with parallel lines on its two faces. Given the irregularity of the lines, it could have been rejected as a preform and so restructured into a tool. It has scraped sides and the distal end has been scraped and polished/used. In addition, there is a

possible but irregular use-break, so its use is enigmatic; it could fit as a handle or receptacle or even be decorative (Fig. 10 No. 13).

- 43 Another long bone fragment obtained by knapping has been converted into a sort of projectile point/awl. It has rectilinear convergent edges and the proximal end has been flattened by bifacial scraping, drawing a rounded form and so a general lozenge-shaped silhouette. The distal end is slightly rounded, maybe by use. There is strong measurement relationship between this preform (length 81 mm; width 14 mm; thickness 8 mm) and a lozenge-shaped point-based point (length 80.69 mm; width 8.89 mm; thickness 4.68 mm) (Fig. 10 No. 24; Fig. 11 No. 4), it could imply a direct reduction pattern. So the highly fire altered point-based point could be made of bone rather than antler as we had previously supposed (Duarte *et al.* 2014).

Finished objects

- 44 The group of projectile points consists of 39 pieces. The distal and mesio-distal fragments (n = 20, 53.84%) dominate over the rest and some of them are very short and show tongue fractures. There are no longitudinal fractures. The sections vary between oval, rounded and biconvex (Fig. 10 Nos. 1-5, 8; Fig. 11 Nos. 1-14). Biconvex section points are usually distal fragments that have also been documented in Cuzoul de Vers; the origin of the break and the type of point they belong to are uncertain (Le Guillou 2012). Maybe these points were recovered with the game and the mesio-proximal fragments were recycled (Fig. 11 No. 9). In general, projectile points have rectilinear profiles –except for the long refitted point (Fig. 10 No. 8)– and diverse lengths for complete pieces (Fig. 10 No. 9). They have diverse silhouettes related to base types and sections. Thus single bevels show rectilinear silhouettes and rounded sections; flattened proximal end have lanceolate silhouette and oval section; pointed bases show forms that vary between lanceolate or rhomboidal and oval-biconvex sections. This has led us to propose six main templates, taking into account the maintenance/recycling processes and the fragmentary state of the assemblage:

- Point-based point (Fig. 11 No. 12);
- Point-based point with rectilinear proximal end (Fig. 10 No. 8);
- Rhomboidal-type point-based point (Fig. 11 No. 4);
- Flattened proximal end point with transverse incisions (Fig. 11 No. 11);
- Single-beveled point (Fig. 11 No. 1);
- Point with crenated distal end and sharp edges (Fig. 11 No. 14).

- 45 It is curious that the rhomboidal-type point-based point are complete and decorated, so we hypothesized that they could be awls rather than projectile points, such as other with similar profile from Cuzoul de Vers (Le Guillou 2012). Could they otherwise be symbolic?
- 46 Rods are only two and they can be separated by their width and flattened section. They are broken (transverse-mesial) and their inferior faces are only scraped/abraded and lack oblique lines. One of them has a complex fracture and the opposite end shows a retouch, similar to a truncation (Fig. 10 No. 9; Fig. 11 No. 7).
- 47 Needles are broken at the hole, except for one. They show small round sections with a flattened proximal end and sharp edges (Fig. 10 Nos. 15, 17-23). Their width is different from the projectile points (~2-5 mm versus >5~15 mm), but from the three medial fragments (3-5 mm), provisionally awls. Their profile is rectilinear and rectified by

polishing. The marginal fractures are very short-tongued, as a result of use or post-depositional processes. The length/width relationship shows that some of them could have been recycled (Fig. 10 Nos 10 and 18). They also show intense scraping in the distal ends. A decoration on the irregular awl stands out, made by oblique short lines that could help sewing, hafting, etc. (Fig. 10 No. 23).

- 48 There are three pendants made on herbivore teeth with perforation in the root (Fig. 11 No. 15). Red deer stags canines are perforated as well, one is decorated but partially broken, and hind red deer canines show fine transversal marks at the root as possible hafting means (Fig. 11 Nos. 18-20). There are two perforated bone fragments, but one of them is doubtful.
- 49 We have recorded several types of engravings, functional and/or decorative. For the projectile points, the “pike bevel” typical of Le Placard site (or *tipo Placard*: Utrilla 1981) stands out; it was recovered in other sites with similar culture/chronology such as Rascaño, Castillo, La Paloma, Lumentxa, El Gato 2 or Parpalló for the Iberian Peninsula. At Llonin Gallery, we find two types: one consists of two pairs of short oblique lines, one from left to right and the other the opposite, with long central line/s (Fig. 11 No. 8). The second consists of an irregular and linear beam, composed of longitudinal lines on the left and oblique lines on the right, all of them being convergent in the distal end (Fig. 11 No. 1). At the same time, there are other bevels with a less complex drawings such as parallel oblique lines, fine oblique-transverse lines, transverse mid-long incisions or intense scraping. All of them are rather ubiquitous in the Upper Paleolithic, but more numerous at least in the Cantabrian Solutrean and Archaic Magdalenian/Badegoulian (Utrilla 1981, Corchón 1986) (Fig. 11 Nos. 2-3, 6, 9-13).
- 50 A bi-pointed piece shows an animal-like figure made by the engraving technique known as “pseudo-excise” (Barandiarán 1967 and 1973, Utrilla 1986, Duarte *et al.* 2014). From a morphological point of view, it consists of a series of short incision-like tracings (2 mm long × 1 mm wide on average), with an asymmetric V-shaped inner section on its long axis and a U-shaped section on its short axis. These tracings are organized in two ways, completely joined in the short axis or in oblique, touching the vertex and the short end (Fig. 11 No. 4, and probably No. 5).
- 51 So the defining features are:
- Series of short lines;
 - Each line is linked to the other by the width edge or by one vertex;
 - Each stroke shows an asymmetric V-shaped longitudinal section.
- 52 The technological process is tentatively determined; it would consist of the antler uplifting by each tracing, but experimentation is in process. Moreover, a similar technological process has been proposed for an Epigravettian bone of Poiana Ciresului (Romania) (Cârciumaru and Tutuianu-Cârciumaru 2009).
- 53 A mesial rod has a doubled pattern consisting of a long line combined with a series of transverse-oblique short tracings or “pectiniform” (Corchón 1986, Duarte *et al.* 2014) (Fig. 11 No. 7).
- 54 These functional/decorative designs are recorded in other sites and other similar patterns are added, like the series of longitudinal short tracings (i.e. Cuzoul de Vers, Le Placard). These combinations of short lines or with a long line seem to start in this period, making more complex the transverse short incisions series that are typical of

Solutrean times and abundant in, for example, Llonin level IV. In Llonin level III, a bone fragment preserves a similar series of incisions but in an irregular outline.

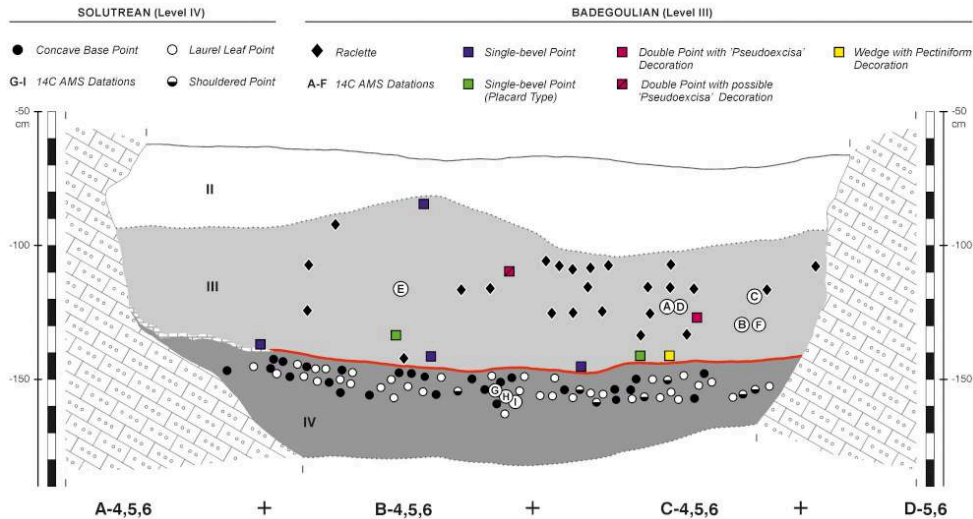
- 55 Finally, there are three bone fragments with more complex decoration:
- Undulated line or “serpentine” on a projectile point and a scapula fragment (Fig. 11 Nos. 14, 17): although broken, they seem to be vegetal patterns observed in this period (Duarte et al. 2014);
 - Groups of short incisions similar to Magdalenian short lines for drawing an animal silhouette;
 - Small rib fragment with several, irregular and interweaved lines; it could belong to the multiple and striated lines engravings (Fig. 11 No. 16). Although it is doubtful because it is a small fragment, it would be the only evidence of this engraving technique in portable art. On the other hand, in the Principal Rock art panel in Llonin’s cave (Panel Principal) there are several hinds engraved with this technique/style (Fig. 3A).

Level III functionality and spatial distribution

- 56 While we await the results of the microstratigraphy, organic/inorganic soil constituents, fauna, charcoal and the use wear analysis, just to define the main on-site activity, we may highlight some elements about the level functionality that agree really well with a specialized activity.
- 57 Comparing all the site levels, it is clear that level III has a different characteristic. It is a generalized combustion area that was covered by spreading iron oxides before the beginning of the occupation (Fig. 4); this practice continued in some specific areas. The presence of iron oxides in Paleolithic sites is well known, as well as the combination of fire (hearth) and iron oxides. For example, among many others, the French Cuzoul de Vers rock shelter (Clottes *et al.* 2012) or the South African Sibudu Cave (Golberg *et al.* 2009).
- 58 Along with the massive presence of charcoal, ashes and iron oxides, the transport to the site of quartz-arenite and sandstone pebbles (~750 pieces/~200 kg) is also relevant and extended all around the excavated area (~5 m²). They are usually burnt, fractured/fissured and dehydrated to different degrees (but not calcined): their heat exposure and their spatial distribution show that they were exceptionally used to structure hearths but rather as “hot stones”: to maintain room temperature, to make vapour or smoke?
- 59 Another remarkable association contributes to support this evidence: faunal remains are abundant. Their manipulation through lithic and bone tools is intensive, from hunting to charcoal. Several domestic tasks would have been developed such as disarticulation, defleshing and intensive breaking, fur treatment (there are awls and needles), drying and/or smoking meat. The large amount of common tool types and mostly splintered pieces would serve these purposes as well as the preparation of wood and bone charcoal. Moreover, distal projectile points would have been recovered with the game. Non-utilitarian activities are absent. Several pendants and decorated objects are also in connection with the domestic sphere and the *Mustelidae*-type “pseudo-excise” decoration point could be related to *Mustelidae* clothing, extremely useful in changing climate contexts (Collard *et al.* 2016).
- 60 The distribution of the archeological record shows that Badegoulian lithic or bone typical tools are distributed all around the level III, confirming its homogeneity.

Solutrean tools have an ample distribution through the level IV and there are no interstratigraphic contaminations with the upper level (Fig. 12).

Fig. 12. – Llonin Cave (Peñamellera Alta, Asturias, Spain): datation samples and main lithic and bone tools from level III (Badegoulian) and lithic points from level IV (Solutrean) projected in the stratigraphy.



The Solutrean projected points come from the two first layers of that level just to illustrate its organisation next to the level III base. The levels and the artefacts are both projected over cave level 0 and over the maximum upper limit of level III and the lower limit of level IV (dotted line). The limit between both levels is uniform in squares A and B, while in squares C it is represented in the square C4 where the intersection reaches higher depth. The projected *raclettes* are the best examples, but there are some more in the collection distributed all over the level. A, B, C, D, E, F, G, H, I: samples references for ^{14}C AMS datations –see Table 10.

Chronology

- 61 The dating is coherent (Table 10). Usually the samples were taken in the middle part of the level, to avoid contaminations from adjacent levels (Fig. 12). Focusing on the Badegoulian dates, they range between 18,400-17,500 years BP uncalibrated, so they are between the end of Older Dryas and the beginning of the Lascaux Interstadial. In the first phase, cold conditions were really significant with lower humidity compared with the previous phase (Laugerie Interstadial); the second phase was characterized by relatively “cool” conditions and a marked humidity. It is relevant to consider that usually the upper part of the levels corresponding to the Older Dryas have suffered from erosion processes caused by the increase of humidity during Lascaux, losing the information about that part of the sequence; in the last period mentioned the erosions, fluvial or flood deposits, are also present with the corresponding implications (Hoyos 1994 and 1995, Rasilla and Straus 2004).

Table 10. – Llonin Cave (Peñamellera Alta, Asturias, Spain): ¹⁴C AMS datations of Llonin Badegoulian and Upper Solutrean (Aura *et al.* 2012 and 2014, Bronk-Ramsey *et al.* 2015). Calibration IntCal 13 dataset (*Radiocarbon* 55 (4), 2013).

Fig. 12 sample reference	Sample number	Laboratory number	Date BP	SD	Material	Cal age BP (95%) [0 = AD 1950]	Cultural phase
A	LLO-71	OxA-26042	17480	75	<i>Ericacea</i>	21520–20734	Badegoulian
B	LLO-70	OxA-26041	17610	90	<i>Ericacea</i>	21630–20950	Badegoulian
C	LLO-68	OxA-26338	17650	130	<i>Juniperus</i>	21628–21045	Badegoulian
D	LLO-71	OxA-26340	17920	80	<i>Juniperus</i>	21540–21903	Badegoulian
E	LLO-31	OxA-X-2559-11	18100	90	Bone	22241–21660	Badegoulian
F	LLO-69	OxA-26339	18345	75	<i>Fabacea</i>	22418–21954	Badegoulian
G	LLO-28	OxA-22700	19300	110	Bone	23460–22900	Upper Solutrean
H	LLO-27	OxA-22699	19330	100	Bone	23460–22980	Upper Solutrean
I	LLO-26	OxA-22698	19480	110	Bone	23550–23190	Upper Solutrean

62 Looking at the Cantabrian region sites involved in the above named interval radiocarbon dating, for instance: Las Caldas (levels: II-XIVc, Pasillo 3, I-11, Pasillo 7), Mirón (level 313), Aitzbitarte IV (level III), Altamira (level 6) and Las Aguas (level C2 and Hogar Inferior sector 3) (Aura *et al.* 2012: 70, Aura *et al.* 2014, Rasines del Río 2016: 113 and 139, Muñoz and Montes 2016: 802), we clearly verify that the sedimentological and taphonomical processes are disturbing the cultural attribution of the archaeological record. Fortunately, Llonin's level III didn't suffer such disturbances because of its particular location in a protected gallery (Fig. 2), so we expect that the evidence is correct.

Discussion

63 Actually the debate revolves around the features of Solutrean/Magdalenian transition (~18,300-17,000 BP). Utrilla (2004) perfectly summarized the Magdalenian historiographical development in the Cantabrian Region, taking into account the research of Bosselin and Djindjian (1999, 2000) because they include the term Badegoulian in the sequence together with its general features. Besides the precisions added to that proposition, we may stress its significance now, because it renews a chrono-stratigraphy and a cultural systematization between the Solutrean and the Magdalenian (Utrilla 2004: 254).

64 Nevertheless, those *facies*/phases allow us to make out a changing cultural phase during a climate instability and therefore the existence of derived sedimentological processes that in many cases create biases in the archeo-stratigraphic levels' integrity. Moreover, soil morphology at the end of the Solutrean is normally irregular. The sediment is full of cryoclasts (Hoyos 1994 and 1995, Rasilla and Straus 2004), so tools belonging to next cultural groups would fill the remaining interstices. In the same way, trampling would make Solutrean previous tools come up into the upper level. Finally, different natural processes like removal, percolation, leaching and erosion would end up producing disruptions and interstratigraphic contaminations within these levels. That is why it is sometimes difficult to conclude that a particular collection belongs to one or another period. In Llonin case, the stratigraphic discontinuity is drastic, anthropically driven and isolated from this natural dynamics, so cultural mixing is to be rejected but for potential refits.

65 What does Llonin level III (Galería) tell us?

- When the level is not disrupted and the occupational rate is intense (long stratigraphy and abundant archeological remains), there is a complete and specific lithic and bone assemblage.
- Despite the site's particular functionality, general features of the period are present: absence of flat and bifacial retouch and lithic projectile points, predominance of common tool types –including splintered pieces–, scarce bladelet production and microlithic tools, presence of *raclettes*, existence of antler single-beveled points, some of them of the Placard type, with a predominance of oval sections and pieces with “*pseudo-excise*” decoration, absence of art in non-utilitarian objects.
- Particularly here and generally in Asturias, the frequency of quartzite as main raw material is very important. Flaking is simple (orthogonal-centripetal) and it is focused on flake production. Nevertheless, non-local flints (from up to 200 km away) are carried to the site from both sides (western/eastern) of the Cantabrian Region as mobile toolkits, and in this case blade-bladelet production is notorious and entails a higher investment than local flints.
- Bone industry is made by percussion and not by grooving.
- The chronology dates fairly well the typo-technological change (or the change process) between the Solutrean and Magdalenian: 18,000-17,000 BP in round figures.
- As a hypothesis, the archeological sequence and its correlation with the rock art could modify, but just a little, the cultural assignation –at least the beginnings– of a specific and unique kind of rock engravings –and portable art?– found on the cave walls (Rasilla 2014: 116).

66 Therefore, are these elements enough to describe a cultural period? Are they different enough from previous and following periods? For us, Llonin level III contains more specific typological features –basically determined by the absence of– than those belonging to the Solutrean or the Magdalenian. These specificities can be related to the French and Iberian (for the moment less known) Badegoulian, as defined in cultural terms. Chronologically, it is also in relation to this period (Aura *et al.* 2012, Banks *et al.* 2011, Ducasse *et al.* 2014, Rasilla 2005, Raynal *et al.* 2014) and it is older than the Initial or Archaic Magdalenian (Straus *et al.* 2014, Utrilla *et al.* 2012).

67 In technological terms, Llonin level III would be defined by flaking and retouching simplification and microlithic discard. Obviously, the lithic variability is strong in comparison with other sites, because the raw material dimensions and quality are highly diverse. Anyway, it is more variable than in Solutrean or Magdalenian periods, given the higher normative and/or standardized characteristic of microlithic and microlaminar production and tools, and also for the antler grooving technique *versus* percussion. Overall tool groups are also in this fast-making dynamics. This technological change seems to overtake Llonin site's specificity and it takes part in all the technological and toolkit change (Aura *et al.* 2012, Banks *et al.* 2011, Borao *et al.* 2016, Ducasse 2010, Langlais *et al.* 2010, Pétillon and Ducasse 2012, Utrilla 2004, Utrilla *et al.* 2012). As to splintered pieces and bipolar reduction, it has been proposed as a more efficient utilization of raw material (Pargeter and Eren 2017) and an increase has been detected in other areas during the LGM as a technological response to climate instability and precarious access to raw materials (Marwick *et al.* 2016). Here these aspects need to be assessed, together with the whole archeological assemblage's data.

68 In this unsteady atmosphere, we may bring to discussion how the relationship took place between, on the one hand, the size of the population and the kind of connections

and the development of cultural accumulation and complex technologies (at least the change processes) and, on the other hand, climate and environmental variables in the distribution of human populations and its social and cultural evolution (Ducasse 2012, Burke *et al.* 2014 and 2017, Barton *et al.* 2018, Derek and Boyd 2016, Kobayashi *et al.* 2016, Schmidt *et al.* 2012).

- 69 Finally, it would be advisable to analyze again, with a new look, some levels located in the part of the archeological sequence that concerns us from sites like Las Caldas, Cova Rosa, Cueto de la Mina, La Riera, Rascaño, Antoliña and Aitzbitarte IV. If so, we could weigh the sedimentological, taphonomical and toolkit information to definitely precise its cultural attribution or the problems that make it difficult or prevent it (Rasilla and Duarte 2017).

Conclusions

- 70 In our opinion, the main question is not the term used (Archaic, Initial Magdalenian or Badegoulian) to define what is going on in the Cantabrian Region during the period we are considering. The point is that now we can better explain those problematic levels in the final part of the Solutrean or in the beginning of the Magdalenian. There are environmental (climate and sedimentological), taphonomical and cultural (techno-typological change) combinations that mess up the archeological information and, sometimes, confound researchers. In this case, depending on the Solutrean or Magdalenian “eyes” of the participants, the prevalence of the cultural attribution goes on one or the other direction.
- 71 We think that Llonin clarifies sufficiently the main lines of the cultural development that coincides with shocking climatic episodes: the rattling of the LGM, at least in the Cantabrian region, continued by a real increase in humidity. Despite its main functionality, there are distinguishing elements equally observed, with their particular territorial specificities, in the same European and Iberian chronological context. Nevertheless, besides the conclusion of all the studies around this level and weaving all the data of what seems an isolate case in the Cantabrian general geological dynamics, the study of other sequences and their stratigraphic problems will allow us to better define the transition and evaluate its uni/multistep characteristics and the relationship with the possible French primary core and the Mediterranean world.

BIBLIOGRAPHY

AURA J.E., TIFFAGOM M., JORDÁ J.F., DUARTE E., FERNÁNDEZ DE LA VEGA J., SANTAMARÍA D., RASILLA M. de la, VADILLO M., PÉREZ RIPOLL M., 2012, The Solutrean–Magdalenian Transition: a view from Iberia, *Quaternary International* 272–273, 75–87.

- AURA J.E., RASILLA M. de la, SANTAMARÍA D., DUARTE E., JORDÁ J.F., PÉREZ RIPOLL M., SANCHÍS A., CARRIÓN Y., WOOD R., 2014, New dates for the Iberian Badegoulian: data from Cantabrian and Mediterranean regions, in: *Abstracts Book XVII World UISPP Congress, Burgos 1–7 september 2014*, pp. 250–251.
- BANKS W.E., AUBRY T., D'ERRICO F., ZILHÃO J., LIRA-NORIEGA A., PETERSON A.T., 2011, Eco-cultural niches of the Badegoulian: Unravelling links between cultural adaptation and ecology during the Last Glacial Maximum in France, *Journal of Anthropological Archaeology* 30, 359–374.
- BARANDIARÁN I., 1967, *El Paleomesolítico del Pirineo occidental*, Zaragoza, Universidad de Zaragoza (Monografías Arqueológicas, 2).
- BARANDIARÁN I., 1973, *Arte mueble del Paleolítico cantábrico*, Zaragoza, Universidad de Zaragoza (Monografías Arqueológicas, 14).
- BARTON C.M., AURA J.E., GARCÍA-PUCHOL O., RIEL-SALVATORE J.G., GAUTHIER N., VADILLO M., POTHIER G., 2018, Risk and resilience in the late glacial: A case study from the western Mediterranean, *Quaternary Science Reviews* 184, 68–84.
- BORAO M., VILLAVERDE V., AURA J.E., 2016, Debitage by fracturing in the osseous industry of Cova del Parpalló (Gandía-Valencia, Spain): A preliminary study, *Quaternary International* 403, 118–131.
- BOSSELIN B. and DJINDJIAN F., 1999, Une révision de la séquence de la Riera (Asturies) et la question du Badegoulien cantabrique, *Bulletin de la Société préhistorique française* 96(2), 153–173.
- BOSSELIN B. and DJINDJIAN F., 2000, Le Badegoulien en Europe sud-occidentale : faciès régionaux, paléoenvironnement et filiations, in: *Actas III Congreso de Arqueología Peninsular, Vol. II : Paleolítico de la Península Ibérica*, Oporto, ADECAP, pp. 363–401.
- BRONK-RAMSEY C., HIGHAM T.F.G., BROCK F., BAKER D., DITCHFIELD P., STAFF R.A., 2015, Radiocarbon dates from the Oxford AMS system: Archaeometry Datelist 35*, *Archaeometry* 57(1), 177–216.
- BURKE A., LEVAVASSEUR G., JAMES P.M.A., GUIDUCCI D., IZQUIERDO M.A., BOURGEON L., KAGEYAMA M., RAMSTEIN G., VRAC M., 2014, Exploring the impact of climate variability during the Last Glacial Maximum on the pattern of human occupation of Iberia, *Journal of Human Evolution* 73, 35–46.
- BURKE A., KAGEYAMA M., LATOMBE G., FASEL M., VRAC M., RAMSTEIN G., JAMES P.M.A., 2017, Risky business: The impact of climate and climate variability on human population dynamics in Western Europe during the Last Glacial Maximum, *Quaternary Science Reviews* 164, 217–229.
- CÂRCIUMARU M. and TUTUIANU-CÂRCIUMARU M., 2009, Étude technologique effectuée à l'aide du microscope digital VHX-600 sur un os gravé épigravettien de l'habitat de Poiana Ciresului-Piatra Neam, *Annales d'Université "Valahia" Targoviste* XI, 7–22.
- CASTEL J.-C. 2012, Archéozoologie, in: Clottes J., Giraud J.-P., Chalard P. (Eds.), *Solutréen et Badegoulien au Cuzoul de Vers : des chasseurs de rennes en Quercy*, Liège, Université de Liège (ERAUL, 131), pp. 209–268.
- CLOTTE J., GIRAUD J.-P., CHALARD P. (Eds.), *Solutréen et Badegoulien au Cuzoul de Vers : des chasseurs de rennes en Quercy*, Liège, Université de Liège (ERAUL, 131).
- COLLARD M.T.L., SANDGATHE D., ALLAN A., 2016, Fauna evidence for a difference in clothing use between Neanderthals and early modern humans in Europe, *Journal of Anthropological Archaeology* 44, 235–246.
- CORCHÓN M.S., 1986, *El arte mueble paleolítico cantábrico: Contexto y análisis interno*, Santander, Ministerio de Cultura (Monografías del Centro de Investigación y Museo de Altamira, 16).

- DAVID É., 2004, Transformation des matières dures d'origine animale dans le Mésolithique de l'Europe du Nord, in: Ramseyer D. (Ed.), *Industrie de l'os préhistorique*, cahier XI : *Matières et techniques*, Paris, Société préhistorique française, pp. 113–149.
- DEREK M. and BOYD R., 2016, Partial connectivity increases cultural accumulation within groups, *Proceedings of the National Academy of Sciences* 113, 2982–2987.
- DUARTE E., RASILLA M. de la, AURA E., 2014, La técnica pseudoexcisa en el Badeguliense/Magdalenienense arcaico de Asturias, *Archivo de Prehistoria Levantina* XXX, 27–55.
- DUARTE E., SANTAMARÍA D., FORCELLEDO E., TARRIÑO A., RASILLA M. de la, 2016, El sílex como recurso mineral en la Prehistoria de Asturias, *Cuadernos de Prehistoria y Arqueología de la Universidad de Granada* 26, 11–28.
- DUCASSE S., 2010, *La « parenthèse » badegoulienne : fondements et statut d'une discordance industrielle au travers de l'analyse techno-économique de plusieurs ensembles lithiques méridionaux du Dernier Maximum Glaciaire*, thesis, Toulouse, Université Toulouse II – Le Mirail.
- DUCASSE S., 2012, What is left of the Badegoulian “interlude”? New data on cultural evolution in southern France between 23,500 and 20,500 cal. BP, *Quaternary International* 272–273, 150–165.
- DUCASSE S. et LANGLAIS M., 2007, Entre Badegoulien et Magdalénien, nos cœurs balancent... Approche critique des industries lithiques du sud de la France et du Nord-Est espagnol entre 19000 et 16500 BP, *Bulletin de la Société préhistorique française* 104(4), 771–785.
- DUCASSE S., PÉTILLON J.-M., RENARD C., 2014, Le cadre radiométrique de la séquence solutréo-badegoulienne du Cuzoul de Vers (Lot, France) : lecture critique et compléments, *Paleo* 25, 37–58.
- FONTES L.M., STRAUS L.G., GONZÁLEZ M.R., 2016, Lithic raw material conveyance and hunter-gatherer mobility during the Lower Magdalenian in Cantabria, Spain, *Quaternary International* 412, 66–81.
- FORTEA J., RASILLA M. de la, RODRÍGUEZ OTERO V., 1995, La Cueva de Llonin (Llonin, Peñamellera Alta): Campañas de 1991 a 1994, in: *Excavaciones Arqueológicas en Asturias 1991-94*, Oviedo, Gobierno del Principado de Asturias (Excavaciones Arqueológicas en Asturias, 3), pp. 33–43.
- FORTEA J., RASILLA M. de la, RODRÍGUEZ OTERO V., 1999, La Cueva de Llonin (Llonin, Peñamellera Alta): Campañas de 1995 a 1998, in: *Excavaciones Arqueológicas en Asturias 1995-98*, Oviedo, Gobierno del Principado de Asturias (Excavaciones Arqueológicas en Asturias, 4), pp. 59–68.
- FORTEA J., RASILLA M. de la, RODRÍGUEZ OTERO V., 2004, L'art pariétal et la séquence archéologique paléolithique de la grotte de Llonin (Peñamellera Alta, Asturias, Espagne), *Préhistoire, art et sociétés* LIX, 7–29.
- FORTEA J., RASILLA M. de la, SANTAMARÍA D., MARTÍNEZ L., DUARTE E., FERNÁNDEZ DE LA VEGA J., 2010, El Paleolítico Superior en Asturias en los albores del siglo XXI, in: Mangado X. (ed.), *Jornadas Internacionales sobre el Paleolítico Superior Peninsular: Novedades del siglo XXI. Homenaje al Prof. Javier Fortea*, Barcelona, Universidad de Barcelona (Monografías del SERP, 8), pp. 271–289.
- GENESTE J.-M., 1988, Les industries de la grotte Vaufray : technologie du débitage, économie et circulation de la matière première lithique, in: Rigaud J.-P. (Ed.), *La grotte Vaufray à Cenac et Saint-Julien (Dordogne) : paléoenvironnements, chronologie et activités humaines*, Paris, Société préhistorique française (Mémoires de la Société préhistorique française, 19), pp. 441–518.
- GOLDBERG P., MILLER C.E., SCHIEGL S., LIGOUIS B., BERNA F., CONARD N.J., WADLEY L., 2009, Bedding, hearths, and site maintenance in the Middle Stone Age of Sibudu Cave, KwaZulu-Natal, South Africa, *Archaeological and Anthropological Sciences* 1 (2), 95–122.

- GÓMEZ-OLIVENCIA A., ARCEREDILLO D., ÁLVAREZ-LAO D.J., GÁRATE D., SAN PEDRO Z., CASTAÑOS P., RÍOS-GARAZAR J., 2013, New evidence for the presence of reindeer (*Rangifer tarandus*) on the Iberian Peninsula in the Pleistocene: an archaeopalaontological and chronological reassessment, *Boreas*, 10.1111/bor.12037.
- HISCOCK P., 2002, Quantifying the size of artefact assemblages, *Journal of Archaeological Science* 29, 251–258.
- HOYOS M., 1994, Características sedimentokársticas y paleoclimáticas de los interestadios de Laugerie y Lascaux en la Cornisa Cantábrica, *Férvedes* 1, 21–37.
- HOYOS M., 1995, Paleoclimatología del Tardiglaciario en la Cornisa cantábrica basada en los resultados sedimentológicos de yacimientos arqueológicos kársticos, in: Moure A. and González Sainz C. (Eds.), *El final del Paleolítico cantábrico*, Santander, Servicio de Publicaciones de la Universidad de Cantabria, pp. 15–75.
- KOBAYASHI Y., OHTSUKI I., WAKANO J.Y., 2016, Population size vs. social connectedness: A gene-culture coevolutionary approach to cumulative cultural evolution, *Theoretical Population Biology* 111, 87–95.
- LANGLAIS M., PÉTILLON J.-M., DUCASSE S., LENOIR M., 2010, Badegoulien versus Magdalénien : entre choc culturel et lente transition dans l'Aquitaine paléolithique, in: Mestrot V. (Ed.), *De Néandertal à l'homme moderne : l'Aquitaine préhistorique, vingt ans de découvertes (1990-2010)*, Bordeaux, Confluences, pp. 117–129.
- LE GUILLOU Y., 2012, Premier regard sur la matière dure animale ouvragée, in: Clottes J., Giraud J.-P., Chalard P. (Eds.), *Solutréen et Badegoulien au Cuzoul de Vers : des chasseurs de rennes en Quercy*, Liège, Université de Liège (ERAUL, 131), pp. 279–354.
- LEBON M., 2010, Caractérisation des ossements chauffés en contexte archéologique : étude comparative de matériel moderne et fossile par spectroscopie infrarouge, *Palethnologie* 2, 149–162.
- MARTÍNEZ L., 2015, *El Gravetiense en el sector occidental cantábrico y sus conexiones pirenaicas*, Oviedo, Servicio de Publicaciones de la Universidad de Oviedo.
- MARWICK B., CLARKSON C., O'CONNOR S., COLLINS S., 2016, Early modern human lithic technology from Jerimalai, East Timor, *Journal of Human Evolution* 101, 45–64.
- MUÑOZ E. and MONTES R., 2016, Los datos culturales y su organización crono-estratigráfica: La secuencia crono-cultural de la zona estudiada, in: Lasheras J.A. (Ed.), *Proyecto de Investigación "Los tiempos de Altamira": Actuaciones arqueológicas en las cuevas de Altamira, Cualventi, El Linar y Las Aguas (Alfoz de Lloredo, Cantabria, España)*, Madrid, Ministerio de Educación, Cultura y Deporte (Monografías del Museo y Centro Nacional de Altamira, 26), pp. 793–827.
- PARGETER J. and EREN M.I., 2017, Quantifying and comparing bipolar versus freehand flake morphologies, production currencies, and reduction energetics during lithic miniaturization, *Lithic Technology* 42(2-3), 90–108.
- PÉTILLON J.-M. and DUCASSE S., 2012, From flakes to grooves: A technical shift in antlerworking during the last glacial maximum in southwest France, *Journal of Human Evolution* 62(4), 435–465.
- RASILLA M. de la, 2005, El Solutrense Cantábrico: reflexiones en torno a un diagnóstico recurrente, *Lancia* 5, 33–44.

- RASILLA M. de la, 2014, Los espacios rupestres paleolíticos de la cuenca de los ríos Cares-Deva (Asturias), in: Blas Cortina M.Á. de (Ed.), *Expresión simbólica y territorial: los cursos fluviales y el arte paleolítico*, Oviedo, Real Instituto de Estudios Asturianos, pp. 93–128.
- RASILLA M. de la and DUARTE E., 2017, El final del Solutrense en la región cantábrica, in: *Abstracts Book of the Solutrean: Third International Conference, 12-14 October 2017*, ICArEHB-Universidad do Algarve, p. 53.
- RASILLA M. de la and DUARTE E., 2018, ¿Casualidad o Estrategia? Las aguas termales y minero-medicinales en la configuración de los yacimientos con arte paleolítico de Asturias y su correlato cantábrico, *Nailos* 5, 43–64.
- RASILLA M. de la and SANTAMARÍA D., 2011-12, El Paleolítico Medio en Asturias, *Mainake* XXXIII, 31–62.
- RASILLA M. de la and STRAUS L.G., 2004, El Poblamiento de la Región Cantábrica durante el Último Máximo Glacial: Gravetiense y Solutrense, *Kobie*, series *Anejos* 8, 209–242.
- RASILLA M. de la, SANTAMARÍA D., RODRÍGUEZ OTERO V., 2014, Llonin Cave (Peñamellera Alta, Asturias), in: Sala R., Carbonell E., Bermúdez de Castro J.M., Arsuaga J.L. (Eds.), *Los cazadores recolectores del Pleistoceno y del Holoceno en Iberia y el Estrecho de Gibraltar: Estado actual del conocimiento del registro arqueológico*, Burgos, Universidad de Burgos y Fundación Atapuerca, pp. 663–665.
- RASILLA M. de la, SANTAMARÍA D., DUARTE E., 2015, Asturias en la geografía neandertal y musteriense de la península ibérica, *Espacio, Tiempo y Forma*, series I, *Prehistoria y Arqueología* 8, 237–260.
- RASILLA M. de la, DUARTE E., CAÑAVÉRAS J.C., SANTOS G., CARRIÓN Y., TORMO C., SÁNCHEZ-MORAL S., MARÍN-ARROYO A.B., JONES J.R., AGUDO L., GUTIÉRREZ I., SUÁREZ P., LÓPEZ C., GONZÁLEZ-PUMARIEGA M., 2018, El Abrigo de La Viña (La Manzaneda, Oviedo) 2013-2016, *Excavaciones Arqueológicas en Asturias 2013-2016*, Oviedo, Gobierno del Principado de Asturias (Excavaciones Arqueológicas en Asturias, 8), pp. 107–120.
- RASINES DEL RÍO P., 2016, Cronología de los yacimientos arqueológicos de Altamira, Cualventi, El Linar y Las Aguas (Cantabria), in: Lasheras J.A. (Ed.), *Proyecto de Investigación “Los tiempos de Altamira”: Actuaciones arqueológicas en las cuevas de Altamira, Cualventi, El Linar y Las Aguas (Alfoz de Lloredo, Cantabria, España)*, Madrid, Ministerio de Educación, Cultura y Deporte (Monografías del Museo y Centro Nacional de Altamira, 26), pp. 132–147.
- RAYNAL J.-P., LAFARGE A., RÉMY D., DELVIGNE V., GUADELLI J.-L., COSTAMAGNO S., LE GALL O., DAUJEARD C., VIVENT D., FERNANDES P., LE CORRE-LE BEUX M., VERNET G., BAZILE F., LEFÈVRE D. 2014, Datations SMA et nouveaux regards sur l’archéo-séquence du Rond-du-Barry (Pignac, Haute-Loire), *Comptes rendus palevol* 13(7), 623–636.
- RIGAUD A., 2004, Transformation du bois de renne au Badegoulien : l’exemple de l’abri Fritsch (Indre, France), in: Ramseyer D. (Ed.), *Industrie de l’os préhistorique, cahier XI : Matières et techniques*, Paris, Société préhistorique française, pp. 75–78.
- RISSETTO J.D., 2009, *Late Pleistocene Hunter-Gatherer Mobility Patterns and Lithic Exploitation in Eastern Cantabria (Spain)*, thesis, Albuquerque, University of New Mexico.
- RODA X., MORA R., MARTÍNEZ-MORENO J., 2015, Identifying bipolar knapping in the Mesolithic of Font del Ros (northeast Iberia), *Philosophical Transactions of the Royal Society*, series B 370, 20140354.
- SANTAMARÍA D., 2012, *La transición del Paleolítico Medio al Superior en Asturias: El abrigo de La Viña (La Manzaneda, Oviedo) y la Cueva de El Sidrón (Borines, Piloña)*, Oviedo, Servicio de Publicaciones de la Universidad de Oviedo.

SCHMIDT I., BRADTMÖLLER M., KEHL M., PASTOORS A., TAFELMAIER I., WENINGER B., WENIGER G.-C., 2012, Rapid climate change and variability of settlement patterns in Iberia during the Late Pleistocene, *Quaternary International* 274, 179–204.

STINER M.C., KUHN S.L., WEINER S., BAR-YOSEF O., 1995, Differential Burning, Recrystallization, and Fragmentation of Archaeological Bone, *Journal of Archaeological Science* 22, 223–237.

STRAUS L.G., GONZÁLEZ MORALES M.R., FONTES L.M., 2014, Initial Magdalenian artifact assemblages in El Mirón cave (Ramales de la Victoria, Cantabria, Spain): A preliminary report, *Zephyrus* LXXIII, 45–65.

TARRIÑO A., 2016, Procedencia de los sílex del proyecto Los tiempos de Altamira (yacimientos de Cualventi, El Linar y Las Aguas), in: Lasheras J.A. (Ed.), *Proyecto de Investigación “Los tiempos de Altamira”: Actuaciones arqueológicas en las cuevas de Altamira, Cualventi, El Linar y Las Aguas (Alfoz de Lloredo, Cantabria, España)*, Madrid, Ministerio de Educación, Cultura y Deporte (Monografías del Museo y Centro Nacional de Altamira, 26), pp. 457–476.

TARRIÑO A., DUARTE E., SANTAMARÍA D., MARTÍNEZ L., FERNÁNDEZ DE LA VEGA J., SUÁREZ P., RODRÍGUEZ V., FORCELLEDO E., RASILLA M. de la, 2013, El Sílex de Piloña: Caracterización de una nueva fuente de materia prima en la Prehistoria de Asturias, in: Rasilla M. de la (Ed.), *F. Javier Forzea Pérez, Universitatis Ovetensis Magister: Estudios en Homenaje*, Oviedo, Ediciones de la Universidad de Oviedo y Ménsula Ediciones, pp. 115–132.

TARRIÑO A., ELORRIETA I., GARCÍA-ROJAS M., 2015, Flint as raw material in prehistoric times: Cantabrian Mountain and Western Pyrenees data, *Quaternary International* 364, 94–108.

UTRILLA P., 1981, *El Magdaleniense Inferior y Medio en la Costa Cantábrica*, Santander, Ministerio de Cultura (Monografías del Centro de Investigación y Museo de Altamira, 4).

UTRILLA P., 1986, La varilla ‘pseudoexcisa’ de Aitzbitarte IV y sus paralelos franceses, in: *Estudios en homenaje al Dr. Antonio Beltrán Martínez*, Zaragoza, Universidad de Zaragoza, pp. 205–225.

UTRILLA P., 2004, Evolución histórica de las sociedades cantábricas durante el Tardiglaciario: el Magdaleniense Inicial, Inferior y Medio (16.500-13000 BP), *Kobie*, series *Anejos* 8, 243–274.

UTRILLA P., DOMINGO R., MONTES L., MAZO C., RODANÉS J.M., BLASCO F., ALDAY A., 2012, The Ebro Basin in NE Spain: A crossroads during the Magdalenian, *Quaternary International* 272–273, 88–104.

ABSTRACTS

Llonin cave is located in the Cares river valley, between the sea and the Cantabrian Cordillera. In level III, hunted fauna comes from a rocky and mountainous biotope with chamois predominance over red deer and Spanish ibex. On top of this level there is an Upper Magdalenian level (II) and underneath an Upper Solutrean one (IV). Level III is formed by materials linked to fire, with a specific functionality, and there is an extraordinary association of elements: *raclettes*, single-beveled points (Placard type) and “pseudoexcisa” decoration. In addition, the substrate tools dominate, beginning with the splintered pieces, which are the best represented, both in quartzite and flint, followed by notches and denticulates in quartzite. Flakes are the priority blanks; blade production is low and bladelets are scarce. Actually the archaeological record is not related to the Cantabrian Solutrean or the Magdalenian, but agrees with the Badegoulian. The level has been dated ~18.000 BP (21584–21935 cal BP).

La grotte de Llonin est située dans la vallée du Cares, entre la mer et la cordillère cantabrique. La faune chassée du niveau III correspond à celle d'un biotope rocheux et montagnard où le chamois

prédomine sur le cerf et le bouquetin. Ce niveau est situé entre les niveaux IV (Solutrén supérieur) et II (Magdalénien supérieur). Il est constitué de matériaux liés au feu, avec une destination fonctionnelle très spécifique. Il a livré une association exceptionnelle d'éléments: raclettes, sagaies du type Placard et technique pseudo-excisée. Les outils lithiques du fonds commun sont majoritaires: les pièces esquillées sont les outils les plus représentés, tant en quartzite qu'en silex, suivies par les encoches et denticulés en quartzite. Les supports prioritaires sont les éclats, tandis que la production laminaire est réduite et que les lamelles sont rares. Sans rapport avec le Solutrén ou le Magdalénien cantabriques, ce niveau, daté d'environ 18000 BP (21 584-21 935 cal. BP) renvoie aux traditions techniques badegouliennes.

INDEX

Keywords: Last Glacial Maximum, chronology, fire, site functionality

Mots-clés: chronologie, feu, fonctionnalité

Geographical index: Région cantabrique

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