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Lower paleolithic butchery knives and carpentry tools: MODE 1 industry of “El Pino” (Campos del Paraíso, Cuenca, Spain)

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ABSTRACT

This paper contains the results of the archaeological campaigns carried out at the El Pino Site (Campos del Paraíso, Carrascosa del Campo, Cuenca, Spain). The stratigraphy belongs to the Valdejudíos River floodplain and is rich in Mode 1 prehistoric industry made from quartzite rolling stones. The site has been dated by Optically Stimulated Luminescence (OSL) and Electron Spin Resonance (ESR), giving the last technique a *terminus ante quem* of 1 Ma for this technological horizon. The excellent preservation of the lithic surfaces has allowed us to discover the use given to the instruments through traceological methods. An effective usage of retouched and unretouched flakes (not the cores) for butchery, and rabots for processing wood is verified. The manufacturing operational systems of Mode 1 pieces have been studied and subsequently evaluated as being similar to the oldest ones of the Oldowan industries in Africa (2.6 Ma); however, they showed more “archaism” than other contemporary worldwide examples. The ineffectiveness of the idea of a linear evolution of material culture “from simplicity to complexity”, to assess the lithic technology of the European Lower Paleolithic, is revealed.

1. Introduction: The El Pino site in context

The “El Pino” Archaeological Site is located in the municipality of Campos del Paraíso (Cuenca), between the limits of Alcarria and Mancha, two natural regions of the central Iberian Peninsula (Spain). Specifically, it is integrated into the Valdejudíos riverine valley, a tributary of the Cigüela River, which in turn, is a tributary of the Guadiana River. The common bibliography about the geology of the area (Querol Muller, 1989; Vv.aa. , 2008: 74), identified the formation processes of the hills of the old gorges and the basins in this part of Alcarria, as having developed during the Miocene (6 Ma ago), but the presence of a huge amount of lithic materials classified in modes 1, 2 and 3 (Domínguez-Solera and Muñoz, 2014), specifies and certifies the Pleistocene as the formation date of the basins of the rivers and streams still in existence today. Other authors have mentioned the true nature of the Pleistocene-Holocene context of the Valdejudíos river basin and its surroundings, and have published a more precise stratigraphy (Díaz et al., 1999: 36). These deposits are arranged on low-sloped hills and are lithologically constituted of sandy clay and silt with angular limestone pebbles and smaller, rounded, quartzite pebbles (3–15 cm).

El Pino was discovered in the 1970′s by Inocente López and Jesús María Martínez. The material collected by them was donated in 2012 to the Archeological Museum of Cuenca, and the precise location of the site was shown to the corresponding author of this paper. From then on, the specific work at El Pino was added to the larger-scale research project “*El Paleolítico Inferior y Medio en la Provincia de Cuenca*” (Domínguez-Solera and Muñoz, 2014; Domínguez-Solera, 2019). Two intensive survey and excavation campaigns were undertaken between 2013 and 2015. Sampling for the different dating techniques (OSL and ESR) and the technological and traceological analyses of the recovered lithic industry, were carried out at the same time. The preliminary results verifying the traces of use of just 4 pieces, have already been published (Domínguez-Solera and Martín-Lerma, 2015). The unpublished and summative final results derived from the last campaigns, constitute the contents of this paper.

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2. Methods

2.1. Archaeological fieldwork and morpho-technological analysis

The archaeological works were developed in plots 5299, 5300, 5301, 5302 and 5303 of the 508 polygon of the municipality of Campos del Paraíso (UTM 522.226,05/4.428.063,12, Zone 30), and their contact and surrounding areas. This land was mostly dedicated to cereal and olive tree farming. Two little quarries also existed, as well as intercalated land free from areas dedicated to agriculture, and unaltered geological cuts (Fig. 1). The presence of a significant volume of unworked quartzite pebbles in the excavated sandy clay strata should be noted.

Prospecting works began in 2012 with the reconnaissance of the site alongside one of the discoverers and personnel from the Archaeological Museum of Cuenca. After that, two intensive survey and excavation campaigns were undertaken between 2013 and 2015.

The survey of the surface covered 1.49 Ha intensively, and extensively, more than 4 Ha. Lithic pieces with signs of human modification and some samples of unworked quartzite pebbles were collected and classified according to the geological stratum in which they were found.

The archaeological excavation was designed by choosing certain squares of an ideal and orthogonal grid, oriented north–south, and

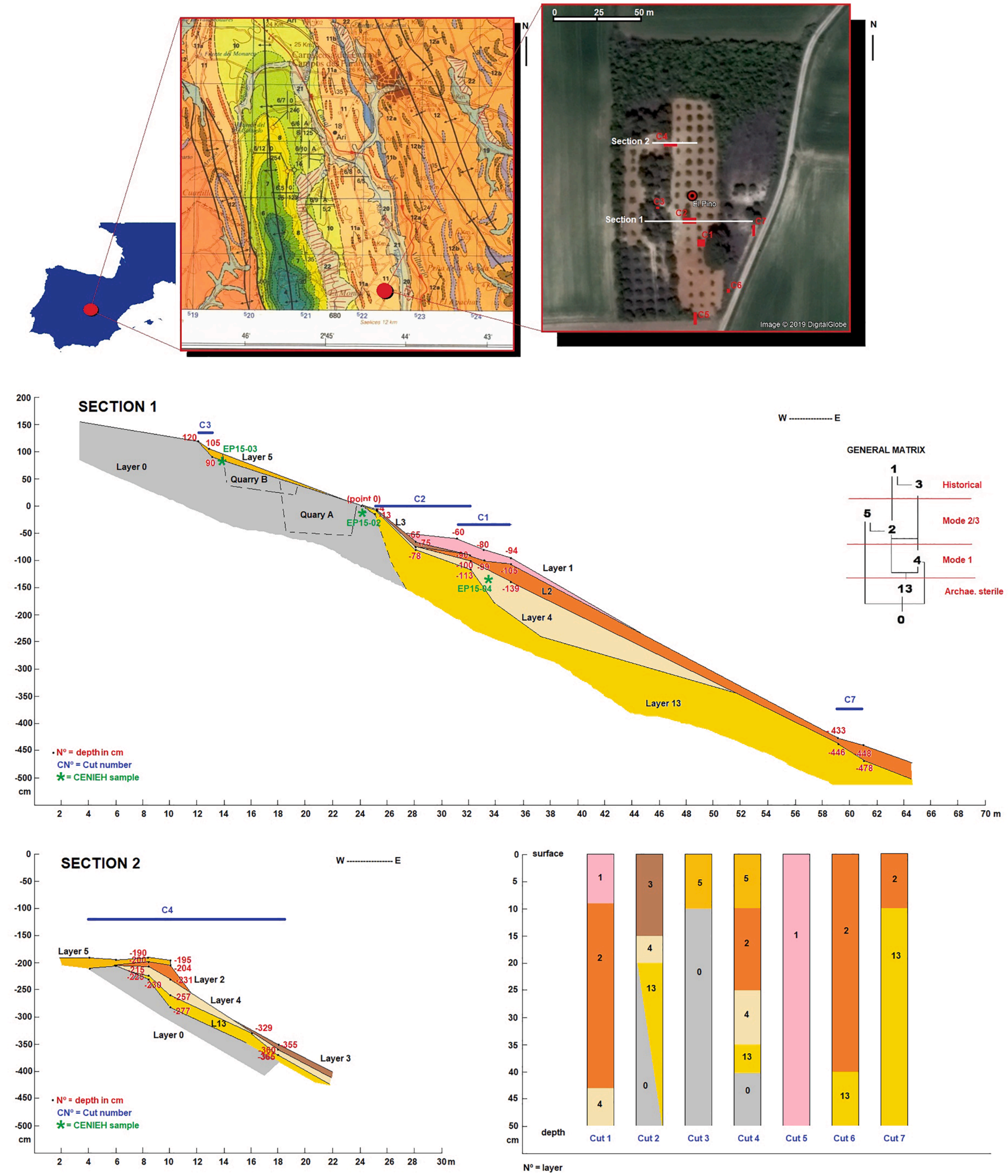


Fig. 1. Maps, stratigraphic sections, detailed stratigraphy of the first 50 cm of the 7 cuts and general matrix of El Pino. (All drawings by Santiago D. Domínguez-Solera; geological map taken from the IGN –MAGNA 50, 608 (Huete), and satellite photography taken from Google Earth).

digging a total of 7 different length cuts or trenches distributed throughout the intensively surveyed area. The depth of each cut was determined by reaching a sterile strata (from an archaeological point of view). In addition to obtaining pieces in a secure stratigraphic context, the intention of the excavation was to characterize the stratigraphy itself. Every lithic artefact recovered was classified by layers.

The lithic items were cleaned by water washing and non-abrasive methods. They were systematically photographed, drawn, characterized (morphologically and technologically), and inventoried. The categories of cores, tool debris and others, were also distinguished. The non-fractured pieces were measured for length, thickness and width, using a precision caliper. The preferable nomenclature used to classify the lithic technology followed the “modes” proposed by Clark (1977). For stylistic writing reasons, Oldowan and Acheulean and Mousterian nomenclatures were also applied in discussion as synonyms. The classification of the reduction strategies follows traditionally widespread nomenclature for the technology on Oldowan pebbles (Bordes, 1961; Ramendo, 1963; Biberson, 1967; Leakey, 1971), generating categories or own groups to organize the specific cases of this site (see the SD2 appendix in supplementary data). Diacritical analyses of the cores (Baena and Cuartero, 2006) were developed to determine the strategies and the operational sequence of knapping (Leroi-Gourhan, 1964; Boëda et al., 1990). Statistical calculations were based on average, standard deviation and 95% confidence intervals.

2.2. Use-wear analysis

The methodology employed in the analysis of the El Pino pieces, began with the recreation of the tools using raw rolling stones taken from the stratigraphy for a better understanding between the kinematics of the tools and the genesis of the traces. We experimentally used the flakes generated from different materials, in accordance with the variables established in previous programmes (Lemorini et al., 2014; Pedergnana and Ollé, 2017), to compare the traces on the tools, generated empirically, with those observed on the prehistoric ones.

During the classification process, the values for an own scale of erosion values from 1 to 4 was carried out (designed by the authors for the research project developed in Cuenca; Domínguez-Solera and Martín-Lerma, 2015; Domínguez-Solera et al., 2020). Value 1 corresponded to items without bearing and value 4 to a total bearing that, although allowing the identification of the piece as an anthropic production and to even guess the reduction process, did however blur all edges and prevented the appreciation of retouching. Only cases with an erosion index of between 1 and 1.5 underwent traceological analysis.

These archaeological pieces were cleaned using an ultrasonic bath, so that the original material would not suffer alterations and preventively discarding the possibility of adhering waste. Finally, a MOTIC DM143 binocular magnifier and an OLYMPUS BBHMJ 10x-500x petrographic microscope were used for the meticulous analysis of each edge and surface of the pieces. The BHMJ model of the Olympus microscope with Nomarski -DIC- type Interferential Contrast, offers better definition for non-siliceous materials.

2.3. Geochronology

2.3.1. Sampling

A geochronological sampling campaign was carried out in October 2015 and a total of three samples were collected to be analysed by two different dating methods: Electron Spin Resonance (ESR: 2 samples) and Optically Stimulated Luminescence (OSL: 1 sample). The ESR samples EP15-02 and EP15-03 were taken from layer 0 of Cut 2 and level UE2 of Cut 3, respectively. The OSL sample was collected from layer UE4 of Cut 4. For details on the sampling technique see Moreno et al (2017).

2.3.2. Sample preparation

All samples were prepared under dark room conditions at the Centro Nacional de Investigación sobre la Evolución Humana (CENIEH) in Burgos (Spain) following standard procedures explained in detail in; Aitken, 1985; Aitken, 1998; Porat, 2006; Domínguez-Solera et al., 2020; Moreno et al., 2021. The samples yielded a sufficient amount of quartz-rich fraction to perform OSL and ESR measurements and tests.

2.3.3. ESR dating of quartz grains

Samples were dated by using the standard Multiple Aliquots Additive Dose (MAAD) approach. Each natural sample was divided into 12 multiple-grains aliquots. For each sample, one aliquot was preserved as a natural reference and one aliquot was optically bleached for ~ 1500 h using a SOL2 solar light simulator (Dr. Hönle), in order to evaluate the ESR intensity of the non-bleachable residual signal associated to the Aluminium centre of quartz (Voinchet et al., 2003). The other 10 aliquots were irradiated with a calibrated Gammacell-1000 ^{137}Cs gamma source at different doses (100 to 20.000 Gy) following a sub-exponential dose step distribution.

ESR measurements were performed at low temperature (90 K) using a nitrogen gas flow system connected to an EMXmicro 6/1 Bruker X-band ESR spectrometer coupled to a standard rectangular ER4102ST cavity at the CENIEH. The Multiple Center (MC) approach defined by Toyoda et al. (2000) was also applied and the ESR signals of both Al and Ti centers were systematically measured in each sample. Further details can be found in Domínguez-Solera et al. (2020). The fitting procedures for calculating the equivalent dose values (DE) were carried out with the Microcal Origin 8.5 software using the Levenberg-Marquardt algorithm by chi-square minimization. Two different functions were fitted through the data points: an exponential + linear function (SSE + LIN) (Duval et al., 2009) for the Al centre and a Ti-2 function (Woda and Wagner, 2007) for the Ti-centers.

The total dose rate value was derived from the analysis of radioactive elements in the sample and its surroundings by a combination of in situ and laboratory analyses. A NaI probe connected to an Inspector1000 multichannel analyser (Canberra) was used to make the in-situ measurements while around 100 g of raw sediment from the sample were analysed by high-precision Germanium detectors.

ESR age calculation was carried out using a non-commercial software based on DRAC (Durcan et al., 2015), which takes into account the uncertainties derived from concentrations, depth, water content, in situ gamma dose rate, attenuation and DE values. ESR age results are given at 1σ.

The ESR results obtained are shown in Fig. 10 and additional data can be found in Supplementary SD1.

2.3.4. OSL dating of quartz grains

Quartz-rich fraction (90–125 μm) were mounted in a stainless-steel disc (2 mm diameter) and measured on a Risø TL/OSL Reader Model DA20 (^{90}Sr/^{90}Y source with a dose rate of 0.10 ± 0.01 Gy·s^{-1}). Luminescence signals was recorded by a PM Tube equipped with a 7 mm Hoya-U340 filter. The luminescence data acquisition was obtained using a Single-Aliquot Regenerative-Dose (SAR) protocol (Murray and Wintle, 2000). To obtain a representative number of data, 20 multiple-grain aliquots were measured. All the age calculations and corrections factors were performed using the code eM-Age (Pérez-Garrido, 2020) to obtain the final ages.

3. Results

3.1. Surface survey and excavation

3.1.1. Stratigraphic characterization

One of the objectives of the surveys and the excavation of the different cuts, was the characterization of the stratigraphic sequence. The stratigraphic context of El Pino precisely consists of an archaeologically sterile hard sandstone base, folded/eroded, and with a 10–15° slope on which superimposed alluvial deposits would be arranged in the fluvial environment of the Valdejudíos old channel and floodplain. Gravitational derivation processes similar to glacis, are interspersed. As previously pointed out for other valley bottoms in the Alcarria Conquense area, according to geological cartography (*MAGNA 50–608, Huete),* the excavated strata would be clayey silts with intercalations of gravel and sands of Paleogene origin, but with the presence of archaeological material inside them, and the absolute dating presented in this work contradicts the previous chronology (Fig. 1). This valley bottom stratigraphy of the Valdejudíos River is complemented by a piedmont with colluvial processes also found in the Pleistocene.

Once the stratigraphy on the surface of the authorized area had been characterized and the areas of concentration of materials determined through the surveys, the finality of the trenches was to characterize the level from which the Mode 1 technology came, and to take more lithic pieces from the secure strata (Fig. 1). The archaeologically sterile sandstone base on which the excavate strata laid, was called Layer 0. It had quartzite pebbles inside. Layer 13 was another sterile stratum with yellow clay laying over it. Layer 4, with only Mode 1 quartzite items inside, was directly above these heavy sandstone and sterile clay levels. The thickness of this layer varied due to the slope, with a maximum of 1 m.

Oldowan tools also appeared in the immediately younger strata (Layers 1, 2, 3, 5 and 10), but they originated from the oldest strata and had undergone erosive processes and were mixed with Mode 2 and Mode 3 lithic flint pieces (Layer 2 of orange sandy clay and Layer 5 of sand), and finally, with historical rubbish (Layers 1, 3 and 10, mixtures of clay, sand and organic earth).

All the stratigraphic units (Layers 0, 2, 4, 5 and 13) overlapped sequentially, but they showed $< 10\%$ slope, proof of subsequent alluvial and detrital glacis processes. After that, during the Holocene, new erosive processes occurred and finally, agricultural actions lowered the soil level and left part of the Pleistocene strata and their Paleolithic contents on the surface, generating new levels of mixture (Layers 1, 3 and 10). Layer 11, fertile in modes 1 and 3 pieces, and Layer 12, only with Mode 1, have been defined in a secondary working area and only studied by surface survey (see appendix SD3 of supplementary data).

The archaeological lithic materials are all derived from a secondary position and included in clay and sand strata constructed by fluvial and gravitational processes. For this kind of movement, it is necessary to add the typical vertical migration of the materials included in clay deposits produced by successive dilation and contraction (Domínguez-Solera, 2010). It is a Type A, B or C archaeological record (Isaac, 1978), but biased by an almost total absence of faunal remains due to the presence of plaster in this stratigraphy, and the relative pH which destroyed the

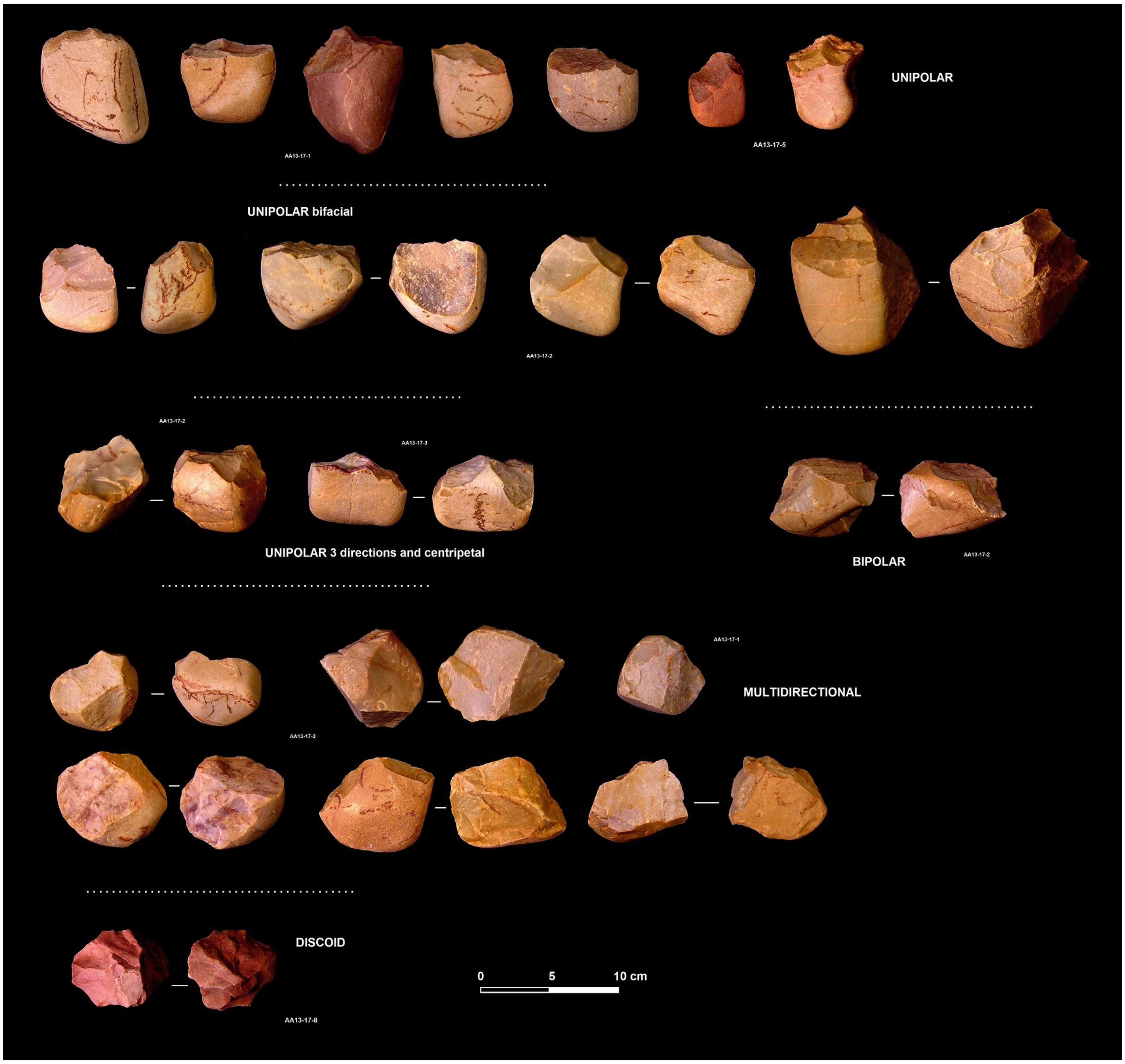


Fig. 2. Selected Mode 1 quartzite cores from El Pino. (Santiago D. Domínguez-Solera.)

bones. In older paleontological sites in the same area, dated to the Eocene and Miocene Epochs, the conservation of fauna is better (see Morales et al., 1993).

3.1.2. Morpho-technological analysis

From now on, all examples of materials classified as belonging to Modes 2 and 3 onward, are to be excluded. Beyond the study of the stratigraphy, it was assumed that all the Mode 1 lithic pieces made from quartzite and obtained during the surface survey and excavation campaigns, came from Layer 4 and could be studied in a unitary way, because all the examples of this material are identical and very divergent to flint pieces. The complete Mode 1 collection recovered (including the discoverers' donation to the Archaeological Museum of Cuenca), is made up of 243 items and consists of cores/choppers, retouched and non-retouched flakes, production debris, and production rejects (Figs. 2–5). There is an absence of an intense fluvial selection for bones (Behrensmeyer, 1988), since fragments smaller than 0.5 cm were not documented in abundance. However, the sample is representative of the entire knapping process.

The operational system defined is resumed in the following scheme:

- Provisioning: The quartzite pebbles (5–15 cm) for cores and stone hammers were selected from the riverine context, with no evidence of long-distance or medium-distance transport.
- Manufacturing:
  - Preparation: 30% of the cores show failed percussion marks, searching for the first flake extraction. There are no previous decortication actions, since all the flakes transformed into tools are cortical (see below).
  - Exploitation: After this first extraction, several more extractions from the same pole of the core or from the other one, took place. The reduction strategies are both unidirectional and bifacial on each pole, but there are a few cases of three or four directional reductions. The cores were not completely used-up. The morphological analysis of negatives and positives (volumetric and topographic), indicates the exclusive use of direct percussion with an active hard hammerstone (another quartzite pebble).
  - Retouching: During the reduction process, suitable cornices were prepared by retouching. This is the only explanation for the presence of retouching on the sharp points of the choppers, because these never show traces of usage (see below). The real stone tools are the flakes. All the flakes have a cortex (primary flakes), which is strongly consistent with the less intense reduction strategies of the cores. At first, their natural sharp points were used, and later, once worn, with alternating and discontinuous retouching. The only kinds of stone tools documented are denticulates, scrapers and rabots, in terms of classical typology.
- Usage and discarding: The usage actions and discarding decisions took place in the same locus. The way the stone tools were used is better explained in the following epigraph. The place would be the margin of the course of a river, which would drag the pieces from their original position to the point of sedimentation, with the absence of frictional alteration.

The tools were not only made from primary flakes. The biggest debris fragments were retouched too. This must be the reason for preparatory retouching, but some however, show evidence of use.

The evolution of the operational sequence is relatively simple, but not lineal (Grace, 1997). The first usage starts after the extraction of primary flakes with natural sharp points.

Lithic reassembly was not possible due to the fluvial-derived nature of the collection, but 8 different reduction strategies of the quartzite pebbles were identified through diacritical lectures (Figs. 2, 6 and 7). The most common ones are unipolar (unifacial and bifacial making up 65% of all identified examples), choppers and chopping tools in classical typology (Bordes, 1961). Flakes were obtained by means of a direct hard-hammer percussion technique. The sequence begins always with a first cortical flake extraction, followed by a few other flake extractions from the cornice generated by this first extraction (Fig. 6). There would appear to be a low intensity of activity in the exploitation of the core before it was discarded. The number of overlapped and identifiable flake extractions varies in all the complete cores between 1 and 8. The same process is obtained from the diacritical analysis of the flakes: they are all product of the first core opening extractions (natural and cortical platform) or of the subsequent ones that take advantage of the generated cornice. Despite the impossibility of reassembling, therefore the flakes are confirmed as part of the same operational system as the cores. The flake dimensions were measured in length (10.5–1.5 cm range), width (8.6–1.3 cm range) and thickness (2.9–0.3 cm range), and 80 complete pieces were statistically compared (point cloud distribution, average,

Fig. 3. Selected Mode 1 retouched and unretouched quartzite flakes from El Pino. (Santiago D. Domínguez-Solera.)

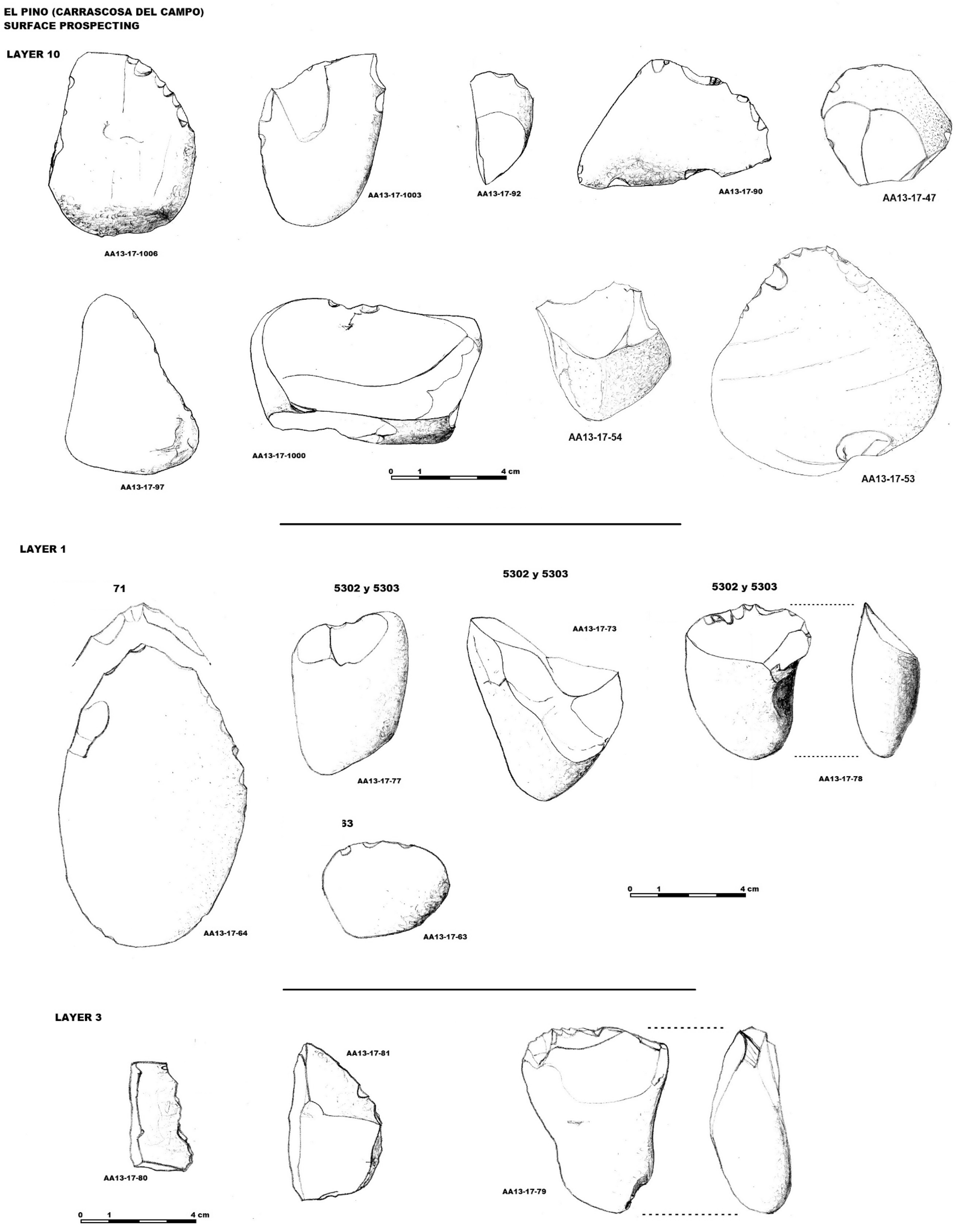


Fig. 4. Selected Mode 1 quartzite pieces from the surface survey in the El Pino area. (Santiago D. Domínguez-Solera.)

standard deviation and 95% confidence intervals). The production of flakes would have been aimed at obtaining pieces significantly longer than their width, but relatively equivalent in these two values (Figs. 3 and 7).

3.2. Use-wear analysis

The preliminary use-wear analysis of a small sample of 8 quartzite Mode 1 pieces recovered in 2012–2013, only found traces of use in the flakes, but not in the choppers (Domínguez-Solera and Martín-Lerma, 2015). The development of the following archaeological campaign provided a larger and proper sample of pieces with no geological erosion on their edges (Figs. 8 and 9). Thus, it was possible to submit 83 pieces with an erosion value of 1 or 1.5 to use-wear analysis, out of the 243 that represent the complete collection:

Cores:

- Large and medium-size cores with only technological traces, such as percussion stretch marks, but without traces of use. 16 pieces.

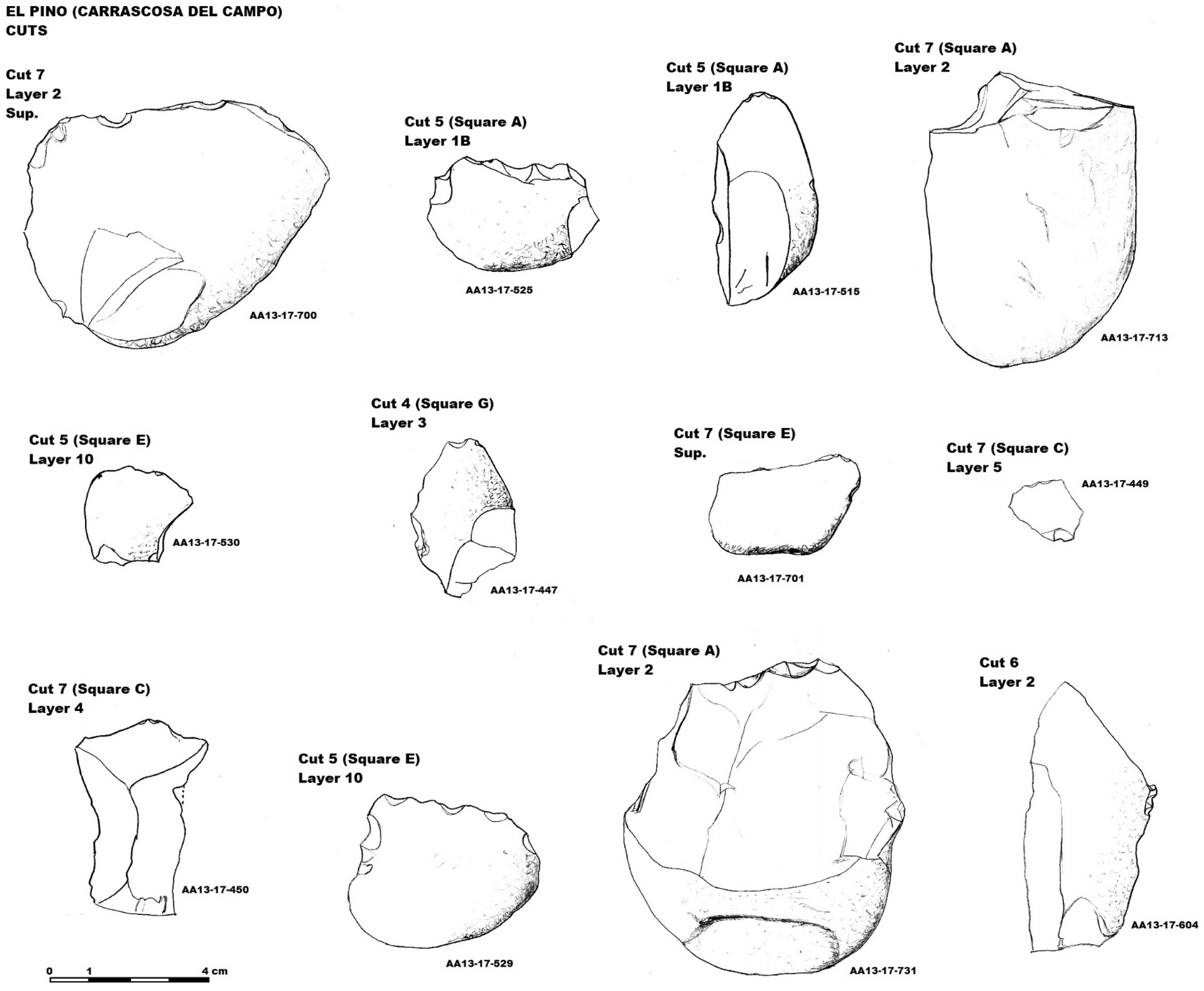
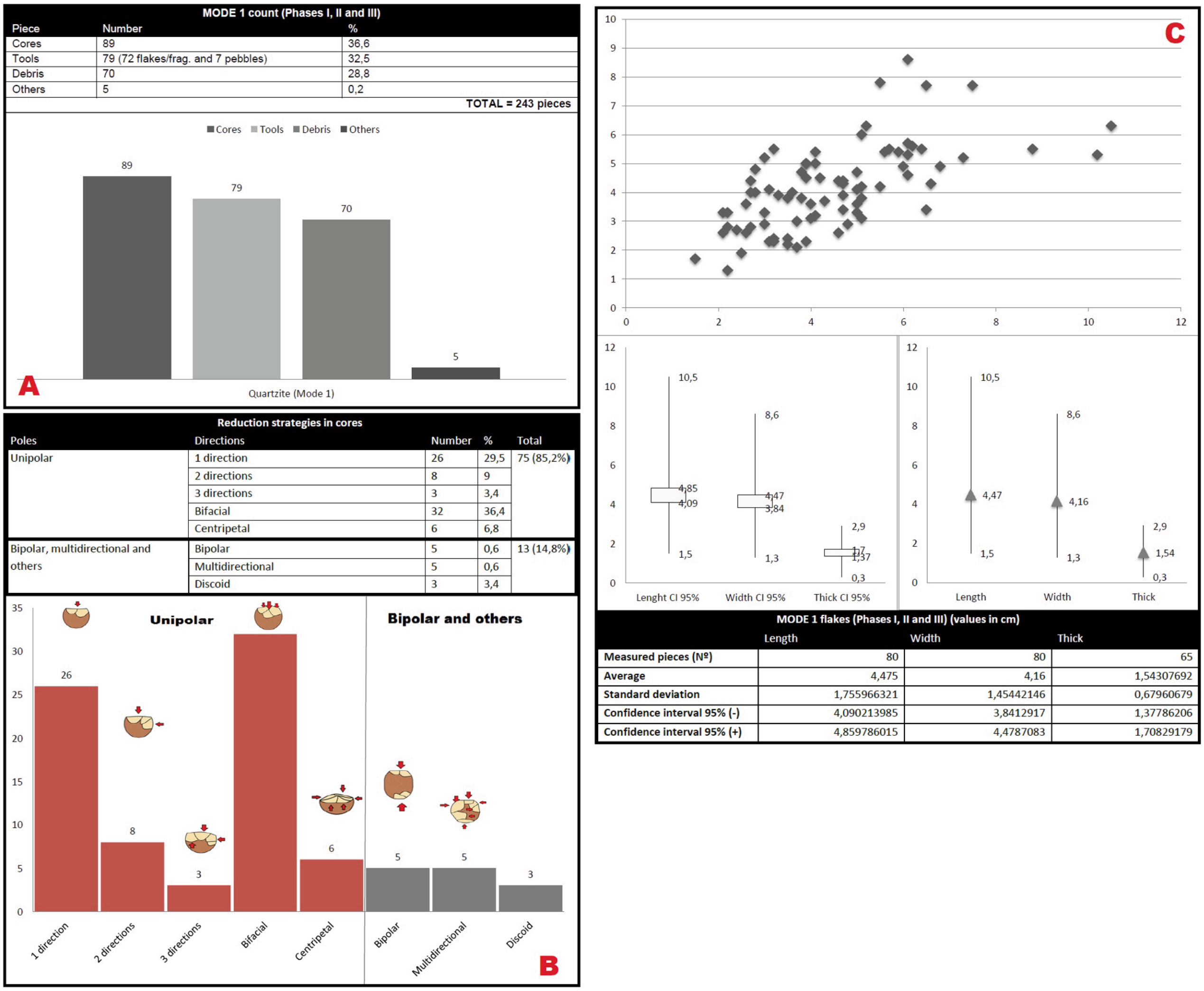


Fig. 5. Selected Mode 1 quartzite pieces from the El Pino excavation (cuts 1 to 7). (Santiago D. Domínguez-Solera.)

Fig. 6. Diacritical lectures of three representative cores with unipolar reduction. (Santiago D. Domínguez-Solera.)



MODE 1 count (Phases I, II and III)		
Piece	Number	%
Cores	89	36,6
Tools	79 (72 flakes/frag. and 7 pebbles)	32,5
Debris	70	28,8
Others	5	0,2
		TOTAL = 243 pieces

Reduction strategies in cores				
Poles	Directions	Number	%	Total
Unipolar	1 direction	26	29,5	75 (85,2%)
	2 directions	8	9	
	3 directions	3	3,4	
	Bifacial	32	36,4	
	Centripetal	6	6,8	
Bipolar, multidirectional and others	Bipolar	5	0,6	13 (14,8%)
	Multidirectional	5	0,6	
	Discoid	3	3,4	

MODE 1 flakes (Phases I, II and III) (values in cm)	Length	Width	Thick
Measured pieces (Nº)	80	80	65
Average	4,475	4,16	1,54307692
Standard deviation	1,755966321	1,45442146	0,67960679
Confidence interval 95% (-)	4,090213985	3,8412917	1,37786206
Confidence interval 95% (+)	4,859786015	4,4787083	1,70829179

Fig. 7. A = Count and classification of the Mode 1 quartzite pieces recovered during Campaigns I, II and III at El Pino. B = Classification of cores by reduction strategies. C = Study of flake dimensions (averages, standard deviations and 95% confidence intervals). (Santiago D. Domínguez-Solera.)

Flakes and debris:

- Large format flakes (≥15 cm) without traces of use. 12 pieces.
- Medium and small size flakes (≤15 cm) without traces of use. 16 pieces.
- Large and cortical flakes with traces of use. The traces detected in these kinds of pieces are associated to working with heavy materials such as bone or antler. At a microscopic level, microfractures are always apparent on the edges and the periphery of the crystals. They are larger and more abundant when having come into contact with hard materials. Normally they are arranged according to the movement made. In transverse actions, the microfractures occupy the proximal zones and are arranged perpendicularly or obliquely to the edge. In longitudinal actions, they are located on the sides of the crystals, parallel to the edge. At a macroscopic level, the edges of the instruments that come into contact with bone in the tasks of fleshing, suffer nicking in a crescent shape, and a slight rounding that affects the most outstanding areas. 4 pieces.
- Small and medium cortical flakes. The traces detected on the edges lead us to talk about activities related to soft materials such as meat, and are usually associated with activities of animal de-fleshing. They show a poorly developed micro-polish, open weave, matt gloss and "fat" appearance in the raised and protruding areas of the matrix, where the rounding on the edge is more apparent. 12 pieces.
- Tools with sharp edges with traces of use associated to de-fleshing, with micro-polish indicating bone-scraping, as well as a poorly defined polish associated to use with meat, and always located on the useful edge of the instruments. 10 pieces.
- Debris without traces of use. 9 pieces.

Others:

- Percutor, with marks indicating its use as a hammer. 1 piece.
- Rabots. Pieces with intense usage on wooden materials, always associated with the front of the rabots. In these cases, the rounding is considerable, indicating contact with wood for a long time or with a kind of hard wood, although the edges are not chipped. In addition, they have a bright polish, a semi-closed frame and bulging morphology. In the more compact polished areas, large depressions, free from clogging, can be seen, as well as small micro-holes with irregular edges. All these traces are typical of activity with wood. The clear striations that are perpendicular and slightly oblique to the edge, indicate frontal and unidirectional work. 3 pieces.

The microscopic analysis generated a very interesting volume of

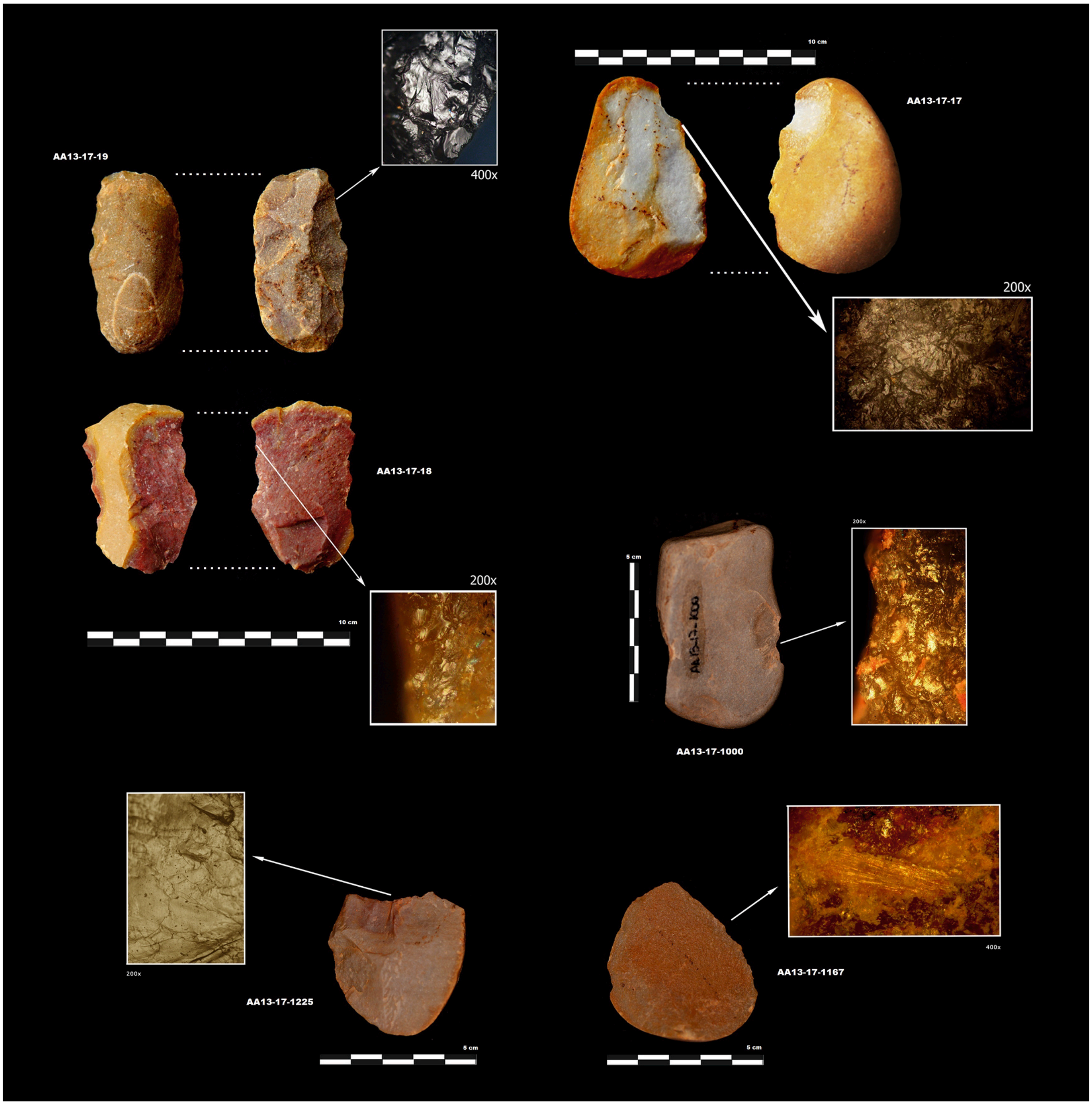


Fig. 8. Use-wear analysis in 5 flakes with meat/bone processing marks. (Ignacio Martín.)

information about the management of the raw resources, the lithic production and the usage. A total of 83 pieces were analyzed by microscope. Of these, 30 pieces had been used versus 53 unused (36.15% vs. 63.85%). The pieces with the largest format, traditionally classified as choppers or chopping tools, did not show traces of use and must be interpreted as cores. Their purpose was to provide flakes, which were the real tools, because they show traces of use on their respective edges.

Apart from the fact that the choppers were unused, El Pino's sample shows an important production of debris and flakes, which are finally revealed without traces of effective use. Most of the used tools indicate work with animal materials, both hard and soft, although work with wood is also observed. The morphology (size) of the pieces seems to be associated with the use given to them: the largest ones for working with harder materials such as bones, antlers or wood, and the smaller pieces for working with softer materials such as meat. The natural edges were normally used for processing animals since their clean and sharp edges were ideal for meat, and the retouched edges were better for more thorough work.

Most of the flakes with traces are cortical.

The flakes from the first extraction maintain 100% of the cortex of the pebble, obviously and gradually reducing up to 20% on the dorsal surface of the flakes from subsequent extractions. This is consistent with the core reduction strategies, all unrelated to previous decorticating processes. It is understood that the presence of cortex was a preference, because the products with cortical surfaces would facilitate their use with bare hands, acting as griping, handle or prehensile areas (*sensu* Boëda, 1991; Baena, et al., 2016) while the edges act as active areas.

The micro-polish generated by use is relatively comparable to the analogous ones generated in the flint. However, its development is much slower. This is due to different factors such as the mineralogical composition of the quartzite, the degree of compactness, and a more irregular micro-topography, etc. In addition, we only observed stretch marks in the quartz crystals and inside the micro-polish when very developed, which is not the case.

The fact that quartzite instruments were not used very intensively, except for the rabots which were, must be highlighted and interpreted as follows. Under experimental observation, the edges of the quartzite instruments quickly became dull, losing their effectiveness after a few

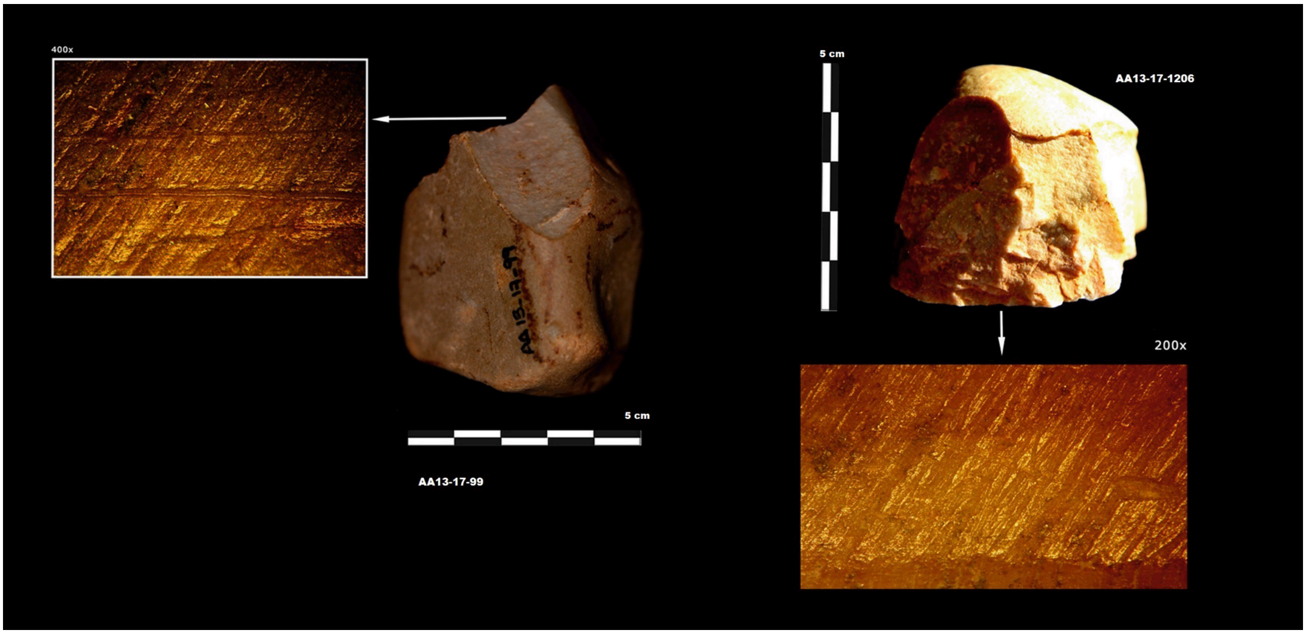


Fig. 9. Use-wear analysis in 2 rabots with traces of use on wood. (Ignacio Martín.)

	El Pino site	
	EP1502	**EP1503**
D_{int} (μGy/a)	50 ± 30	50 ± 30
D_{α} (μGy/a)	8 ± 2	9 ± 2
D_{β} (μGy/a)	709 ± 10	309 ± 4
D_{γ} (μGy/a)	380 ± 13	218 ± 8
D_{cos} (μGy/a)	219 ± 22	224 ± 22
Bl (%)	58.9 ± 1.1	52.9 ± 1.2
D (μGy/a)	1365 ± 41	809 ± 39
D_E (Gy) Al	1207 ± 95	686 ± 42
D_E (Gy) Ti-Li D option	1214 ± 79	867 ± 50
Age (ka) Al	884 ± 74	848 ± 66
Age (ka) Ti-Li D option	889 ± 64	1071 ± 80

Fig. 10. ESR results obtained on quartz grains for the El Pino site (Bl: bleaching; Dint: internal dose rate; Dα: alpha dose rate; Dβ: beta dose rate; Dγ: gamma dose rate; Dcos: cosmic dose rate; D: total dose rate; DE: equivalent dose). (Davinia Moreno.)

minutes of work. However, one should consider that quartzite is a very abundant local rock and the instruments could easily be replaced when they had lost their original effectiveness.

3.3. Geochronology

3.3.1. ESR dating of quartz grains

The D_E values derived from Al and Ti-Li *Option D* centers are 1σ-consistent (D_E-Al = 1207 ± 95 Gy and D_E-Ti-Li = 1214 ± 79 Gy) for sample EP15-02 and 2σ-consistent for sample EP15-03 (D_E-Al = 686 ± 42 Gy and D_E-Ti-Li = 867 ± 50 Gy). Taking into account the principle of the MC approach (Toyoda *et al.*, 2000), the Al-signal of these samples may be considered as completely bleached during fluvial transport. Ages derived from these D_E values for EP15-02 are 884 ± 74 ka (Al center) and 889 ± 64 ka (Ti-Li *Option D*). Thus, as both Ti-Li and Al centers, have provided similar ages, a final mean age for the EP1502 was calculated: 886 ± 69 ka (Fig. 10). In the case of EP15-03, the Al age is slightly younger than the Ti-Li *Option D* age which is not usually seen. It is considered that the Al-centre age of 848 ± 66 ka as the maximum age for this deposit.

3.3.2. OSL dating of quartz grains

The results obtained in sample EP15-04 are summarized in Fig. 11. All the aliquots measured showed a strong and fast luminescence signal (Fig. 11c), with a normal distribution of the D_E values (Fig. 11a) around a mean value of 22.1 ± 0.7 Gy. With respect the model used for age calculation, a Central Age Model (Galbraith et al., 1999) was used due to the low overdispersion values (15.7%) obtained. A total dose rate of 1.81 ± 0.04 Gy·ka^{-1} was obtained, that is in accordance with a typical quartz-rich sediment. All the collected data has been put in common to obtain the final OSL age for sample EP15-04 (Layer UE4, Fig. 1) using the eM-Age code (Pérez-Garrido, 2020).

The OSL age obtained gives a value of 12.2 ± 0.5 ka, a value that clearly do not correspond with the remains identified in the immediately inferior layer (Mode 1, lower paleolithic). This fact points to an important gap in the sequence due to a diverse sedimentation/erosion process. We cannot ensure the age of the level where the Mode 1 remains are located, but this age tell us that the agricultural works has not affected, in this part of the site, the sequence where the fertile levels with Mode 1 technology are upon the sterile sandstone levels. Also, the young age obtained has confirmed that a progressive sequence in the formation of the river terraces does not exist.

4. Discussion

The analysis of the lithic remains in quartzite, which can be classified as belonging to Mode 1 or Oldowan technocomplex, revealed the relative technical simplicity of the collection; a characteristic that requires a search for comparative parallels not only in the Iberian Peninsula, but also in much older examples from Africa. Several experts (Domínguez-Rodrigo and Alcalá, 2016), claim that more data is needed to consider the cases of the Mode 1 industry of Lomekwi -Kenya, West Turkana (Harmand et al., 2015), and the marks interpreted as cuts in the osteological record of Dikika–Afar, Ethiopia (McPhenrron et al., 2010), as reliable evidence of the first *Homo* agency, around 3.3 million years old, in the Pliocene Age. This unclear archaeological record -a hypothetical

Sample	Aliquots	Water Content (%)	Beta dose (Gy·ka $^{-1}$)	Gamma dose (Gy·ka $^{-1}$)	Cosmic dose (Gy·ka $^{-1}$)	Internal dose (Gy·ka $^{-1}$)	Total Dose Rate (Gy·ka $^{-1}$)	De	Overdispersion (%)	Age (ka)
EP15-04	20	15.7±1.6	1.01±0.04	0.64±0.03	0.19±0.02	0.03±0.01	1.87±0.05	22.5±0.8	15,7	***12.0±0.5***

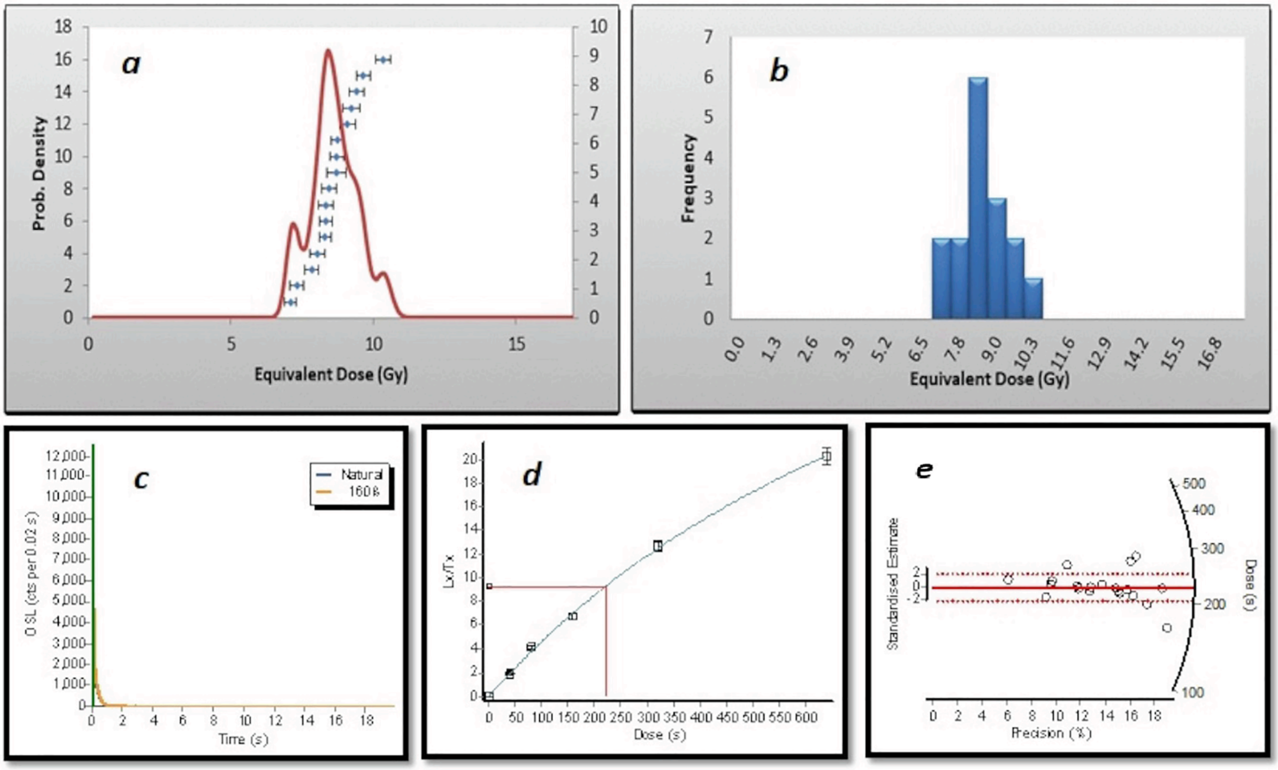


Fig. 11. Summary of the data obtained from sample EP15-04: a) DE probability density distribution; b) DE histogram; c) example of the sample signal and d) curve response; e) radial plot with the distribution of the DE. (Carlos Pérez-Garrido.)

“Lomekwian” of Mode 0- must be a mixture of levels and the result of abrasion or trampling taphonomic processes. Thus, only the undiscussed 2.6-million-year-old data of the Gona stone tools and butchering marks, or the 2.8-million-year-old fossil bones found in the Afar region, must be accepted as the top of early human existence nowadays (Semaw et al., 1997; Semaw et al., 2003; Domínguez-Rodrigo et al., 2005; DiMaggio et al., 2015; Villmoare et al., 2015).

The Iberian Peninsula was inhabited by humans in a 1.5-millon-year-old frontier. While the oldest *Homo* fossil remains were dated as 1.4 Ma in Orce (Toro Moyano et al., 2013), and as 1.2/1.3 Ma in Atapuerca (Carbonell et al., 2008; Bermúdez de Castro et al., 2011; Moreno et al., 2015), the oldest known stone tools come once again, from Barranco León and Fuente Nueva-3 (Orce), and the bottom layers of Atapuerca, at 1.5 to 1.4 million years old (Toro-Moyano et al., 2011; Parés et al., 2013; Blain et al., 2016; Michel et al., 2017; Parés et al., 2018).

Since the geological base that supports the oldest archaeological strata of El Pino has been dated between 1 and 0.9 Ma, the Mode 1 industry analyzed here (only slightly altered by post-depositional processes), must be classified as more recent than this *terminus ante quem*. The oldest Mode 1 remains dated in the Catalonian locus of Vallparadís, are set at 1–0.8 Ma (Carbonell and Rodríguez, (2007–2008); García et al., 2013; Duval et al., 2015). The Jarama and Manzanares valleys (Madrid), contain evidence of human occupation without interruption from 0.8 Ma (Panera et al., 2010; Panera et al., 2019; Rubio-Jara and Panera, 2019; Moreno et al., 2019). This would be a chronological range consistent with the closer site of the El Provencio Complex (El Provencio, Cuenca), whose *terminus ante quem* for the Mode 1 lithic collection is set at 0.8 Ma (Domínguez-Solera et al., 2020).

El Pino joins all those other indicated contexts of between 1 and 0.8 Ma and offers additional proof of the continued human presence in Western Europe since 1.5 Ma (García et al., 2011). This is a different point of view from that traditionally contributed by certain authors, who argue that the population size during the Iberian Lower Paleolithic period was marginal or intermittent in correlation to other European zones (Roebroeks, 2001).

The uppermost limit or *terminus post quem* for the Mode 1 horizon of El Pino cannot be easily established. The oldest Mode 2 hand-axes were defined at the south-eastern Spanish sites of Solana del Zamborino and Estrecho del Quípar (Scott and Gibert, 2009) belonging to reverse magnetic polarity layers, and with an expanded antiquity of 0.9 Ma. Other researchers (Jiménez-Arenas et al., 2011) dispute the results of Solana del Zamborino and Estrecho del Quípar, understanding the reverse polarity of Solana del Zamborino in relation to the paleontological record of the area, to situate the archaeological context of such first-hand axes in the Middle Pleistocene in Brunhes Chrom; the time when short polarity inversions took place. Recently, the Acheulean industry recovered in Barranc de la Boella (Catalonia, Spain), has been dated at 0.9–0.7 Ma (Vallverdú et al., 2014). If these data are accepted, the problem with establishing the bottommost age for the technocomplex studied in El Pino, derives from the already evident overlap between technological modes 1 and 2 in the Iberian Peninsula. This convergence has again been found a million years earlier in Africa (Semaw et al., 2020).

Nevertheless, it should be noted that the oldest Acheulean industry known in Africa is 1.7 million years old (Lepre et al., 2011; VV.AA., 2018; Diez-Martín et al., 2015). This means that, while the less elaborate Oldowan industries were being produced in the Iberian Peninsula, in certain parts of Africa as well as in other locus of Eastern Europe and the

Near East, the Acheulean industry had already been running for hundreds of thousands of years.

The same idea can be taken to the extreme by comparing the reduction strategy observed in El Pino to other examples from the Iberian Peninsula, also considered Mode 1: the oldest industry from the Orce, Atapuerca, Vallparadís and Madrid riverine valleys (Carbonell and Rodríguez, 2000; Toro et al., 2000; Rosas et al., 2006; Panera et al., 2010; Toro-Moyano et al., 2011; García et al., 2013; Martínez and García, 2014; de Lombera-Hermida et al., 2015; Titton et al., 2020), as well as the lithic assemblages recovered in El Provencio (Domínguez-Solera et al., 2020), El Pino or in other localities detected in the Province of Cuenca (Domínguez-Solera, 2019). Among all the knapping strategies inventoried, the unipolar (unifacial and bifacial) schemes and, as priority objectives, the genesis of flakes (cortical) for the production of knives, always stand out.

Although the simple unipolar unifacial and bifacial direct percussion reduction strategy, with few parallel extractions and taking advantage of the cornice generated by the previous extraction, is observed in the oldest levels of the Sima del Elefante (de Lombera-Hermida et al., 2015; Huguet et al., 2017), the operational schemes of El Pino are still much simpler than those of other Iberian deposits, even older. For example, in Fuente Nueva 3 (1.2 Ma) the use of large-format flakes as cores has been documented to obtain smaller flakes (Barsky et al., 2014). Fact not documented in the diacritical analysis of El Pino tools. In Barranco León, one of the oldest Oldowan open-air sites in Europe (1.4 Ma), divergent knapping strategies are developed according to raw material for making small cutting tools or larger percussion instruments and the toolkit includes subspheroids (Toro-Moyano et al., 2011; Titton et al., 2020; Titton et al., 2021). In these Orce deposits systematic use of extended orthogonal knapping episodes producing multiplatform cores had been showed (Toro-Moyano et al., 2011), a complex way of reduction for the oldest Oldowan industry in West Europe.

Carbonell et al. (2016) argue that, after the first phase of "Homogeneity" (relative in our opinion) there would be processes of "Diversity" and "Multiplicity" in the traditions of Modes 1 and 2, coinciding with the expansion at a global level and with the diversity of contexts to which the faced by human communities in different parts of the Old World. However, despite their evident variability, all the Oldowan industries of the Iberian Peninsula have displayed great similarities to the first and oldest African tools of Gona or Olduvai (Semaw et al., 1997; Semaw et al., 2003), even so far as functionality/behaviour is concerned (Isaac, 1978; Isaac, 1997), although they are 1.6–1.7 million years younger. Nevertheless, they are simpler than the case of the next Oldowan tool kits: e.g. Peninj and Omo Mode 1 industry (Domínguez-Rodrigo et al., 2004; De la Torre, 2006), with an antiquity of 1.7 and 2.3 Ma respectively, even being considered equivalent to the Levallois strategies during the evaluation of results. These collections have been defined as "Developed Oldowan" (Semaw et al., 2009). Additionally, the Mode 1 industry from El Pino analyzed here, appears simpler than those from other parts of Europe related to the "Out of Africa" transit line from Dmanisi, such is the case of the Kozarnika Cave (Bulgaria), dated 1.4 Ma (Sirakov et al., 2010). The incongruities regarding a strict linearity from simplicity to complexity between the oldest and most recent Paleolithic industries, have already been repeatedly demonstrated, especially given the fact that *Homo floresiensis* developed an industry analogous to the 1.9–1.2 Ma African Oldowan protrudes during the Upper Pleistocene (Moore and Brumm, 2009).

The authors of Mode 1 artefacts in the Iberian Peninsula may be chronologically associated to *Homo* sp. and *Homo antecessor* populations that were already chronostratigraphic and well defined in Atapuerca and Orce (Carbonell et al., 2008; Bermúdez de Castro et al, 2011; Moreno et al., 2012; Parés et al., 2013). Those from Africa are attributed to *Homo habilis, H. rudolfensis* or *H. ergaster.* The open debate on whether the first Acheulean in Europe is the responsibility of *H. antecessor* or *H. heidelbergensis* (Mosquera et al., 2016) is not addressed here, because it exceeds the objectives of the present work.

El Pino site represents the context of fluvial activity in the bottom of a valley. Between MIS 22 and MIS 21, it was probably a gallery forest, a meeting point of water, providing plant and animal resources for the hunter-gatherer bands of the aforementioned species, using only the abundant local quartzite. The importance of human presence in the river channels of the interior of the peninsula during the Lower Paleolithic should be highlighted (Santonja and Pérez-González, 2002). There is also a context of "sedimentary traps" where the lithic materials were prone to being moved and accumulated (Binford, 1988; Domínguez-Rodrigo, 1996; Domínguez-Rodrigo et al., 2007).

The provisioning of raw materials in the immediate area that we argued for the El Pino case, is a common characteristic of the behaviour of the first humans who lived in the Iberian Peninsula, as the Orce case also suggests (Morilla, 2010). In the fluvial terraces of the Madrid area (central Spain), a strong preference for immediate provisioning has also been confirmed (Panera et al., 2010; López et al., 2010a; López et al., 2010b); a situation recently detected in Guadalajara by the Henares River, close to Mohernando and Yunquera de Henares (Domínguez-Solera et al., 2017). The variability of the oldest Lower Paleolithic record in the Iberian Peninsula is explained by successive migratory episodes and/or by independent evolution during the Early Pleistocene and would suggest the development of regional technological traditions (García et al., 2013). In other cases, the influence of raw material on knapping decisions has been highlighted (Terradillos-Bernal and Rodríguez-Álvarez, 2014). Here, the hypothesis of a different way of working appropriate to different extrasomatic contextual situations, such as the availability and characteristics of raw material or the activity to be carried out, is added.

Research works focused on the study of the functional determination through usage marks on quartzite tools are scarce (Gibaja et al., 2002; Donahue and Burroni, 2004; Ollé et al., 2016; López-Ortega et al., 2017; Pedergnana and Ollé, 2017; Stemp et al., 2018), and the experimental models and results of marks and tracks on flint, have usually been directly transferred to the field of quartzite. However, the empiric experience causes us to reject any supposed parallelism between flint and quartzite with regards to its wear properties because of the lithological peculiarities of the different quartzites (Burroni et al., 2002; Ollé et al., 2016; Stemp et al., 2018).

There are only a few studies worldwide concerning the traces of use for Oldowan industries. Again, one should turn to the African case (Isaac, 1978; Isaac, 1997) to find a comparative framework with which to assess the results of El Pino. The study of the Kanjera South (Kenya) quartzite and quartz Mode 1 assemblage (2–1.5 Ma), is also based on actualistic experimentation and reveals specific works on faunal and vegetable materials (Lemorini et al., 2014; Lemorini et al., 2019). However, the type of knapping is more elaborate, and quartz and quartzite are transported from 10 km away, since these raw materials are preferred to the softer, more locally available and abundant materials in the area. While in the African example (although the use of Oldowan stone tools for butchery is mainly identified) the results suggest a wide range of activities including cutting, percussion and scraping (Ríos Garaizar et al., 2016) and their usage also has been indicated on wood and other plant materials, such as tubers (Gibbons, 2009), the fossilized activities in El Pino are more specific. Flakes were used for butchery work and the same tool was used both for work on soft materials such as meat or leather, as well as for working on bones. The cores were not used as tools, with the exception of a few instances where cores and thick flakes were used as carpentry tools. This indirectly provides evidence of an archaeologically invisible wooden tool kit that could have been used as hunting equipment. The most efficient use of flakes of relatively small sizes for butchering activities has been verified in Revadim, compared to weightier and large-format tools such as choppers, chopping tools and bifaces (Venditti et al., 2019).

5. Conclusions

Prior to the current research programme (Domínguez-Solera and Muñoz, 2014; Domínguez-Solera and Martín-Lerma, 2015; Domínguez-Solera, 2019; Domínguez-Solera et al., 2020), very little data existed regarding the Lower and Middle Paleolithic history of the area that today occupies the Province of Cuenca (Osuna, 1974; Osuna, 1976; Millán Martínez, 2012). The El Pino Site is one of the new locations where the most intensive works have been carried out, and from where the most interesting results have been obtained.

The main characteristics of this location, baptized as “El Pino”, have been presented in a general way. Their Mode 1 lithic assemblage shows very simple and little expeditious unipolar knapping methods of the quartzite pebbles to generate knives from cortical retouched and unretouched flakes, together with the examples of Mode 1 in the oldest archaeological sites of the Iberian Peninsula, as well as the Oldowan industry 1 million years older analyzed in Africa (Semaw et al., 2003). There are even examples of Oldowan in Africa and Europe, older than the Iberian, with theoretically more “advanced” or elaborated features. Also, the Acheulean complex in Africa was in development for more than 700,000 years (Diez-Martín et al., 2015), while at the origin of the human colonization of the Iberian Peninsula, an infinitely simpler industry was created and used. The case of El Pino represents an excellent example that contradicts the classical hypotheses that still advocate a technological evolution “from simplicity to complexity“. However, more importantly, the archaeological record of El Pino has made it possible to know how this industry was created and what it was used for: butchery and wood work.

There are no other absolute dates as old as those of El Pino or El Provencio (Domínguez-Solera et al., 2020) neither in the Province of Cuenca nor in the Castilla-La Mancha region. Of course, certain aspects of the research need to be developed further and their conclusions will be extensible to analogous discoverers of Mode 1 industry in other locations in the provinces of Cuenca, Albacete and Guadalajara; for example, in the villages of Mohernando, Ossa de Montiel, Arcas, Fresneda, Sotoca, Chillarón de Cuenca, Sotos, Priego, and El Provencio, etc., with scientifically unexploited deposits that demonstrate the potential of this part of the interior of Iberia to understand its first human settlers.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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