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1 Neanderthal mobile toolkit in short-term occupations at Teixoneres Cave (Moia, Spain)

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17 Abstract

18 Hunter–gatherers have a nomadic lifestyle and move frequently on the landscape based on the seasonal
19 distribution of resources. During these displacements, carrying capacities are limited, and the composition
20 of the transported gear is generally planned ahead of the activity to perform. During the Pleistocene,
21 prehistoric hunter–gatherers faced similar difficulties in exploiting the territory and employed different
22 strategies for coping with their subsistence needs and the possible shortage of stone tools. The
23 understanding of how these behaviors developed diachronically is pivotal for the reconstruction of the
24 human trajectories of land use in different environments, orographic settings, and climates. Thus far, the
25 identification of the mobile toolkit has been related to blanks produced with allochthonous rocks, whereas
26 the recognition of the transported artefacts knapped in local and semi-local raw materials encounters more
27 difficulties because of the possible association with the lithic production conducted at the site. In this paper,
28 we present the mobile toolkit of sub-unit IIIb and IIIa of Teixoneres Cave, a Middle Paleolithic site where
29 a clear differentiation between *in-situ* knapping activities in local quartz and the import of stone tools in
30 other raw materials is documented. The analysis of these latter assemblages reveals that the bulk of the
31 toolkit is composed of knapping by-products and that the number of curated artefacts, Levallois flakes, and
32 cores is significantly lower. Results show that the main strategy of transport at Teixoneres Cave was a
33 combination of hunting and cutting tools aiming toward a generalized set of gears instead of narrowing the
34 equipment to few specialized items. These new data highlight the plasticity of Neanderthals’ technological
35 organization in the western Mediterranean.

36 1. Introduction

37 Studies on the lifestyle of modern hunter–gatherers have provided pivotal insights into the human land use
38 and strategies applied for the acquisition of resources (Binford, 1978, Binford, 1982, Kelly, 1983, Kelly,
39 1995). Climatic and ecological settings are two of the main causes influencing the productivity of the
40 environment and therefore the mobility and dispersal of foragers groups. Generally, in territories with
41 relatively scarce biotic resources, hunter–gatherers tend to move frequently, whereas in plentiful
42 environments, they are less mobile and tend to camp near ecotones, where resources from several habitats
43 can be gathered at the same time (Binford, 2001, Kelly, 1995). These two types of settlements reflect
44 different amounts of investment and planning in the technological strategies, as indicated by Binford (1977,
45 1979) in the concept of curation. Curation requires an investment for future use, as the artefacts are
46 produced in advance of anticipated use. This strategy can cope with the possible shortage of tools during
47 the completion of specific tasks or when the exploitation of high seasonal resources prompts for a greater
48 organization of the activities (Binford, 1979). At the other end of the spectrum is expedience, which refers
49 to the opportunistic production of tools, as needs arise with the artefacts used and discarded in one place.
50 In high-mobility contexts, the strategy of artefact curation and the preparation of the toolkit in advance of
51 the foraging foray is a better strategy for hunter–gatherers that could not predict when and where they would
52 need it (Binford, 1979, Binford, 1980). Conversely, in low-mobility contexts, the uncertainty of biotic and
53 abiotic resources is reduced, and a strategy of expediency is favored because artefacts are made on a needs
54 basis (Binford, 1979, Binford, 1980).

55 In the last 50 years, these concepts have been largely used and rephrased by Paleolithic
56 archaeologists because of their applicability to understand the patterns of prehistoric technological
57 organization, human mobility, and land use (Bamforth, 1986, Kelly, 1983, Kelly, 1988, Kuhn, 1992, Kuhn,
58 1994, Kuhn, 1995, Nelson, 1991, Shott, 1986, Shott, 1996, Torrence, 1983). After Binford’s (1979) primary
59 association between curated technologies and the features of artefact transport, efficiency, and maintenance,
60 others scholars enlarged the original formulation by adding other characteristics, such as the possibility to
61 be hafted (Hayden, 1993), repaired (Gamble, 1986), recycled, or designed for multi-functionality
62 (Bamforth, 1986). However, the ambiguity of the definition of curation also yielded some criticisms
63 because it was unclear whether Binford (1979) referred to stone tools, assemblages, or technologies in
64 general (Nash, 1996, Odell, 1996, Shott, 1996) and what were the relations to other variables (e.g.,
65 availability of raw materials, distribution of resources, time–stress, degree of tool reduction) in encouraging
66 hunter–gatherers to adopt curation instead of expedience (Andrefsky, 1994, Andrefsky, 2009, Bamforth,
67 1991, Bleed, 1986, Kuhn, 1992, Nelson, 1991, Roebroeks, et al., 1988, Torrence, 1983, Vaquero and
68 Romagnoli, 2018). To some extent, curation can also be interpreted as the degree of utility of a particular

69 technology or artefact. An extreme example is that a single flake can be curated when the point of maximum
70 utility is reached for the activity performed (Shott, 1996, Shott and Scott, 1995).

71 During the Pleistocene, hominins developed different strategies for raw material management and
72 lithic production for coping with the daily need of cutting tools (Boëda, et al., 1990, Féblot-Augustins,
73 1997, Féblot-Augustins, 2009, Kuhn, 1992, Le Brun-Ricalens and Otte, 2014). The understanding of these
74 processes, particularly how prehistoric hunter–gatherers organized their technology when moving in the
75 landscape or disperse in other territories, is critical for unveiling the trajectories of human adaptation to
76 shortages of lithic gears and the behavioral reactions to different orographic settings, environmental
77 changes, and climatic fluctuations. Identifying the transported lithic artefacts in the archaeological record
78 is not an easy task. These lithic artefacts have been commonly associated with blanks produced with
79 allochthonous rocks or curated tools (Féblot-Augustins, 1997, Geneste, 1988, Porraz, 2009, Turq, et al.,
80 2013). As the transport cost of raw material rises as the travel distance increases, archaic humans could
81 have balanced the effort of carriage by removing the cortex, configuring the cores, or choosing to carry
82 only specific blanks (e.g., Levallois flakes, bifaces) (Metcalf and Barlow, 1992). In high-mobility contexts,
83 the number of lithic items in allochthonous raw materials (> 20 km) is generally lower than the number of
84 artefacts knapped in local sources, and flakes, transported over long distances, show evidence of re-
85 sharpening more frequently than stone tools produced from the neighboring outcrops (Geneste, 1988).
86 These re-sharpening events could have also contributed to the changing morphology of the blanks over
87 time, thus increasing their shape variability (Dibble, 1987, Dibble, 1995).

88 In foraging systems, hunter–gatherers are always equipped with personal gears. A main issue in the
89 identification of the toolkit composition is the recognition of the transported artefacts knapped in local and
90 semi-local raw materials. As their number in the assemblages are larger than the allochthonous rocks, and
91 their cutting edges do not display recurrent re-sharpening events because of their transport over a reduced
92 area, the artefacts of the mobile toolkit in local and semi-local raw materials can be mistaken for by-products
93 of the lithic production conducted at the site. This problem hampers our comprehension of the variability
94 of the prehistoric toolkits in the short mobility range that could have been composed of artefacts from
95 different raw materials at different stages of reduction. This paper aims to discuss this issue by presenting
96 new results from the technological analysis of the late Middle Paleolithic industries at Teixoneres Cave
97 (Moià, Spain). In these assemblages, a clear differentiation between *in-situ* knapping activities and the
98 import of stone tools at the site is documented (Picin, et al., 2020, Rosell, et al., 2017, Talamo, et al., 2016).
99 Whereas quartz pebbles, which were gathered from the nearby stream, were reduced by bipolar and *tranche*
100 *de saucisson* (sausage slice) methods, the other portion of the lithic collections is composed of isolated
101 artefacts made mainly from chert and other rocks (metamorphic, sedimentary, and igneous), distributed in
102 a radius of 15 km and with little evidence of reduction at the site. These new evidence from Teixoneres

103 Cave aims to shed light on the variability of the mobile toolkit, providing new examples for the
104 understanding of Neanderthals' technological organization in the western Mediterranean.

105

106 **1.1. Mobile toolkit: concepts and variability**

107 During the Pleistocene, the diet of archaic humans was mostly based on meat (Fiorenza, et al.,
108 2015, Hublin and Richards, 2009, Jaouen et al., 2019), a behavior that could have been prone to shortfalls
109 and, consequently, to subsistence risk. In this perspective, lithic technologies played a major role in
110 reducing the probabilities of failing and in enhancing the spectrum of food supply (Bamforth and Bleed,
111 1997, Bousman, 1993, Torrence, 1989). However, lithic productions can also be susceptible to possible
112 shortages (e.g., deficiency of raw material), making the equilibrium of the foragers' sustenance precarious
113 under stressful conditions (e.g., climate change, faunal turnover). Among prehistoric hunter-gatherers,
114 carrying capacities were limited, and the coping with the potential demand for stone tools could have been
115 solved by keeping individuals equipped with various implements (provision of individuals), supplying the
116 place of the activity with a stockpile of raw materials (provision of places), or producing artefacts when the
117 need arises (provisioning of activities) (Kuhn, 1992, Kuhn, 2004). For mobile groups, this planning strategy
118 in the management of the stone resources equates to a form of risk minimization (Kuhn, 1992).

119 Thus far, the investigation on prehistoric toolkits has been generally associated with retouched
120 artefacts knapped in allochthonous raw materials and with particular attention to handaxes and Clovis points
121 (Andrefsky, 1994, Beck, et al., 2002, Jennings, et al., 2010, Jeske, 1992, Kelly, 1988, Kelly and Todd, 1988,
122 Wiśniewski, et al., 2019). These items are extremely versatile because they have a long use-life, can be
123 utilized as cutting tools and cores, and can easily be resharpened when blunted (Kelly, 1988). Other studies
124 referred to retouch intensity in stone tools as evidence that the artefact had been transported frequently
125 across the territory (Andrefsky, 2006, Blades, 2003, Dibble, 1995, Hiscock and Attenbrow, 2003). In the
126 Middle Paleolithic, among bifaces and asymmetrical (*Keilmesser*) bifacial knives (Jöris, 2006, Soressi,
127 2004), Quina scrapers are stone tools designed for frequent sharpening events in high-mobility contexts
128 (Hiscock, et al., 2009, Lebègue and Meignen, 2014). Other works on the Middle Paleolithic record
129 suggested that Levallois cores and Levallois by-products (e.g., flakes, blades, points) were the items carried
130 farther on the landscape (Geneste, 1988, Henry, 1995, Hovers, 2009, Moncel, et al., 2014, Picin and
131 Carbonell, 2016, Roebroeks, 1988, Turq, et al., 2017) because of their features that were more appealing
132 during longer forays (Brantingham and Kuhn, 2001, Eren and Lycett, 2012, Picin and Vaquero, 2016).
133 Conversely, simpler technologies (e.g., discoid, orthogonal, globular) reflected a more expedient approach
134 and a broader utilization in low mobility areas (Wallace and Shea, 2006). Levallois and Mousterian points
135 were also proposed to have been transported more frequently than other tools because they were considered

136 to be the main components of the Neanderthals' hunting kits (Rios-Garaizar, 2016, Rots, 2013, Sharon and
137 Oron, 2014, Shea, 2006, Yaroshevich, et al., 2016). A recent synthesis of the Mousterian subsistence and
138 technological strategies in Western France found that Quina and discoid methods are related more to high-
139 mobility patterns for the acquisition of migrating large ungulates. The applicability of the knapping methods
140 to different types of stones facilitated their use during long displacements. Conversely, laminar and
141 Levallois technologies are more dependent on better-quality chert nodules, implying a reduced mobility
142 and an enlargement of the faunal spectra (Delagnes and Rendu, 2011).

143 These pieces of evidence point out that the lithic reduction and human mobility are dynamic
144 systems and that the personal gear carried on the landscape could have changed through time based on
145 different variables (e.g., environment, climate, cultural traditions). This variability, documented during the
146 Middle Paleolithic, is somehow in contrast with the previous ethnographic observations that the mobile
147 toolkits tend to be more specialized in highly seasonal environments and generalized in temperate habitats,
148 where resources are less scattered and the faunal communities do not migrate (Binford, 1978, Oswalt, 1976,
149 Torrence, 2001). Conversely, Neanderthals are flexible in their choice of lithic items to carry on the
150 landscape (Delagnes and Rendu, 2011, Picin, 2017, Picin, 2020, Picin and Carbonell, 2016, Turq, et al.,
151 2013, Vaquero, et al., 2012). This behavioral plasticity is also recorded during periods of subsistence stress,
152 when the visits to carnivore dens for exploiting meat, fat, and warm pelts are accompanied by curated and
153 expedient artefacts (Airvaux, et al., 2012, Brugal and Jaubert, 1991, Charles, 1997, Romandini, et al., 2018,
154 Talamo, et al., 2014). Recently, digging sticks have been found in several Middle Paleolithic sites
155 (Aranguren, et al., 2018, Carbonell and Castro-Curel, 1992, Castro-Curel and Carbonell, 1995, Rios-
156 Garaizar, et al., 2018), broadening the possibility that Mousterian toolkits could have been composed of
157 different subsistants, as shown in the ethnography by Oswalt (1976).

158 **2. Materials and Method**

159 **2.1 Teixoneres Cave**

160 Teixoneres Cave is located northeast of the Iberian Peninsula at 760 m a.s.l. near the town of Moià, 50 km
161 north of Barcelona (Fig. 1). The natural shelter is part of the karstic system called Toll Caves that developed
162 on sedimentary material in the margin of the Central Catalan depression, which includes another cave (Toll
163 Cave) and an aven (l'Avenc del Bassot). The caves are located on the fluvial terraces created by the Mal
164 stream in the Neogene limestones of the Collsuspina Formation. The sites were discovered during the
165 speleological explorations of the karstic systems at the end of the 1940s, and several archaeological
166 excavations were performed in the following years, unveiling rich Pleistocene and Holocene sequences

167 (Castellví, 1974; Serra et al., 1957; Donner and Kurten 1958). Since 2003, a new project is exploring Toll
168 Cave and Teixoneres Cave. This latter is excavated in extension over a surface of 250 m².

169 The stratigraphic sequence of Teixoneres Cave is composed of three main large deposits sealed by
170 a stalagmitic crust dated to approximately 16 ky BP (Tissoux, et al., 2006). The upper deposit contains units
171 II and III, which are radiocarbon dated from 44,840–33,060 cal. BP (68.2%) and from greater than 51,000–
172 44,210 cal. BP (68.2%), respectively (Talamo, et al., 2016). This sequence is located over another
173 stalagmitic layer dated between 98 and 100 ky BP (Tissoux, et al., 2006), which separates the upper and
174 middle sets. The upper units II and III are the most studied archaeological assemblages. Their faunal record
175 shows a high diversity of ungulates, such as red deer (*Cervus elaphus*), horse (*Equus ferus*), aurochs (*Bos*
176 *primigenius*), wild ass (*Equus hydruntinus*), roe deer (*Capreolus capreolus*), wild goat (*Capra pyrenaica*),
177 chamois (*Rupicapra pyrenaica*), wild boar (*Sus scrofa*), woolly rhino (*Coelodonta antiquitatis*), woolly
178 mammoth (*Mammuthus primigenius*), and lagomorpha such as rabbit (*Oryctolagus cuniculus*) and hare
179 (*Lepus* sp.) (Álvarez-Lao, et al., 2017, Rosell, et al., 2017). Human remains are represented by three
180 deciduous teeth corresponding to at least two different individuals younger than 7 years old and a molar of
181 an adult. Even though the presence of Neanderthals is recurrent at the site, the activities of carnivores are
182 common in all the stratigraphic units [e.g., cave bear (*Ursus spelaeus*), hyena (*Crocota crocuta*), wolf
183 (*Canis lupus*), fox (*Vulpes vulpes*), lynx (*Lynx spelaea*), and badger (*Meles meles*)], and hyenas are the
184 most active predators (Rosell, et al., 2017). According to the spatial distribution of the finds, the items
185 associated with the carnivore den activities are mainly clustered in the inner parts of the cave, and the
186 anthropogenic items (i.e., lithics and bones with cut marks) are mainly clustered in the main entrance. Some
187 small and thin hearths have been excavated in this area as well, suggesting that short-term domestic
188 activities were also conducted at the site.

189 Preliminary surveys on the raw material distribution in the region indicate that the formations with
190 chert are located at about 10–15 km from the site in Triassic deposits of the Lower Muschelkalk facies
191 running in a northeast–southwest axis (Mangado and Nadal, 2001). In this area, nodules of chert, limestone,
192 hornfels, and quartzite are found in primary and secondary positions in the Llobregat valley and its fluvial
193 terraces, in the Congost valley, and at the bottom of the Montseny Massif. At about 8 km south from the
194 cave, sources of quartz and chert in the secondary context are found at Sant Quirze, and chert outcrops in
195 the secondary context are found at Coll Can Tripeta situated at about 15 km northwest of the site (Mangado
196 and Nadal, 2001). Nodules of jasper are found at Morrot (Barcelona), and flint sources of the “Gasteropoda-
197 dolomite type” and “Oolithic type” are still unknown (Mangado, et al., 2006). Within the vicinity of the
198 cave, cobbles of quartzite, sandstone, and quartz can be gathered in the secondary context in the nearby
199 Mal stream. Provenance studies on the raw materials uncovered in the archaeological levels are still

200 underway. In the current study, the lithic materials are discriminated solely based on their macroscopic
201 features.

202 **2.2 Methodological approach in the lithic analysis**

203 This study aims to identify the transported toolkit and is restricted to the lithic materials produced in
204 metamorphic, sedimentary, and igneous rocks. The lithic assemblages are initially distinguished by the raw
205 material units defined according to stone macroscopic features, including type of cortex, color, grain size,
206 and texture (Roebroeks, 1988). Then, the different raw material groups are analyzed following the *chaîne*
207 *opératoire* approach, a methodological framework that defines the reconstruction of the various processes
208 of flake production from the procurement of raw materials through the phases of manufacture and utilization
209 until final discard (Boëda, 2013, Inizian, et al., 1992, Pelegrin, et al., 1988). Following this methodological
210 scheme, lithic production is examined from a techno-economic perspective, documenting the patterns of
211 nodule/artefact transport and/or reduction at the site. According to the principle of economic zonation
212 (Binford, 1982, Geneste, 1988), in this study, the distribution of the raw material sources on the landscape
213 are divided into local (< 5 km), semi-local (5–20 km), and allochthonous (> 20 km).

214 The analysis of the core assemblage is performed by identifying the number of flaking surfaces,
215 the presence or absence of the hierarchical preparation of the core volume, the angle between the flaking
216 surface and the striking platform, and the direction of the flakes detached. The Levallois and discoid
217 technology is identified following the criteria defined by Boëda (1993, 2013), and the intermediate core
218 morphologies, which are characterized by the hierarchization of the flaking surface and core configuration
219 with secant fracture planes, are considered hierarchized and discriminated based on the direction of the
220 detachments (e.g., unidirectional, bidirectional, or centripetal) (Picin, 2018, Vaquero and Carbonell, 2003).

221 The study of the flake assemblage is performed by analyzing the presence (cortex > 50% = cortical
222 flake; cortex < 50% = semi-cortical flake) or absence of the cortex, the number and direction of the
223 detachments on the dorsal face, the angle and the type of striking platform, the flaking axis, the presence of
224 knapping accidents (e.g., overshoot and hinged removal, silet fracture), and the retouch. Retouched tools are
225 distinguished following Bordes' (1961) typological list, and pointed artefacts are discriminated into the
226 following: a) Mousterian point: a triangular/subtriangular blank with a pointed end produced by retouching
227 on both sides, b) point: a triangular/subtriangular blank with a pointed end produced by retouching on one
228 side, and c) convergent tool: a triangular/subtriangular blank with the long axis relatively oblique to the
229 flaking axis and a pointed end produced by retouching on one side. Denticulates and notched tools are
230 analyzed according to Picin et al. (2011). The intensity of the retouch is measured using the modified
231 version of Kuhn's (1990a) geometric index of unifacial reduction (GIUR) (Hiscock and Attenbrow, 2003).
232 The average of three ratios between the height of retouch ("t") and the flake thickness in the same

233 orientation (“T”), following the formula $[(t1/T1+ t2/T2+ t3/T3)/3]$, provides a value between 0 and 1 that
234 estimates the proportion of the original mass removed from the blank through unifacial retouching. In
235 denticulates, the GIUR is calculated on the concavities, and the average is performed at times on two ratios
236 between the height of retouch (“t”) and the flake thickness in the same orientation (“T”). In notched tools,
237 the GIUR is calculated by multiplying the sine of the angle of retouch (*a*) by the extension of the retouch
238 scar (D) with the maximum thickness at the center of the blank (T) using the formula $[\sin a (D)/T]$ (Kuhn,
239 1990b).

240 3. Results

241 3.1 Sub-unit IIIb

242 The lithic assemblage of the sub-unit IIIb is composed of 3,314 lithic artefacts. Among these items, 1,950
243 are quartz (59%), mostly knapped at the site, and the remaining 1,364 stone artefacts are produced on other
244 raw materials (41%) . In this latter collection, chert (73%) is the most common, whereas quartzite (11%),
245 hornfels (6%), limestone (6%), and other rocks are documented the least (Fig. 2). The analysis of the core
246 assemblage indicates that the use of the Levallois technology is limited only to chert artefacts and that
247 the use of hierarchized configuration of the core volume is recorded in chert and hornfels (Table 1). The
248 Levallois recurrent unidirectional core is an exhausted and small artefact characterized by an overshoot
249 removal and two smaller detachments on the lateral side. Similarly, the second Levallois recurrent
250 centripetal core arrived at the site already exhausted, and the refitted pieces show different stages of re-
251 utilization (Fig. 3 n. 2). After a knapping accident, a portion of the core was removed, and the fracture was
252 used as a new striking platform for continuing the Levallois production. A second knapping accident broke
253 another portion of the artefact, and then the core was discarded (Fig. 3 n. 2). The hierarchized cores in chert
254 and hornfels show similar technical expedients with the preparation of the striking platforms and a
255 centripetal exploitation of the flaking surfaces (Fig. 3 n. 1, 3). Similar to the Levallois artefacts, lithic
256 production is aimed at small flakes smaller than 3 cm. The remaining chert cores show the broader use of
257 a simpler method as unidirectional, centripetal, or bidirectional (Table 1). These artefacts are reduced
258 opportunistically. A striking example is a small and broken chert blank in which the fracture is used as a
259 new striking platform for the detachment of two small flakes (Fig. 3 n. 5-7). In the assemblage of the other
260 raw materials, a semi-cortical flake is produced from a portion of a limestone pebble, and three quartzite
261 cores attest the use of the centripetal method. In one core, a centripetal flake is refitted (Fig. 3 n. 4).

262 In the assemblage, the discovery of a small amount of core-on-flakes shows a change in the function
263 of some flakes from the cutting tools to the source for blanks (Table 1), corroborating a technical behavior
264 of the ramification of the lithic production (Bourguignon, et al., 2004, McPherron, 2009). Cortical elements

265 are the preferred blanks for core-on-flake in chert (55.5%), quartzite, and limestone. The striking platforms
266 are prepared by truncating one or two proximal sides of the flake, detaching up to four flakes from the
267 ventral surface. The blanks produced are small with a mean size of 12.4 ± 2.2 mm.

268 The study on the flake collection reveals the presence of artefacts from different phases of reduction
269 (Table 2). However, refitting analysis highlights only two examples of refitted fragments in chert, three
270 examples of knapping refitting between the flakes in chert, and one refitting of a centripetal flake with the
271 core in quartzite. These data indicate that the knapping activities at the site using chert and metamorphic
272 rocks are rare. A broad comparison of the frequencies of complete flakes by stage of reduction shows that
273 the phase of decortication is underrepresented in chert, quartzite, and hornfels, absent in sandstone and
274 slate, and common in limestone and lydian stone (Fig. 4). The pre-determined by-products, such as
275 Levallois flakes or other commonly transported blanks, as core-edge removal flakes and pseudo-Levallois
276 points are documented in lesser frequencies than, for example, ordinary flakes or the by-products of the
277 preparation of the striking platform (Table 2, Fig. 3 n. 8-9). In lydian stone, porphyry, sandstone, or slate
278 raw materials, the artefacts comprise mostly isolated objects that are transported at the site after different
279 knapping events (Fig. 3 n. 10).

280 In the high-mobility context, the size of the transported artefacts affects the portability of the lithic
281 toolkit (Kuhn, 1992). Therefore, to reveal the characteristics of these transported objects, the metric features
282 of the complete flakes are analyzed (Fig. 5). The comparison of the length distribution indicates that the
283 bulk of the flake assemblage is less than or equal to 30 mm and that few longer blanks are documented in
284 the chert raw material (Fig. 5). The flakes are also small in quartzite, and some blanks are larger than 30
285 mm in limestone and hornfels. However, a detailed analysis of the length size by reduction stage indicates
286 that the median values of the cortical flakes are generally larger than those of the non-cortical flakes (Fig.
287 6), and the chert artefacts have median values smaller than those of quartzite and limestone (Fig. 6). A
288 statistical comparison reveals a significant difference in the median values of the flake length between chert
289 and quartzite (cortical flakes: Mann–Whitney test, $p=0.0186$; non-cortical flakes: Mann–Whitney test,
290 $p=0.0035$) and between chert and limestone (cortical flakes: Mann–Whitney test, $p=0.0387$; non-cortical
291 flakes: Mann–Whitney test, $p=0.0002$). Conversely, no difference is recorded in the median flake length
292 values between quartzite and limestone (cortical flakes: Mann–Whitney test, $p=0.5147$; non-cortical flakes:
293 Mann–Whitney, $p=0.1598$). The flake length shows a significant correlation with weight values in chert
294 ($n=333$, $r=0.9015$, $p< 0.0001$), quartzite ($n=62$, $r=0.9321$, $p< 0.0001$), limestone ($n=35$, $r=0.7495$, $p<$
295 0.0001), and hornfels ($n=44$, $r=0.8230$, $p< 0.0001$). However, a comparison between the assemblages
296 reveals that, by similar length values, quartzite and hornfels flakes are weightier than chert and limestone
297 flakes (Fig. 7). Moreover, the linear regression model indicates that the differences between the slopes are
298 extremely significant ($F=22.3326$, $DFn=3$, $DFd=466$, $p=> 0.0001$). Levallois flakes in the different raw

299 materials have similar median length sizes (Kruskal–Wallis test: $p=0.9884$), and the comparison of the
300 relation between the length and the weight indicates that the samples in other raw materials reenter in the
301 variability of the Levallois blanks in chert (Fig. 8).

302 The assemblage of retouched tools is composed of scrapers, convergent tools, and denticulates
303 (Table 3, Fig. 3 n. 14). The technical behavior of re-sharpening the cutting edges is common in chert
304 artefacts but rare in quartzite and in other raw materials (Table 3). This pattern is also supported by the
305 discovery of some flakes retouched in chert. However, these types of items are absent in the assemblages
306 of the other rocks. Cortical elements (51.2%) and core–edge removal flakes (12.1%) are preferred as blanks
307 for scrapers in chert. These tools have larger length values (mean= 37.89 ± 11.05 mm) than the *débitage*
308 items (mean= 22.91 ± 10.51 mm), although their size remains small. The calculation of the GIUR indicates
309 similar values in the scrapers between chert (GIUR index: 0.51 ± 0.17) and jasper (GIUR index: 0.55), and
310 the artefact in quartzite is more resharpened (GIUR index: 0.87). Note that two scrapers in the chert
311 assemblage have the retouch types Quina and demi-Quina, respectively (Fig. 3 n. 12). Before discard, the
312 latter stone tool undergoes an ulterior reduction, and two flakes are detached from the ventral side of the
313 cutting edge (Fig. 3). The thinning of the ventral surface, which is probably used for a better handling of
314 the tool during the actions of cutting, is present in five scrapers, and in most of them, the bulb is removed.

315 Convergent tools, points, and Mousterian points are shaped principally in chert flakes (Fig. 3 n. 11,
316 13), and only three examples in quartzite are recorded (Table 3). Blanks knapped during different stages of
317 reduction are used for their manufacture without any particular preference, and Levallois flakes are
318 documented only in two convergent tools in chert. The lengths of the Mousterian points (mean= 32.4 ± 7.4
319 mm) and points (mean= 33.88 ± 11.96 mm) in chert are slightly smaller than those of the convergent tools
320 (mean= 43.09 ± 10.41 mm), and no significant differences are recorded between their median values
321 (Kruskal–Wallis test: $p=0.3039$). The comparison between the length and weight of the scrapers and pointed
322 artefacts shows that they share the same dimensional variability and that only one Mousterian point exhibits
323 a lower weight value (Fig. 9). Conversely, the quartzite stone tools have larger weight values, although they
324 are included in the range of chert items (Fig. 9).

325 In the assemblage of retouched tools, several denticulates and notched tools are also found. The
326 artefacts in chert show a preference for notched tools characterized by a single concavity (1Ns: simple
327 notch) and denticulates with two or more than three concavities (Table 3). The quartzite raw material is
328 documented to have a complex notched tool (1Nc) characterized by a concavity produced by contiguous
329 removals and few denticulates. In other raw materials, the production of these types of stone tools is sparse
330 (Table 3). The use of cortical elements is common in chert (49%), quartzite (50%), and hornfels. The length
331 values of the notched tools and denticulates in chert (mean: 35.06 ± 11.8 mm) and quartzite (mean: 38.47
332 ± 9.1 mm) are slighter larger than those of the pointed artefacts and similar to those of scrapers. The

333 comparison of the length and weight shows a separation between the denticulates in chert and between the
334 denticulates and the notched tools in metamorphic rocks (Fig. 10). The calculation of the intensity of retouch
335 shows analogous values for denticulates in chert (GIUR index: 0.74 ± 0.13), quartzite (GIUR index: $0.71 \pm$
336 0.15), and lydian stone (GIUR index: 0.8) and smaller values in sandstone (GIUR index: 0.56 ± 0.19) and
337 hornfels (GIUR index: 0.67). The notched tools in chert (GIUR index: 0.83 ± 0.13) and quartzite (GIUR
338 index: 0.94) also have comparable results with denticulates, and the limestone simple notch has lower
339 values (GIUR index: 0.37).

340 **3.2 Sub-unit IIIa**

341 The lithic assemblage of the sub-unit IIIa is composed of 500 artefacts, among 348 items are in quartz
342 (69%) mostly knapped at the sites, and the remaining 152 stone tools are knapped in different raw materials.
343 In this latter collection, the use of chert (65%) is recurrent and that of quartzite (9%), limestone (13%),
344 hornfels (4%), and other rocks is recorded in lesser frequency (Fig. 2). The analysis reveals a small amount
345 of cores, and Levallois technology is documented in two examples (Table 4). The Levallois recurrent
346 centripetal core in chert is an exhausted artefact exhibited on the flaking surface in the production of four
347 flakes smaller than 20 mm. The latter one removes a thicker portion of the striking platform, and then the
348 core is discarded. The other Levallois core is also exhausted and characterized by the use of the preferential
349 modality for the production of a flake smaller than 30 mm (Fig. 11 n. 1). The other artefacts include two
350 core-on-flakes on the cortical elements (Table 4 Fig. 11 n. 5). In both examples, the striking platforms are
351 prepared by truncating a proximal side of the flake, and the ventral reductions are removed by the bulbs.
352 The blanks produced are small with a mean size of 17.6 ± 5.5 mm.

353 The study on the flake assemblage shows a high fragmentation of the operative chains with few
354 artefacts by technological phases (Table 5, Fig. 11 n. 2–4, 7–11, 14), and no refittings have been found thus
355 far. The comparison of the frequencies of the complete flakes by stage of reduction shows that, in quartzite
356 and limestone, the phase of decortication is underrepresented at the beginning of nodule reduction, and the
357 cortical elements are common in chert (Fig. 4). The transport of knapping by-products is common in chert,
358 quartzite, and hornfels, whereas only a few isolated examples are recorded in the other rocks (Table 5). The
359 fragmented character of the flake assemblage is evident by comparing the length of complete flakes (Fig.
360 5). Small flakes are frequent in chert and hornfels, although the latter also records the longest artefacts of
361 the assemblage. In the quartzite collection, blanks are larger than 40 mm, and the bulk of the flakes is 30–
362 40 mm in limestone (Fig. 5). The comparison of the median values of the length of unbroken flakes in chert
363 shows that the cortical elements are larger than the non-cortical blanks (Fig. 6), and no significant
364 differences are found in the chert flakes of sub-unit IIIb (cortical flakes: Mann–Whitney test, $p=0.3642$;
365 non-cortical flakes: Mann–Whitney, $p=0.1772$). The flake length shows a significant correlation with

366 weight value in chert ($n=34$, $r=0.8821$, $p < 0.0001$) and hornfels ($n=5$, $r=1$, $p=0.0167$) but not in quartzite
367 ($n=6$, $r=0.2206$, $p=0.6583$) and limestone ($n=8$, $r=0.6826$, $p=0.6584$). The linear regression model reveals
368 that, by similar length values, the limestone and hornfels artefacts are weightier than the chert and quartzite
369 artefacts (Fig. 7), although the difference between the slopes is not significant ($F=2.59402$, $DFn=3$, $Dfd=45$,
370 $p=0.06417$). The Levallois flakes in chert have similar sizes with the Levallois blanks of sub-unit IIIb, and
371 the only example for hornfels has larger values (Fig. 8).

372 The assemblage of retouched tools is composed mostly of scrapers, pointed artefacts, and
373 denticulates in chert, whereas isolated objects are recorded in other raw materials (Table 6, Fig. 11 n.6, 12,
374 13, 15). The preferred blanks for the re-sharpening of the cutting edges are cortical (38%) and *débordant*
375 (23.8%) elements. In the chert assemblage, the stone tools (mean= 37.89 ± 11.05 mm) have larger mean
376 length values than the *débitage* flakes (mean= 22.05 ± 10.15 mm). The comparison of the length versus the
377 weight values shows that most of the retouched tools of the sub-unit IIIa reenters in the size variability of
378 chert scrapers and chert points and that the quartzite Mousterian point and the Lydian stone convergent tool
379 have larger values (Fig. 9). The calculation of the GIUR of scrapers in chert (GIUR index: 0.47 ± 0.33)
380 indicates lower values in comparison with the retouched tools of sub-unit IIIb. In the collection of pointed
381 artefacts, only one Levallois flake in sandstone is transformed into a Mousterian point, and no clear pattern
382 is observed in the selection of blanks in the remaining pointed tools. Denticulates are documented only in
383 chert, and most of them are characterized by two concavities and inverse retouching (Table 6).

384 4. Discussion

385 The analysis of the lithic collection of sub-units IIIb and IIIa at Teixoneres Cave reveals new insight into
386 the composition of artefacts transported by Neanderthals during their foraging activities in the surrounding
387 areas of the Moianès plateau. The study reveals the use of lithic sources scattered at a semi-local distance
388 from the site (5–15 km) with a clear preference for chert nodules (Table 1-6). The comparison of the raw
389 material units and the reconstruction of the technical behaviors point out that these transported artefacts are
390 isolated pieces, or by-products of operative chains carried out elsewhere in the landscape. The technological
391 reconstruction indicates that the bulk of the toolkits is composed of flakes produced during the different
392 stages of the knapping process, and the typically transported by-products (e.g., Levallois flakes, pseudo-
393 Levallois points) are underrepresented in comparison with ordinary flakes or blanks in the management of
394 core convexities (Table 2, 5). As the occupational horizons of sub-unit IIIb and IIIa are interpreted as
395 palimpsests of the recurrent short-term occupations (Rosell, et al., 2017, Sánchez-Hernández, et al., 2014,
396 Talamo, et al., 2016), the diversity of technological categories found in the lithic series points out that
397 Neanderthals were highly flexible in the selection of blanks to be transported on the way to Teixoneres
398 Cave. This behavioral plasticity is also supported by the near-absence of flake refittings, suggesting that,

399 beyond a few examples, majority of the chert artefacts were not knapped at the site but voluntarily carried
400 to satisfy the possible need for cutting edges all the way through the forays. During the displacements to
401 the cave, Levallois and hierarchized cores were rarely transported, and small artefacts, reduced using simple
402 methods (e.g., unidirectional, bidirectional, centripetal), were preferred (Table 1, 3). Although Levallois
403 flakes are present in both assemblages (Table 2, 4), the discovery of several expedient cores points out that,
404 at times, ordinary flakes produced from small chunks or pebbles were sufficient in fulfilling the butchering
405 or other domestic tasks. Therefore, Neanderthals moving around the Moianès plateau appeared to be
406 occasionally interested in flakes with particular technical features (e.g., Levallois flake, pseudo-Levallois
407 point) and relied on blanks with different morphologies. This behavior can be correlated with the relative
408 short distance from the place of foray to the site. For longer displacements, Neanderthals could have applied
409 different strategies and included in the toolkits larger flakes and stone tools (Delagnes and Rendu, 2011,
410 Picin and Carbonell, 2016, Turq, et al., 2017, Turq, et al., 2013, Vaquero, 2011).

411 Another common characteristic of both core assemblages is the production of small blanks,
412 generally shorter than 30 mm (Fig. 5). Although the dimension of the chert nodules found in the primary
413 and secondary deposits are generally small (Mangado, et al., 2006), the application of centripetal methods,
414 the recycling of short fragments, or the prolongation of knapping activities on broken items shows a sharp
415 tendency to produce short blanks. In other Middle Paleolithic contexts, the reduced sizes of the chert pebbles
416 were contrasted with the use of uni- and bidirectional core reduction strategies to maximize the exploitation
417 of the flaking surfaces (Grimaldi, 1998, Kuhn, 1995, Picin, 2017). Therefore, the maintenance of technical
418 behaviors related to the production of small flakes with limited possibilities of being resharpened implies
419 the relative abundance in the territory of other rocks suitable for knapping that could be used in case of
420 shortage of cutting edges. The isolated artifacts in lydian stone, porphyry, sandstone, gabbro, or slate would
421 reenter in this dynamics, opportunistically enlarging the spectrum of raw materials when the particular need
422 arises. A similar condition can be suggested for the blanks in quartzite, limestone, and hornfels, although
423 their amount in the assemblages is larger (Table 1-8). In fact, even if the cobbles of these raw materials can
424 be found in the nearby Mal stream, the high fragmentations of the operative chains and the absence of
425 refitting suggest that they were knapped elsewhere in the landscape and not *in situ*. Conversely, the
426 complete reduction sequences were accomplished only with quartz pebbles, which are abundant in the Mal
427 stream, and were transported at the site in their natural form and not configured (Picin, et al., 2020).

428 The analysis of the lithic assemblages of sub-units IIIb and IIIa indicates the use of mixed strategies.
429 The transport of small flakes and cores in chert, which is characterized by a high rate of portability, was
430 complemented by larger artefacts in quartzite, limestone, and hornfels, thus assuring a higher degree of
431 durability (Fig. 6-7). However, these latter flakes were occasionally resharpened, and only chert blanks
432 show a recurrent modification of the cutting edges (Table 3-6). Generally, cortical elements are mostly used

433 for scrapers and denticulates, but only a few of them show an extensive transformation of the original
434 volume, such as bulb thinning or high rates of retouch reduction. This suggests that the artefacts had a short
435 lifetime use and were not transported for long time in the landscape. The presence of several pointed
436 artefacts (Table 3, 6), which are a type of stone tool that is uncommon in Southwestern Europe, should be
437 noted in retouched tools. Beyond the few examples in Cantabria (Lazuén, 2012) and at Abrigo de la
438 Quebrada in the Iberian Levant (Eixea, et al., 2015), the Mousterian toolkit in the Iberian Peninsula is
439 generally dominated by denticulates, scrapers, and flakes (Picin, et al., 2011, Rios-Garaizar, 2017, Torre,
440 et al., 2013). This evidence raises the possibility that the Neanderthals in these regions hafted pointed flakes
441 or relied on wooden spears for their hunting activities (Picin, 2012). A broad comparison with the other
442 stone tools of sub-units IIIb and IIIa reveals that, in terms of length and weight, the Mousterian points and
443 convergent tools are clustered in the lower range of the variability of cutting tools (Fig. 9). This result
444 emphasizes that a certain selection was made for blanks assigned for the production of points. Further
445 studies on use–wear analysis can determine whether some of these pointed artefacts had been hafted in
446 wooden implements or if the tip fractures could be related to the impact scars from hunting activities.

447 The transport capacities of hunter–gatherers are limited, and their mobile toolkit reflects a
448 combination of portability, durability, and efficiency (Binford, 1979, Kuhn, 1994, Shott, 1996). In the
449 ethnographic context, the carrying constraints are generally solved by transporting lightweight and
450 multifunctional tools to be used in a wide range of tasks (Binford, 1979, Shott, 1986). This strategy has
451 been documented in groups of different environments during residential displacements, whereas in
452 logistical forays, the search for specific resources promotes the transport for more specialized tools
453 (Binford, 1980, Kelly, 1995). In the latter case, the portability and durability of the toolkit can decrease in
454 favor of enhancing efficiency for the planned task, as the activity is provisory and performed in the
455 neighborhood of the base camp (Binford, 1978, Binford, 1980, Kelly, 1995, Oswalt, 1976). In a
456 computational model, Kuhn (1994) demonstrated that small flakes have higher values of utility/mass ratio,
457 and, in terms of portability, a toolkit composed of several retouched tools and small flakes is more efficient
458 than carrying a core of equivalent mass. Therefore, the analysis of the transported artefacts of sub-units IIIb
459 and IIIa of Teixoneres Cave is similar to the evidence recorded in ethnography and in Kuhn’s (1994) model.
460 Studies on the seasonality of ungulates teeth indicate recurrent short-term occupations during summer and
461 winter in sub-unit IIIb and a succession of seasonal short-term occupations all year round in sub-unit IIIa
462 (Sánchez-Hernández, et al., 2014). During these cyclical movements, Neanderthals moved to Teixoneres
463 Cave carrying lightweight toolkits with a few flakes and stone tools. This behavior implies that
464 Neanderthals not only had good knowledge of the seasonal availability of animal resources in the area
465 (Rosell, et al., 2017, Rufà, et al., 2014) but also of the abundance of quartz pebbles in the nearby Mal
466 stream. Although quartz has lower knapping properties than chert or metamorphic rocks, the repeated

467 exploitation of this raw material at the site during short stays highlights the broad behavioral plasticity of
468 Neanderthals in land use and management.

469

470 **4.1 Mobile toolkit in the carnivore and residential contexts**

471 Archaeological data on the Eurasian Middle Paleolithic records indicate that Neanderthals were
472 highly mobile, moving their residential base on the landscape frequently and settling in different locations
473 (e.g., riverbanks, lakeshores, foothills, mountainous ranges) based on the distribution of resources. During
474 these displacements in the territory, Neanderthals accomplished different tasks (e.g., hunting, bivouac,
475 resting, gear retooling), and the composition of the transported artefacts varied in relation to the activity to
476 be performed, the foraging radius, the availability of raw material sources, and the duration of the settlement
477 (Delagnes and Rendu, 2011, Roebroeks, 1988, Turq, et al., 2017, Turq, et al., 2013). At Teixoneres Cave,
478 Neanderthals arrived at the site after hunting, carrying the appendicular portions of the ungulates richest in
479 meat and marrow and a lightweight toolkit comprising heterogeneous artefacts (Rosell, et al., 2010, Rosell,
480 et al., 2017, Talamo, et al., 2016). Once at the site, the domestic activities were performed around hearths,
481 and local quartz pebbles were knapped *in situ* to provide fresh cutting edges to slice the meat and extract
482 the marrow (Picin, et al., 2020, Rosell, et al., 2010, Rosell, et al., 2017, Talamo, et al., 2016). The mobile
483 toolkit transported at the site is a combination of hunting tools (e.g., Mousterian points, convergent tools)
484 and cutting artefacts (e.g., flakes, scrapers) used during the primary butchery of the chased preys. This
485 variety of lithic artefacts is common in kill sites such as Nahal Mahanayeem Outlet (Israel), where hunting
486 and butchering tools were discarded after the processing of aurochs (*Bos primigenius*) (Sharon, 2018,
487 Sharon and Oron, 2014), or in hunting camps such as Biache Saint-Vaast (France), where a broad spectrum
488 of animals (e.g., aurochs, bears, rhino, elephant, red deer, and horse) was processed, curated tools (e.g.,
489 Mousterian points, scrapers) were imported, and high-quality chert pebbles were exploited (Auguste, 1995,
490 Hérison, 2012).

491 In the northeast of the Iberian Peninsula, economic behaviors similar to those recorded at
492 Teixoneres are found in the eastern fringe of the Pyrenees, specifically at the Arbreda Cave (Serinyà, Spain),
493 which is a natural shelter that was used as a hibernation and breeding site by cave bears during winter and
494 occasionally visited by other large carnivores (e.g., hyenas, wolves, leopards) after the human settlements
495 (Lloveras, et al., 2018, Lloveras, et al., 2010, Maroto, et al., 2001). In the late Middle Paleolithic sequence,
496 Neanderthals exploited mostly the local quartz and, in lesser frequency, the metamorphic rocks abundant
497 in the fluvial terraces of Fluvià and Ser Rivers (Duran and Soler, 2006). Although the bulk of the lithic
498 assemblages was gathered at a radius of less than or equal to 5 km, the mobile toolkit was composed of
499 Levallois artefacts, core–edge removal flakes, and cortical elements produced from the flint formations of

500 Roquefort-des-Corbières (approximately 25 km from the site), d'Attrape Councils (approximately 80 km),
501 and Bages-Sigean (approximately 100 km) in southeastern France (Duran and Soler, 2006). The stone tool
502 collection comprises mostly of scrapers and denticulates. Although convergent tools are absent, Levallois
503 points and flakes with triangular morphologies are common (Duran and Soler, 2006).

504 In other sites northeast of the Iberian Peninsula, where the Neanderthals' seasonal occupations were
505 spaced out by the visiting of carnivores, the composition of the mobile toolkit varies, but pointed artefacts
506 are generally missing. In the Alta Garrotxa, the Ermitons and 120 Cave were used as hibernation and
507 breeding sites by bears during winter and occasionally settled by Neanderthals as bivouacs (Agustí, et al.,
508 1991, Maroto, et al., 1996). The lithic collections of both caves are small and mostly composed of scrapers
509 and denticulates on chert, originating from the carbonated formations of the Lower Eocene, and on
510 metamorphic rocks, gathered in the nearby Llierca River and its tributaries (Agustí, et al., 1991, Maroto, et
511 al., 1996, Ortega and Maroto, 2001).

512 In southwestern Pyrenees at Llenes Cave (Erinyá, Spain), carnivore activities by cave bears and
513 hyenas are documented in the deepest areas of the natural shelter, whereas Neanderthals bivouacked mostly
514 near the entrance (Arilla, et al., 2013). The small lithic collection is made of quartzite, chert, hornfels, and
515 quartz collected in the nearby fluvial terraces and Neogene conglomerates, and it mainly includes flakes,
516 knapping by-products, and denticulates (Picin, et al., 2020). Similarly, Gabasa Cave (Gabasa, Spain) was
517 occupied by hyenas and bears during winter and settled by Neanderthals in other seasons for hunting red
518 deer and horses (Blasco, 1997, Utrilla, et al., 2010). Although the location of the chert sources is still
519 unknown, the use of ophite and quartzite cobbles, abundant at the bottom of the cave, is low. The lithic
520 assemblages are characterized by configured cores, flakes from different stages of reduction, and scrapers
521 mostly shaped on cortical *débordant* or core–edge removal flakes (Santamaría, et al., 2008).

522 In other carnivore dens, the Neanderthals' visits were short and opportunistic, leaving few traces
523 of their stay. At Cova del Coll Verdaguer (Coll Verdaguer, Spain), the anthropogenic evidence is attested
524 by a handful of pseudo-Levallois points and core–edge removal flakes. This finding suggests that
525 Neanderthals only took shelter in the cave during their forays in the Garraf Massif (Daura, et al., 2017).
526 Similarly, at Cova del Gegant (Sitges, Spain), Neanderthals built fires in a bone horizon previously
527 deposited by hyenas without leaving any other trace of domestic activities (Sanz, et al., 2017).

528 In other late Middle Paleolithic Catalan sites, although they are characterized by residential
529 contexts, the patterns of raw material economy and artefact mobility are generally different from those
530 documented at Teixonerés Cave. At Abric Romaní (Capellades, Spain), a rock shelter located at 50 km
531 southwest of the Moianès plateau, limestone, sandstone, and quartz pebbles at the primary and secondary
532 positions are present at a radius of 5 km but are rarely used for knapping activities at some levels.
533 Neanderthals preferred to gather chert pebbles from Tertiary deposits of the Ebro basin located at a different

534 distance from the site [St. Genís formation ($\geq 15\text{--}18$ km) and Montemaneu formation ($\geq 22\text{--}26$ km)]
535 (Chacón, et al., 2013, Gómez de Soler, 2016, Vaquero, et al., 2012). Generally, chert nodules were imported
536 at the site as configured cores and reduced using expedient methods, discoid, and Levallois at levels O and
537 E (Bargalló, et al., 2016, Chacón, 2009, Picin and Carbonell, 2016, Vaquero, et al., 2012, Vaquero, et al.,
538 2001). Although the provision of raw materials from these outcrops remained stable throughout the
539 sequence, changes in the composition of the mobile toolkit were recorded at different events of occupations
540 of the same horizon. In thick palimpsests (e.g., level E, J, L, M, and O), prepared chert cores were
541 transported at the site at the beginning of the settlement, but as the volume of lithic artefacts increased after
542 repeated occupations, cores and flakes from previous reduction sequences were reused for producing small
543 blanks, cobble fragments were reutilized as hammerstones, and exhausted cores were recycled in retouched
544 tools (Vaquero, 2011, Vaquero, et al., 2015, Vaquero, et al., 2019). Thus, during the later phases of the
545 occupations, the behavior of raw material provisioning changed, favoring the recycling of the discarded
546 lithic items and the transport of lightweight mobile toolkit (e.g., pseudo-Levallois points, core–edge
547 removal flakes) (Vaquero, 2008, Vaquero, et al., 2012, Vaquero, et al., 2019). Diachronic changes in the
548 transported artefacts are also verified in the far distant Panadella-Montemaneu zone (PAN) source,
549 characterized by chert nodules of best quality and aptitude for knapping. At level O, cores in PAN chert
550 were carried and knapped at the site, whereas at the younger levels M and J, this raw material entered the
551 site as isolated artefacts produced during different reduction stages (Chacon, et al., 2015, Picin and
552 Carbonell, 2016, Vaquero, et al., 2012). These differences in the transported artefacts (cores vs. flakes)
553 between archaeological levels could have been the result of changes in the areas exploited for the foraging
554 activities or in the duration of the settlements (Picin and Carbonell, 2016).

555 In the southwestern Pyrenees (Noguera, Spain) at Roca del Bous level N10, Neanderthals visited
556 the natural shelter for repeated short-term occupations before moving to other locations (Martínez-Moreno,
557 et al., 2004). Lithic studies found that the local quartzite, which was abundant in the proximity of the site,
558 was used in lesser frequency than chert gathered about 15 km far away (Mora, et al., 2004). During the
559 displacement to the cave, the configured cores in chert were transported to the site and then reduced until
560 exhaustion using the Levallois method (Mora, et al., 2004). The intensive exploitation of the raw material
561 and the production of small flakes are also recorded in quartzite cores even if metamorphic rocks are plenty
562 in the nearby terrace of the Segre River. Similarly to the Abric Romaní, the lithic materials left at the site
563 from previous occupations were recycled afterwards, and cores and flakes were reused for the production
564 of small blanks or retouched tools (Mora, et al., 2004).

565

566

567 **5. Conclusion**

568 This study on the lithic assemblages of units IIIb and IIIa of Teixoneres Cave reveals that, during their
569 displacements to the Toll karstic system, Neanderthals transported a wide range of flakes, tools, and cores
570 (Table 1-6). The excavation in the extension of the archaeological units and the near absence of refitting
571 corroborate the hypothesis that these artefacts were carried to the natural shelter and not produced at the
572 site. This unique circumstance enabled the exploration of the variability of the Neanderthals' toolkit in the
573 high-mobility context in a semi-local environment. Surprisingly, the bulk of the toolkit is composed of
574 knapping by-products and blanks, which are usually interpreted as waste of the lithic production with little
575 utility value; the number of curated artefacts and Levallois flakes is significantly low (Table 1-6). These
576 data point out that Neanderthals preferred chert nodules for their lithic production, and other raw materials
577 were knapped only during events of shortage to cope with the need for fresh cutting edges. The transport
578 of isolated items in metamorphic, sedimentary, and igneous rocks suggests that, in these situations of
579 demand, the gathering of cobbles was unselective and probably related to their abundance in the vicinity of
580 the location where the activity was carried out.

581 A broad comparison of ethnographic observations indicates that the toolkit is composed of a
582 combination of hunting and cutting tools, suggesting that the main strategy of transport was aimed at a more
583 generalized set of tools instead of a few specialized items. In comparison with that in other Middle
584 Paleolithic sites in the region, the evidence at Teixoneres Cave is in agreement with other short-term
585 settlements in the carnivore context. Although human occupations are spaced out by those of hyenas and
586 cave bears, the import of flakes and the exploitation of local sources is a recurrent pattern. Conversely, in
587 the residential context, the strategies of raw material management aim to transport chert nodules and
588 configured cores to knap *on-site*.

589 The findings on the toolkit composition at Teixoneres Cave report the use and the carrying of
590 artefacts that are generally associated with reduction events performed at the natural shelter in the local and
591 semi-local foraging contexts. This result is pivotal for highlighting the Neanderthals' behavioral plasticity
592 in preparing their toolkit in advance of anticipated use. Future works on the microscopic discrimination and
593 association of the raw material types and units of the lithic assemblages with the outcrops can determine
594 the main corridors of movements of Neanderthals to Teixoneres Cave and explain in more detail the
595 composition of personal gear.

596
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608 **References**

- 609 Agustí, B., Alcalde, G., Güell, A., Juan-Muns, N., Rueda, J.M., Terradas, X., 1991. La cove 120, parada
610 de caçadors-recollectors del paleolític mitjà, *Cypsela IX*, 7-20.
- 611 Airvaux, J., Primault, J., Beauval, C., 2012. Le site du Moustérien récent de La Ganne à Mazerolles et les
612 repaires d'hyènes des Plumettes et des Rochers de Villeneuve à Lussac-les-Châteaux (Vienne).
613 Hypothèses sur la relation Homme - Carnivores, *Bulletin Préhistoire du Sud-Ouest* 20, 1-37.
- 614 Álvarez-Lao, D., Rivals, F., Sánchez-Hernández, C., Blasco, R., Rosell, J., 2017. Ungulates from
615 Teixoneres cave (Moià, Barcelona, Spain): presence of cold adapted elements in NE Iberia during the
616 MIS 3, *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 466, 287-302.
- 617 Andrefsky, W., 1994. Raw material availability and the organization of technology, *Am. Antiquity* 59,
618 21-34.
- 619 Andrefsky, W., 2006. Experimental and Archaeological Verification of an Index of Retouch for Hafted
620 Bifaces, *Am. Antiquity* 71, 743-757.
- 621 Andrefsky, W., 2009. The Analysis of Stone Tool Procurement, Production, and Maintenance, *J*
622 *Archaeol. Res.* 17, 65-103.
- 623 Aranguren, B., Revedin, A., Amico, N., Cavulli, F., Giachi, G., Grimaldi, S., Macchioni, N., Santaniello,
624 F., 2018. Wooden tools and fire technology in the early Neanderthal site of Poggetti Vecchi (Italy), *Proc.*
625 *Natl. Acad. Sci.* 115, 2054-2059.
- 626 Arilla, M., Rosell, J., Camarós, E., Blasco, R., Fàbregas, J., Rafel, N., Gallart, J., Piera, M., 2013.
627 Neanderthals a les portes del Pirineu: explorant la Cova de Les Llenes d'Erinyà (Conca de Dalt, Pallars
628 Jussà), *Primeres Jornades d'Archaeologia i Paleontologia del Pirineu i Aran*, 84-87.
- 629 Auguste, P., 1995. Cadres biostratigraphique et paléoécologique du peuplement humain dans la France
630 septentrionale durant la Pléistocène. Apports de l'étude paléontologique des grands mammifères du
631 gisement de Biache-Saint-Vaast (Pas-de-Calais), Ph.D. Thesis unpublished, Muséum national d'histoire
632 naturelle, Paris, p. 1924.
- 633 Bamforth, D.B., 1986. Technological efficiency and tool curation, *Am. Antiquity* 51, 38-50.
- 634 Bamforth, D.B., 1991. Technological Organization and Hunter-Gatherer Land Use: A California
635 Example, *Am. Antiquity* 56, 216-234.

- 636 Bamforth, D.B., Bleed, P., 1997. Technology, Flaked Stone Technology, and Risk, *Archeological Papers*
637 *of the American Anthropological Association* 7, 109-139.
- 638 Bargalló, A., Gabucio, M.J., Rivals, F., 2016. Puzzling out a palimpsest: Testing an interdisciplinary
639 study in level O of Abric Romaní, *Quatern. Int.* 417, 51-65.
- 640 Beck, C., Taylor, A.K., Jones, G.T., Fadem, C.M., Cook, C.R., Millward, S.A., 2002. Rocks are heavy:
641 transport costs and Paleoarchaic quarry behavior in the Great Basin, *J. Anthropol. Archaeol.* 21, 481-507.
- 642 Binford, L.R., 1977. Forty-seven Trips, in: Wright, R.V.S. (Ed.), *Stone Tools as Cultural Markers*,
643 *Australian Institute of Aboriginal Studies, Canberra*, pp. 24-36.
- 644 Binford, L.R., 1978. *Nunamiut Ethnoarchaeology: A Case Study in Archaeological Formation Processes*,
645 *Academic Press, New York, New York*.
- 646 Binford, L.R., 1979. *Organization and Formation Processes: Looking at Curated Technologies*, *J.*
647 *Anthropol. Res.* 35, 255-273.
- 648 Binford, L.R., 1980. Willow smoke and dogs' tail: Hunter-gatherer settlement system and archaeological
649 site formation, *Am. Antiquity* 45, 4-20.
- 650 Binford, L.R., 1982. The archaeology of place, *J. Anthropol. Archaeol.* 1, 5-31.
- 651 Binford, L.R., 2001. *Constructing frames of reference: an analytical method for archaeological theory*
652 *building using ethnographic and environmental data sets*, *Univ of California Press*.
- 653 Blades, B.S., 2003. End Scraper Reduction and Hunter-Gatherer Mobility, *Am. Antiquity* 68, 141-156.
- 654 Blasco, M.F., 1997. In the Pursuit of Game: The Mousterian Cave Site of Gabasa 1 in the Spanish
655 Pyrenees, *J. Anthropol. Res.* 53, 177-217.
- 656 Bleed, P., 1986. The Optimal Design of Hunting Weapons: Maintainability or Reliability, *Am. Antiquity*
657 51, 737-747.
- 658 Boëda, E., 1993. Le débitage discoïde et le débitage Levallois récurrent centripète, *Bull. Soc. Préhist. Fr.*
659 90, 392-404.
- 660 Boëda, E., 2013. *Tech-logique & Technologie. Une Paléo-histoire des objets lithiques tranchants*,
661 *@rchéo-éditions.com, Paris*.
- 662 Boëda, E., Geneste, J.-M., Meignen, L., 1990. Identification de chaînes opératoires lithiques du
663 Paléolithique ancien et moyen, *Paléo* 2, 43-80.
- 664 Bordes, F., 1961. *Typologie du Paléolithique ancien et moyen*, *CNRS, Paris*.
- 665 Bourguignon, L., Faivre, J.-P., Turq, A., 2004. Ramification des chaînes opératoires : Une spécificité du
666 moustérien ?, *Paleo* 16, 37-48.
- 667 Bousman, C.B., 1993. Hunter-Gatherer Adaptations, Economic Risk and Tool Design, *Lithic Technology*
668 18, 59-86.
- 669 Brantingham, P.J., Kuhn, S.L., 2001. Constraints on Levallois Core Technology: A Mathematical Model,
670 *J. Archaeol. Sci.* 28, 747-761.

- 671 Brugal, J.-P., Jaubert, J., 1991. Les gisements paléontologiques pléistocènes à indices de fréquentation
672 humaine : un nouveau type de comportement de prédation ?, *Paléo*, 15-41.
- 673 Carbonell, E., Castro-Curel, Z., 1992. Palaeolithic wooden artefacts from the Abric Romani (Capellades,
674 Barcelona, Spain), *J. Archaeol. Sci.* 19, 707-719.
- 675 Castro-Curel, Z., Carbonell, E., 1995. Wood Pseudomorphs From Level I at Abric Romani, Barcelona,
676 Spain, *Journal of Field Archaeology* 22, 376-384.
- 677 Chacón, M.G., 2009. El Paleolítico medio en el suroeste europeo: Abric Romaní (Capellades, Barcelona,
678 España) Payre (Rompón, Ardèche, Francia) y Tournal (Bize, Aude, Francia). Análisis comparativo de los
679 conjuntos líticos y los comportamientos humanos, *Universitat Rovira i Virgili, Muséum National*
680 *d'Histoire Naturelle, Tarragona*.
- 681 Chacon, M.G., Bargalló, A., Gabucio, J., Rivals, F., Vaquero, M., 2015. Neanderthal Behaviors from a
682 Spatio-Temporal Perspective: An Interdisciplinary Approach to Interpret Archaeological Assemblages,
683 in: Conard, N.J., Delagnes, A. (Eds.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone*
684 *Age, Volume IV*, Kerns Verlag, Tübingen, pp. 253-294.
- 685 Chacón, M.G., Bargalló, A., Gómez de Soler, B., Picin, A., Vaquero, M., Carbonell, E., 2013. Continuity
686 or discontinuity of Neanderthal technological behaviours during MIS 3: level M and level O of the Abric
687 Romaní site (Capellades, Spain), in: Pastoors, A., Auffermanns, B. (Eds.), *Pleistocene Foragers on the*
688 *Iberian Peninsula: Their culture and environment. Wissenschaftliche Schriften des Neanderthal Museum,*
689 *Mettmann*, pp. 55-84.
- 690 Charles, R., 1997. The Exploitation of Carnivores and Other Fur-bearing Mammals during the North-
691 western European Late and Upper Paleolithic and Mesolithic, *Oxford Journal of Archaeology* 16, 253-
692 277.
- 693 Daura, J., Sanz, M., Allué, E., Vaquero, M., López-García, J.M., Sánchez-Marco, A., Domènech, R.,
694 Martinell, J., Carrión, J.S., Ortiz, J.E., Torres, T., Arnold, L.J., Benson, A., Hoffmann, D.L., Skinner,
695 A.R., Julià, R., 2017. Palaeoenvironments of the last Neanderthals in SW Europe (MIS 3): Cova del Coll
696 Verdaguer (Barcelona, NE of Iberian Peninsula), *Quaternary Sci. Rev.* 177, 34-56.
- 697 Delagnes, A., Rendu, W., 2011. Shifts in Neandertal Mobility, Technology and Subsistence Strategies in
698 Western France, *J. Archaeol. Sci.* 38, 1771–1783.
- 699 Dibble, H.L., 1987. The Interpretation of Middle Paleolithic Scraper Morphology, *Am. Antiquity* 52, 109-
700 117.
- 701 Dibble, H.L., 1995. Middle Paleolithic Scraper Reduction: Background, Clarification, and Review of
702 Evidence to Date, *J Archaeol. Method Th.* 2, 299–368.
- 703 Duran, J.-P., Soler, N., 2006. Variabilité des modalités de débitage et des productions lithique dans les
704 industries moustériennes de la grotte de l'Arbreda, sector alpha (Serinyà, Espagne), *Bull. Soc. Préhist. Fr.*
705 103, 241-262.
- 706 Eixea, A., Giner, B., Jardón, P., Zilhão, J., Villaverde Bonilla, V., 2015. Elementos líticos apuntados en el
707 yacimiento del Paleolítico Medio del abrigo de La Quebrada (Chelva, Valencia): caracterización tecno-
708 tipológica y análisis de las macrofacturas, 2015, 32.
- 709 Eren, M.I., Lycett, S.J., 2012. Why Levallois? A morphometric Comparison of experimental
710 "Preferential" Levallois Flake versus Debitage Flakes, *PLOS ONE* 7, e29273.

- 711 Féblot-Augustins, J., 1997. La circulation des matières premières au Paléolithique. Vol. 1 et 2, ERAUL
712 75, Liège.
- 713 Féblot-Augustins, J.J., 2009. Revisiting European Upper Paleolithic Raw Material Transfers: The Demise
714 of the Cultural Ecological Paradigm?, in: Adams, B., Blades, B.S. (Eds.), *Lithic Materials and Paleolithic*
715 *Societies*, Wiley-Blackwell Ltd, Chichester, pp. 25-46.
- 716 Fiorenza, L., Benazzi, S., Henry, A.G., Salazar-García, D.C., Blasco, R., Picin, A., Wroe, S., Kullmer, O.,
717 2015. To meat or not to meat? New perspectives on Neanderthal ecology, *Am. J. Phys. Anthropol.* 156,
718 43-71.
- 719 Gamble, C., 1986. *The palaeolithic settlement of Europe*, Cambridge University Press, Cambridge.
- 720 Geneste, J.-M., 1988. Systèmes d'approvisionnement en matières premières au Paléolithique moyen et au
721 Paléolithique supérieur en Aquitaine, in: Otte, M. (Ed.), *L'Homme de Néandertal. La mutation*, ERAUL,
722 Liège, pp. 61-70.
- 723 Gómez de Soler, B., 2016. Procedencia del aprovisionamiento lítico durante el Paleolítico medio en el
724 yacimiento del Abric Romaní (Capellades, Barcelona). *Niveles M, Oa y P*, Universitat Rovira i Virgili.
- 725 Grimaldi, S., 1998. Analyse technologique, chaîne opératoire et objectifs techniques. Torre in Pietra
726 (Rome, Italie). *Paléo* 10, 109-122.
- 727 Hayden, B., 1993. The cultural capacities of Neandertals: a review and re-evaluation, *J Hum. Evol.* 24,
728 113-146.
- 729 Henry, D.O., 1995. The Influence of Mobility Levels on Levallois Point Production, Late Levantine
730 Mousterian, Southern Jordan, in: L., D.H., Bar-Yosef, O. (Eds.), *The Definition and Interpretation of*
731 *Levallois Technology*, Prehistory Press, Madison, pp. 185-200.
- 732 Hérison, D., 2012. Étude des comportements des premiers Néandertaliens du Nord de la France. Les
733 occupations saaliennes des gisements de Bache-Saint-Vaast et de Therdonne, Université Charles de
734 Gaulle-Lille III.
- 735 Hiscock, P., Attenbrow, V., 2003. Early Australian implement variation: a reduction model, *J. Archaeol.*
736 *Sci.* 30, 239-249.
- 737 Hiscock, P., Turq, A., Faivre, J.-P., Bourguignon, L., 2009. Quina procurement and tool production, in:
738 Adams, A., Blades, B.S. (Eds.), *Lithic Materials and Paleolithic Societies*, Wiley-Blackwell, Chichester
739 (UK), pp. 232-246.
- 740 Hovers, E., 2009. *The Lithic Assemblage of Qafzeh Cave*, Oxford University Press, Oxford.
- 741 Hublin, J.J., Richards, M.P., 2009. *The evolution of the Hominin diets. Integrating approaches to the*
742 *study of Palaeolithic subsistence*, Springer, New York:.
- 743 Inizian, M.-L., Roche, H., Tixier, J., 1992. *Technology of Knapped Stone*, CREP, Meudon.
- 744 Jaouen, K., Richards, M.P., Le Cabec, A., Welker, F., Rendu, W., Hublin, J.-J., Soressi, M., Talamo, S.,
745 2019. Exceptionally high $\delta^{15}\text{N}$ values in collagen single amino acids confirm Neandertals as high-trophic
746 level carnivores. *Proc. Natl. Acad. Sci.* 116, 4928-4933.
- 747 Jennings, T.A., Pevny, C.D., Dickens, W.A., 2010. A biface and blade core efficiency experiment:
748 implications for Early Paleoindian technological organization, *J. Archaeol. Sci.* 37, 2155-2164.

- 749 Jeske, R.J., 1992. Energetic Efficiency and Lithic Technology: An Upper Mississippian Example, *Am.*
750 *Antiquity* 57, 467-481.
- 751 Jöris, O., 2006. Bifacially backed knives (Keilmesser) in the Central European Middle Palaeolithic, in:
752 Goren-Imbar, N., Sharon, G. (Eds.), *Axe Age. Acheulian Tool-making from Quarry to Discard*, Equinox
753 Publishing, London, pp. 287-310.
- 754 Kelly, R.L., 1983. Hunter-gatherer mobility strategies, *J. Anthropol. Res.* 39, 277-306.
- 755 Kelly, R.L., 1988. The Three Sides of a Biface, *Am. Antiquity* 53, 717-734.
- 756 Kelly, R.L., 1995. *The Foraging Spectrum. Diversity in Hunter-Gatherer Lifeways*, Smithsonian
757 Institution Press, Washington D.C.
- 758 Kelly, R.L., Todd, L.C., 1988. Coming into the country: Early Paleoindian hunting and mobility, *Am.*
759 *Antiquity*, 231-244.
- 760 Kuhn, S.L., 1990a. A geometric index of reduction for unifacial stone tools, *J. Archaeol. Sci.* 17, 583-593.
- 761 Kuhn, S.L., 1990b. Geometric index of reduction unifacial stone tools, *J. Archaeol. Sci.* 17, 583-593.
- 762 Kuhn, S.L., 1992. On Planning and Curated Technologies in the Middle Paleolithic, *J. Anthropol. Res.*
763 48, 185-214.
- 764 Kuhn, S.L., 1994. A Formal Approach to the Design and Assembly of Mobile Toolkits, *Am. Antiquity*
765 59, 426-442.
- 766 Kuhn, S.L., 1995. *Mousterian Lithic Technology: An Ecological Perspective*, Princeton University Press,
767 Princeton.
- 768 Kuhn, S.L., 2004. Upper Paleolithic raw material economies at ÜçagIzII cave, Turkey, *J. Anthropol.*
769 *Archaeol.* 23, 431-448.
- 770 Lazuén, T., 2012. European Neanderthal stone hunting weapons reveal complex behaviour long before
771 the appearance of modern humans, *J. Archaeol. Sci.* 39, 2304-2311.
- 772 Le Brun-Ricalens, F., Otte, M., 2014. Modes de contacts et de déplacements au paleolithique
773 eurasiatique: actes du Colloque international de la commission 8 (Paleolithique superieur) de l'UISPP,
774 Universite de Liege, 28-31 mai 2012, Universite de Liege.
- 775 Lebègue, F., Meignen, L., 2014. Quina ou pas? Révision techno-économique d'un site moustérien
776 charentien en Languedoc oriental: la grotte de la Roquette à Conqueyrac (Gard, France), *Bull. Soc.*
777 *Préhist. Fr.* 111, 603-630.
- 778 Lloveras, L., Garcia, L., Maroto, J., Soler, J., Soler, N., 2018. The bird assemblage from the Middle
779 Palaeolithic level I of Arbreda Cave: A taphonomic story, *J. Archaeol. Sci.: Rep* 21, 758-770.
- 780 Lloveras, L., Moreno García, M., Soler, N., 2010. The application of actualistic studies to assess the
781 taphonomic origin of Musterian rabbit accumulations from Arbreda Cave (North-East Iberia),
782 *Archaeofauna* 119, 99-119.
- 783 Mangado, J., Nadal, J., 2001. Àrees de captació de primeres matèries lítiques durant la prehistòria del
784 moianès: com utilitzaven els nostres avantpassats el territori, *Modilianum* 24, 43-53.

- 785 Mangado, X., Calvo, M., Nadal, J., Estrada, A., Garcia-Argüelles, P., 2006. Raw material resource
786 management during the epipalaeolithic in north-Eastern Iberia. The site of Gai Rockshelter (Moià,
787 Barcelona): a case study, in: Bressy, C., Burke, A., Chalard, H.M. (Eds.), *Notions de Territoire et de*
788 *Mobilité: Exemples de l'Europe et des premières nations en Amérique du Nord avant le contact européen.*
789 *Actes de sessions présentées au Xe congrès annuel de l'Association Européenne des Archéologues*
790 *(EAA), Lyon, 8-11 septembre 2004, ERAUL, Liège, pp. 91-98.*
- 791 Maroto, J., Ramió, S., Solés, A., 2001. The *Ursus spelaeus* disappearance archaeologically registered in
792 the Northeast of Catalonia, *Cadernos Lab. Xeolóxico de Laxe*, 407-414.
- 793 Maroto, J., Soler, N., Fullola, J.M., 1996. Cultural change between Middle and upper Palaeolithic in
794 Catalonia, in: Carbonell, E., Vaquero, M. (Eds.), *The last neandertals, the first anatomically modern*
795 *humans: A tale about the human diversity, Universitat Rovira i Virgili, Tarragona, pp. 219-250.*
- 796 Martínez-Moreno, J., Mora, R., De la Torre, I., 2004. Methodological approach for understanding Middle
797 Palaeolithic settlement dynamics at La Roca dels Bous (Noguera, Catalunya, Northeast Spain), in:
798 Conard, N. (Ed.), *Settlement Dynamics of the Middle Paleolithic and Middle Stone Age 2*, Kerns Verlag,
799 Tübingen, pp. 393-413.
- 800 McPherron, S.E., 2009. *Tools versus cores: alternative approaches to stone tool analysis*, Cambridge
801 *Scholars Publishing, Cambridge.*
- 802 Metcalfe, D., Barlow, K.R., 1992. A model for exploring the optimal trade-off between field processing
803 and transport, *Am. Anthropol.* 94, 340-356.
- 804 Moncel, M.-H., Chacón, M.G., La Porta, A., Fernandes, P., Hardy, B., Gallotti, R., 2014. Fragmented
805 reduction processes: Middle Palaeolithic technical behaviour in the Abri du Maras shelter, southeastern
806 France, *Quatern. Int.* 350, 180-204.
- 807 Mora, R., de la Torre, I., Martínez-Moreno, J., 2004. Middle Palaeolithic Mobility and Land Use in the
808 Southwestern Pyrenees: The Example of Level 10 in La Roca dels Bous (Noguera, Catalunya, Northeast
809 Spain, in: Conard, N. (Ed.), *Settlement Dynamics of Middle Paleolithic and Middle Stone Age 2*, Kerns
810 *Verlag, Tübingen, pp. 415-435.*
- 811 Nash, S., 1996. Is Curation a Useful Heuristic?, in: Odell, G. (Ed.), *Stone Tools*, Springer US, pp. 81-99.
- 812 Nelson, M.C., 1991. The study of technological organization, *Archaeological method and theory* 3, 57-
813 100.
- 814 Odell, G.H., 1996. Economizing Behavior and the Concept of "Curation", in: Odell, G.H. (Ed.), *Stone*
815 *Tools: Theoretical Insights into Human Prehistory*, Springer US, Boston, MA, pp. 51-80.
- 816 Ortega, D., Maroto, J., 2001. *Matières premières et technologie lithique du Moustérien final de la grotte*
817 *des Ermitons (Pyrénées Méditerranéennes)*, in: Zilhão, J., Aubry, T., Carvalho, F.A. (Eds.), *Les premiers*
818 *hommes modernes de la Péninsule Ibérique, Actes du Colloque de la commission VIII de l'UISPP,*
819 *Trabalhos de arqueología, Lisboa, pp. 69-76.*
- 820 Oswalt, W.H., 1976. *An anthropological analysis of food-getting technology*, Wiley and Sons, New York.
- 821 Pelegrin, J., Karlin, C., Bodu, P., 1988. "Chaînes Opératoires": un outil pour le préhistorien., *Technologie*
822 *Préstorique. Notes et Monographies Techniques.*, Editions du CNRS, Paris, pp. 55-62.

- 823 Picin, A., 2012. Technological change and hunting behavior during the Middle Paleolithic, in:
824 Cascalheira, J., Gonçalves, C. (Eds.), *Actas das IV Jornadas de Jovens em Investigação Arqueológica -*
825 *JIA 2011*, Tipografia Tavirense, Lda, Faro, pp. 185-191.
- 826 Picin, A., 2017. Short-term occupations at the lakeshore: a technological reassessment of the open-air site
827 Königsau (Germany), *Quartär*, 7-32.
- 828 Picin, A., 2018. Technological adaptation and the emergence of Levallois in Central Europe: new insight
829 from the Markkleeberg and Zwochau open-air sites in Germany, *Journal of Quaternary Science* 33, 300-
830 312.
- 831 Picin, A., 2020. Short-term occupations during the Early Middle Paleolithic in Eastern Germany, in:
832 Cascalheira, J., Picin, A. (Eds.), *Short-term occupations in Paleolithic Archaeology: Definition and*
833 *Interpretation*, Springer Switzerland, Cham, pp. 73-103.
- 834 Picin, A., Blasco, R., Arilla, M., Rivals, F., Chacón, M.G., Gómez de Soler, B., Talamo, S., Rosell, J.,
835 2020. Short-term Neanderthal occupations and carnivores in the North-East of Iberian Peninsula, in:
836 Cascalheira, J., Picin, A. (Eds.), *Short-term occupations in Paleolithic Archaeology: Definition and*
837 *Interpretation*, Springer, Cham, pp. 183-213.
- 838 Picin, A., Carbonell, E., 2016. Neanderthal mobility and technological change in the northeastern of the
839 Iberian Peninsula: The patterns of chert exploitation at the Abric Romaní rock-shelter, *Comptes Rendus*
840 *Palevol* 15, 581-594.
- 841 Picin, A., Peresani, M., Vaquero, M., 2011. Application of a new typological approach to classifying
842 denticulate and notched tools: the study of two Mousterian lithic assemblages, *J. Archaeol. Sci.* 38, 711-
843 722.
- 844 Picin, A., Vaquero, M., 2016. Flake productivity in the Levallois recurrent centripetal and discoid
845 technologies: New insights from experimental and archaeological lithic series, *J. Archaeol. Sci.: Rep.* 8,
846 70-81.
- 847 Porraz, G., 2009. Middle Paleolithic mobile toolkits in short-term human occupations: two case studies,
848 *Eurasian Prehistory* 6, 33-55.
- 849 Rios-Garaizar, J., 2016. Experimental and Archeological Observations of Northern Iberian Peninsula
850 Middle Paleolithic Mousterian Point Assemblages. Testing the Potential Use of Throwing Spears Among
851 Neanderthals, in: Iovita, R., Sano, K. (Eds.), *Multidisciplinary Approaches to the Study of Stone Age*
852 *Weaponry*, Springer Netherlands, Dordrecht, pp. 213-225.
- 853 Rios-Garaizar, J., 2017. A new chronological and technological synthesis for Late Middle Paleolithic of
854 the Eastern Cantabrian Region, *Quatern. Int.* 433, 50-63.
- 855 Rios-Garaizar, J., López-Bultó, O., Iriarte, E., Pérez-Garrido, C., Piqué, R., Aranburu, A., Iriarte-
856 Chiapusso, M.J., Ortega-Cordellat, I., Bourguignon, L., Garate, D., Libano, I., 2018. A Middle
857 Palaeolithic wooden digging stick from Aranbaltza III, Spain, *PLOS ONE* 13, e0195044.
- 858 Roebroeks, W., 1988. From Find Scatters to Early Hominid Behaviour. A Study of Middle Palaeolithic
859 Riverside Settlements at Maastricht-Belvédère (The Netherlands). *Analecta Praehistorica Leidensia* 21,
860 Leiden University Press, Leiden.
- 861 Roebroeks, W., Kolen, J., Rensink, E., 1988. Planning depth, anticipation and the organization of Middle
862 Palaeolithic technology: the archaic natives meet Eve's descendants, *Helinium* 28, 17-34.

- 863 Romandini, M., Terlato, G., Nannini, N., Tagliacozzo, A., Benazzi, S., Peresani, M., 2018. Bears and
864 humans, a Neanderthal tale. Reconstructing uncommon behaviors from zooarchaeological evidence in
865 southern Europe, *J. Archaeol. Sci.* 90, 71-91.
- 866 Rosell, J., Blasco, R., Rivals, F., Chacón, G., Menéndez Granda, D.L., Morales, J.I., Rodríguez-Hidalgo,
867 A., Cebrià, A., Carbonell i Roura, E., Serrat, D., 2010. A stop along the way: The role of Neanderthal
868 groups at level III of Teixoneres cave (Moià, Barcelona, Spain), *Quaternaire* 21, 139-154.
- 869 Rosell, J., Blasco, R., Rivals, F., Chacón, M.G., Arilla, M., Camarós, E., Rufà, A., Sánchez-Hernández,
870 C., Picin, A., Andrés, M., Blain, H.-A., López-García, J.M., Iriarte, E., Cebrià, A., 2017. A resilient
871 landscape at Teixoneres Cave (MIS 3; Moià, Barcelona, Spain): The Neanderthals as disrupting agent,
872 *Quatern. Int.* 435 Part A, 195-210.
- 873 Rots, V., 2013. Insights into early Middle Palaeolithic tool use and hafting in Western Europe. The
874 functional analysis of level IIa of the early Middle Palaeolithic site of Biache-Saint-Vaast (France), *J.*
875 *Archaeol. Sci.* 40, 497-506.
- 876 Rufà, A., Blasco, R., Rivals, F., Rosell, J., 2014. Leporids as a potential resource for predators (hominins,
877 mammalian carnivores, raptors): An example of mixed contribution from level III of Teixoneres Cave
878 (MIS 3, Barcelona, Spain), *Comptes Rendus Palevol* 13, 665-680.
- 879 Sánchez-Hernández, C., Rivals, F., Blasco, R., Rosell, J., 2014. Short, but repeated Neanderthal visits to
880 Teixoneres Cave (MIS 3, Barcelona, Spain): a combined analysis of tooth microwear patterns and
881 seasonality, *J. Archaeol. Sci.* 49, 317-325.
- 882 Santamaría, D., Montes, L., Utrilla, P., 2008. Variabilidad técnica del Paleolítico Medio en el valle del
883 Ebro: la Cueva de los Moros I de Gabasa (Peralta de Calasanz, Huesca), in: Mora, R., Martínez-Moreno,
884 J., De la Torre, I., Casanova, J. (Eds.), *Variabilidad técnica del Paleolítico Medio en el sudoeste de*
885 *Europa*, Universitat Autònoma de Barcelona, Barcelona, pp. 319-339.
- 886 Sanz, M., Daura, J., Égüez, N., Cabanes, D., 2017. On the track of anthropogenic activity in carnivore
887 dens: Altered combustion structures in Cova del Gegant (NE Iberian Peninsula), *Quatern. Int.* 437, 102-
888 114.
- 889 Sharon, G., 2018. A Week in the Life of the Mousterian Hunter, in: Nishiaki, Y., Akazawa, T. (Eds.), *The*
890 *Middle and Upper Paleolithic Archeology of the Levant and Beyond. Replacement of Neanderthals by*
891 *Modern Humans Series*, Springer, Singapore.
- 892 Sharon, G., Oron, M., 2014. The lithic tool arsenal of a Mousterian hunter, *Quatern. Int.* 331, 167-185.
- 893 Shea, J.J., 2006. The origins of lithic projectile point technology: evidence from Africa, the Levant, and
894 Europe, *J. Archaeol. Sci.* 33, 823-846.
- 895 Shott, M., 1986. Technological Organization and Settlement Mobility: An Ethnographic Examination, *J.*
896 *Anthropol. Res.* 42, 1-15.
- 897 Shott, M.J., 1996. An Exegesis of the Curation Concept, *J. Anthropol. Res.* 52, 259-280.
- 898 Shott, M.J., Scott, M.J., 1995. How much is a scraper? Curation, use rates, and the formation of scraper
899 assemblages, *Lithic Technology* 20, 53-72.
- 900 Soressi, M., 2004. From the Mousterian of Acheulean Tradition type A to type B: a change in technical
901 tradition, raw material, task or settlement dynamics, in: Conard, N.J. (Ed.), *Settlement Dynamics of the*
902 *Middle Palaeolithic and Middle Stone Age*, vol. II, Kerns Verlag, Tübingen, pp. 343-366.

- 903 Talamo, S., Blasco, R., Rivals, F., Picin, A., Gema Chacón, M., Iriarte, E., Manuel López-García, J.,
904 Blain, H.-A., Arilla, M., Rufà, A., Sánchez-Hernández, C., Andrés, M., Camarós, E., Ballesteros, A.,
905 Cebrià, A., Rosell, J., Hublin, J.-J., 2016. The Radiocarbon Approach to Neanderthals in a Carnivore Den
906 Site: a Well-Defined Chronology for Teixoneres Cave (Moià, Barcelona, Spain), *Radiocarbon* 58, 247-
907 265.
- 908 Talamo, S., Peresani, M., Romandini, M., Duches, R., Jéquier, C., Nannini, N., Pastoors, A., Picin, A.,
909 Vaquero, M., Weniger, G.-C., Hublin, J.-J., 2014. Detecting Human Presence at the Border of the
910 Northeastern Italian Pre-Alps. 14C Dating at Rio Secco Cave as Expression of the First Gravettian and
911 the Late Mousterian in the Northern Adriatic Region, *PLOS ONE* 9, e95376.
- 912 Tissoux, H., Falguères, C., Bahain, J.-J., Rosell, J., Cebrià, A., Carbonell, E., Serrat, D., 2006. Datation
913 par les séries de l'Uranium des occupations moustériennes de la grotte de Teixoneres (Moià, Province de
914 Barcelone, Espagne), *Quaternaire* 17, 27-33.
- 915 Torre, I.d.l., Martínez-Moreno, J., Mora, R., 2013. Change and Stasis in the Iberian Middle Paleolithic:
916 Considerations on the Significance of Mousterian Technological Variability, *Curr. Anthropol.* 54, S320-
917 S336.
- 918 Torrence, R., 1983. Time-Budgeting and Hunter-Gatherer Technology, in: Bailey, G.N. (Ed.), *Hunter-
919 Gatherer Economy in Prehistory: a European Perspective*, Cambridge University Press, Cambridge, pp.
920 11-22.
- 921 Torrence, R., 1989. Retooling: towards a behavioral theory of stone tools, in: Torrence, R. (Ed.), *Time,
922 Energy and Stone Tools*, Cambridge university press, Cambridge, pp. 57-66.
- 923 Torrence, R., 2001. Hunter-gatherer technology: macro-and microscale approaches, in: Panter-Brick, C.,
924 Layton, R.H., Rowley-Conwy, P. (Eds.), *Hunter-gatherers: An interdisciplinary perspective*, Cambridge
925 University Press, Cambridge, pp. 73-98.
- 926 Turq, A., Faivre, J.-P., Gravina, B., Bourguignon, L., 2017. Building models of Neanderthal territories
927 from raw material transports in the Aquitaine Basin (southwestern France), *Quatern. Int.* 433, 88-101.
- 928 Turq, A., Roebroeks, W., Bourguignon, L., Faivre, J.-P., 2013. The fragmented character of Middle
929 Palaeolithic stone tool technology, *J Hum. Evol.* 65, 641-655.
- 930 Utrilla, P., Montes, L., Blasco, F., Torres Pérez-Hidalgo, T.J., Menéndez, O., Eugenio, J., 2010. La cueva
931 de Gabasa revisada 15 años después: un cubil para las hienas y un cazadero para los Neandertales, *Zona
932 Arqueológica*, 376-389.
- 933 Vaquero, M., 2008. The history of stones: behavioural inferences and temporal resolution of an
934 archaeological assemblage from the Middle Palaeolithic, *J. Archaeol. Sci.* 35, 3178-3185.
- 935 Vaquero, M., 2011. New perspectives on recycling of lithic resources using refitting and spatial data,
936 *Quartär* 58, 113-130.
- 937 Vaquero, M., Bargalló, A., Chacón, M.G., Romagnoli, F., Sañudo, P., 2015. Lithic recycling in a Middle
938 Paleolithic expedient context: Evidence from the Abric Romaní (Capellades, Spain), *Quatern. Int.* 361,
939 212-228.
- 940 Vaquero, M., Carbonell, E., 2003. A temporal perspective on the variability of the discoid method in the
941 Iberian Peninsula, in: Peresani, M. (Ed.), *Discoid Lithic Technology. Advances and Implication*, BAR
942 International Series 1120, Oxford, pp. 67-82.

943 Vaquero, M., Chacón, M., Cuartero, F., García-Antón, M.D., Gómez de Soler, B., Martínez, K., 2012.
944 The Lithic Assemblage of Level J, in: Carbonell i Roura, E. (Ed.), High Resolution Archaeology and
945 Neanderthal Behavior, Springer Netherlands, pp. 189-311.

946 Vaquero, M., Romagnoli, F., 2018. Searching for Lazy People: the Significance of Expedient Behavior in
947 the Interpretation of Paleolithic Assemblages, *J Archaeol. Method Th.* 25, 334-367.

948 Vaquero, M., Romagnoli, F., Bargalló, A., Chacón, M.G., Gómez de Soler, B., Picin, A., Carbonell, E.,
949 2019. Lithic refitting and intrasite artefact transport: a view from the Middle Paleolithic, *Archaeol*
950 *Anthropol Sci.* <https://doi.org/10.1007/s12520-019-00832-5>

951 Vaquero, M., Vallverdú, J., Rosell, J., Pastó, I., Allué, E., 2001. Neandertal Behavior at the Middle
952 Palaeolithic Site of Abric Romaní, Capellades, Spain, *Journal of Field Archaeology* 28, 93-114.

953 Wallace, I.J., Shea, J.J., 2006. Mobility patterns and core technologies in the Middle Paleolithic of the
954 Levant, *J. Archaeol. Sci.* 33, 1293-1309.

955 Wiśniewski, A., Lauer, T., Chłóń, M., Pyżewicz, K., Weiss, M., Badura, J., Kalicki, T., Zarzecka-
956 Szubińska, K., 2019. Looking for provisioning places of shaped tools of the late Neanderthals: A study of
957 a Micoquian open-air site, Pietraszyn 49a (southwestern Poland), *Comptes Rendus Palevol.*
958 <https://doi.org/10.1016/j.crpv.2019.01.003>

959 Yaroshevich, A., Zaidner, Y., Weinstein-Evron, M., 2016. Projectile Damage and Point Morphometry at
960 the Early Middle Paleolithic Misliya Cave, Mount Carmel (Israel): Preliminary Results and
961 Interpretations, in: Iovita, R., Sano, K. (Eds.), *Multidisciplinary Approaches to the Study of Stone Age*
962 *Weaponry*, Springer Netherlands, Dordrecht, pp. 119-134.

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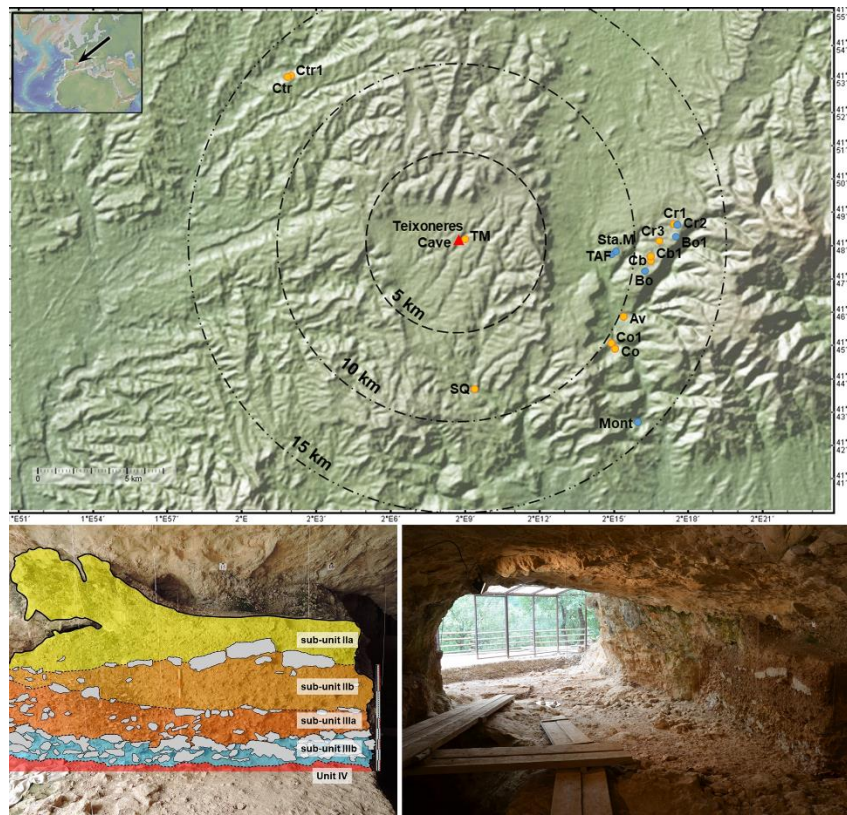
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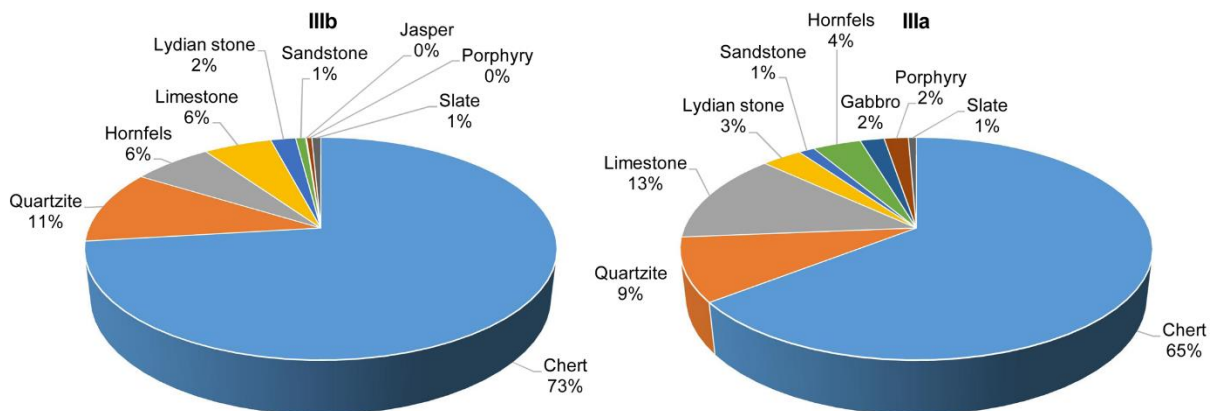
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976 **Figure Captions**



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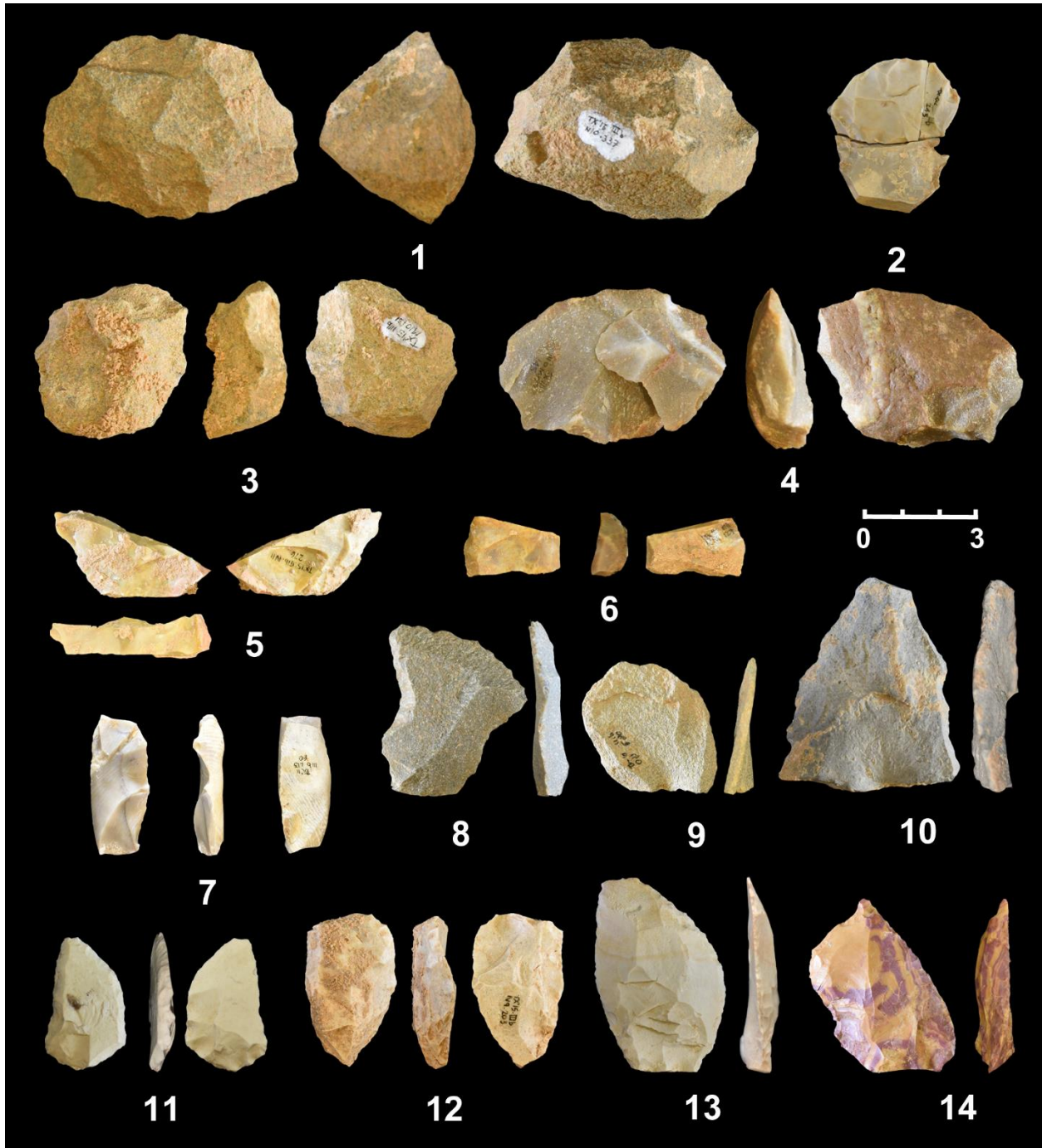
978 **Fig. 1:** Stratigraphic sequence, general overview and geographical location of Teixoneres Cave, and raw
 979 material outcrops. Legend: Raw materials in primary position: Montamany (Mont), Torrent de l’Afrau
 980 (TAF), Sta. Madrona (Sta. M.), Boix (Bo, Bo1), Can Rovira (Cr2); Raw materials in secondary position:
 981 Coll Can Tripeta (Ctr, Ctr1), Torrent Mal (TM), Sant Quirze (SQ), Can Oller (Co, Co1), Avenco (Av),
 982 Can Brull (Cb, Cb1), Can Rovira (Cr1, Cr3).



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984 **Fig. 2:** Percentages of raw materials of sub-unit IIIb and IIIa considered in this study.

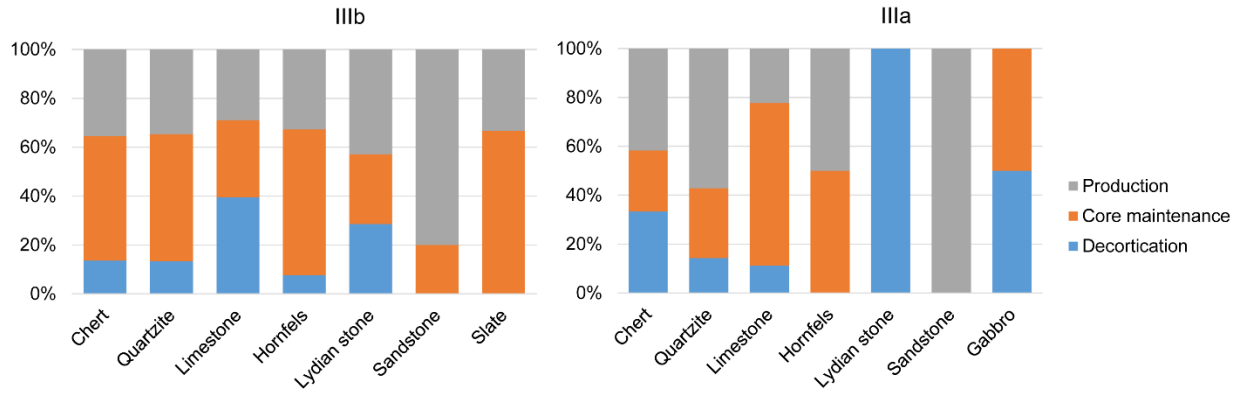
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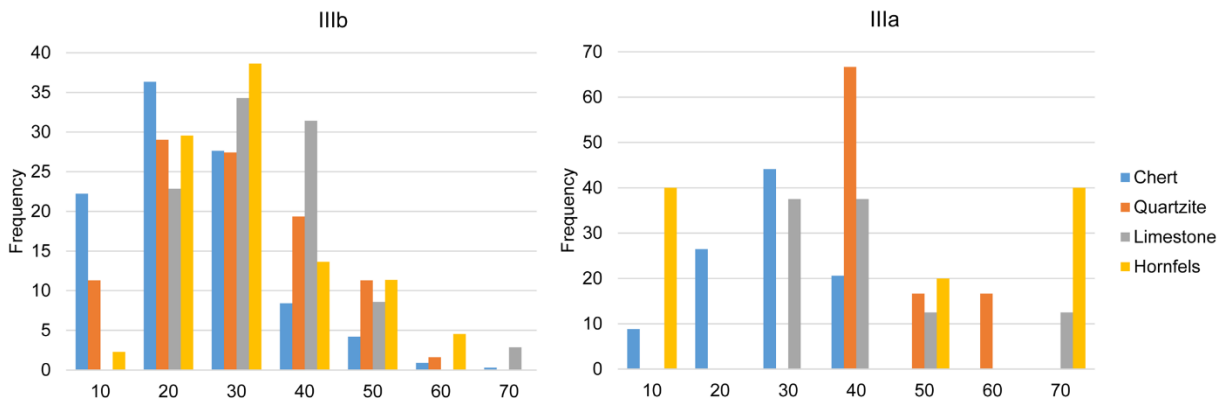
987 **Fig. 3:** Lithic material from sub-unit IIIb of Teixoneres Cave. 1, 3) hierarchized centripetal core in
 988 hornfels; 2) refitted Levallois centripetal core in chert; 4) refitting of a flake and a centripetal core in
 989 quartzite; 5-7) unidirectional core on fragment in chert; 8) Levallois flake in quartzite; 9) Levallois flake
 990 in hornfels; 10) convergent unidirectional flake in limestone; 11, 13) Mousterian point in chert; 12) demi-
 991 Quina scraper in chert; 14) scraper in jasper.

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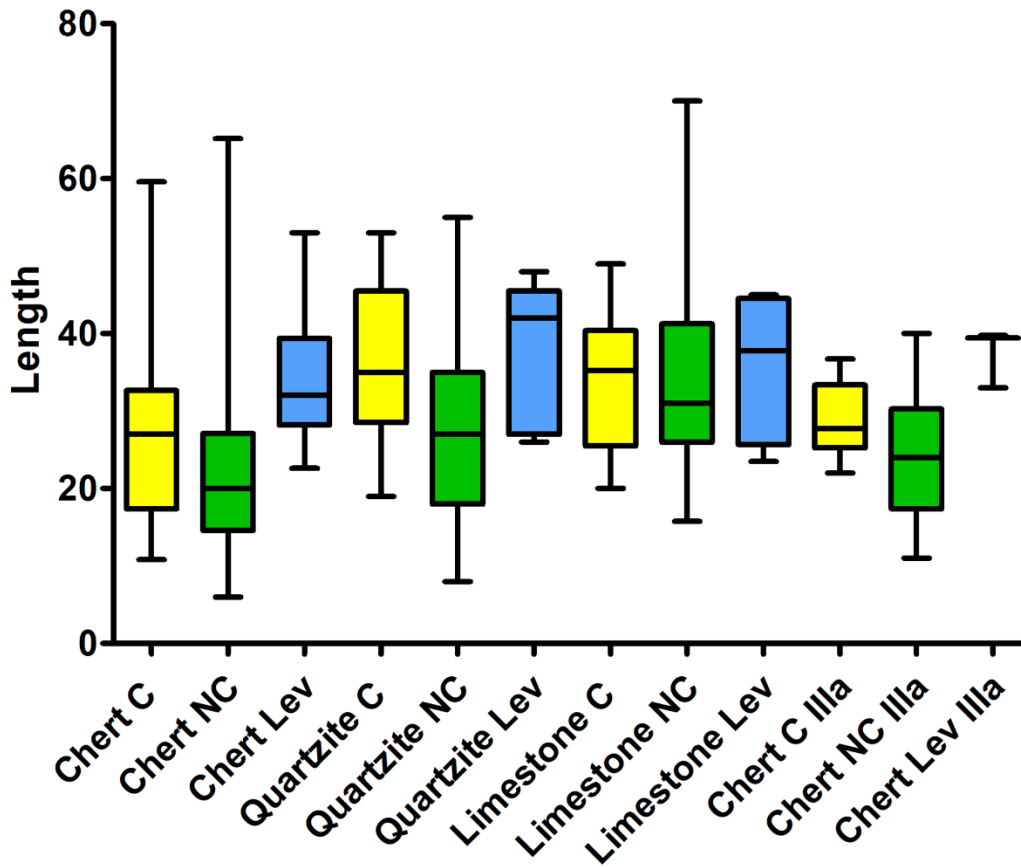
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994 **Fig. 4:** Comparison of the frequencies of complete flakes by the knapping stages in the different raw
 995 materials of sub-unit IIIb and IIIa.



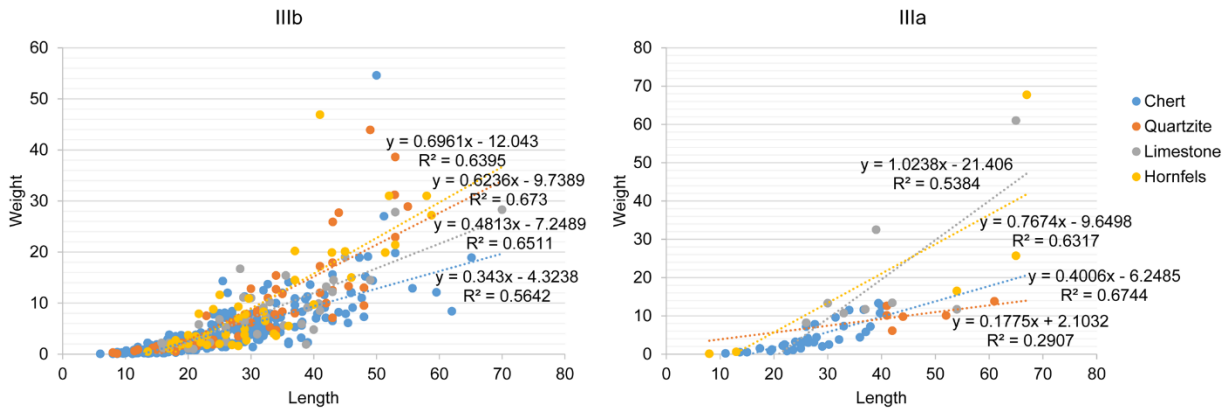
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997 **Fig. 5:** Histogram of comparison between complete flakes in different raw material by length intervals
 998 (mm) of sub-unit IIIb and IIIa of Teixoneres Cave.



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1000 **Fig. 6:** Comparison between cortical flakes (C), no-cortical flakes (NC) and Levallois flakes in different
 1001 raw materials from sub-unit IIIb, and chert from sub-unit IIIa of Teixoneres Cave.

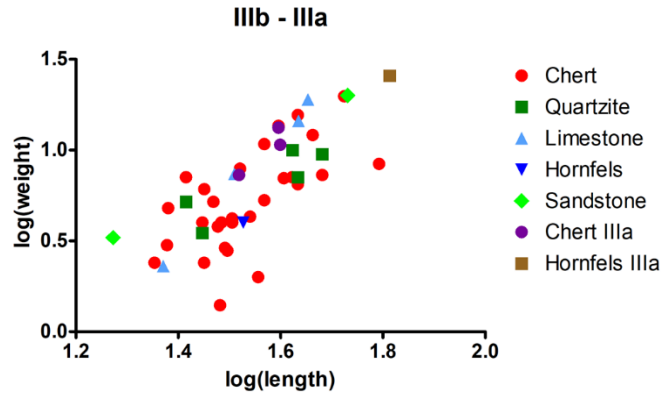


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1003 **Fig. 7:** Plot of the relation between the length (mm) and the weight (gr) of complete flakes in different
 1004 raw materials from sub-unit IIIb and IIIa of Teixoneres Cave.

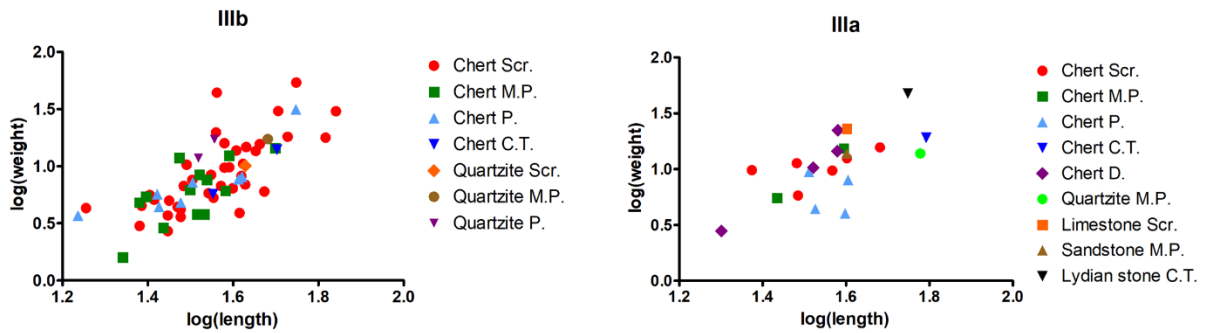
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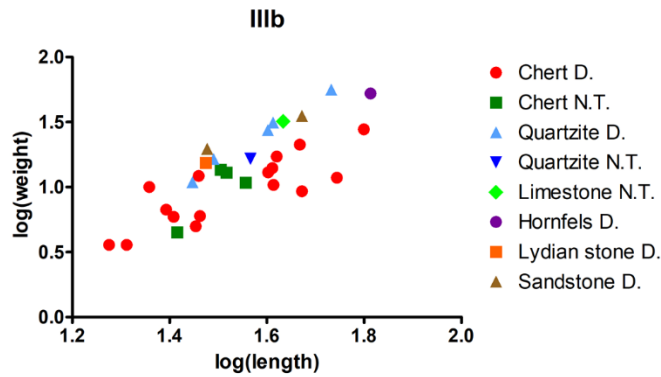
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1008 **Fig. 8:** Log transformation plot of weight and length of Levallois flakes of sub-unit IIIb and IIIa of
 1009 Teixoneres Cave.



1010

1011 **Fig. 9:** Log transformation plot of weight and length of scrapers (Scr.), Mousterian points (M.P.), points
 1012 (P.), and convergent tools (C.T.) in different raw material of sub-unit IIIb and IIIa of Teixoneres Cave.

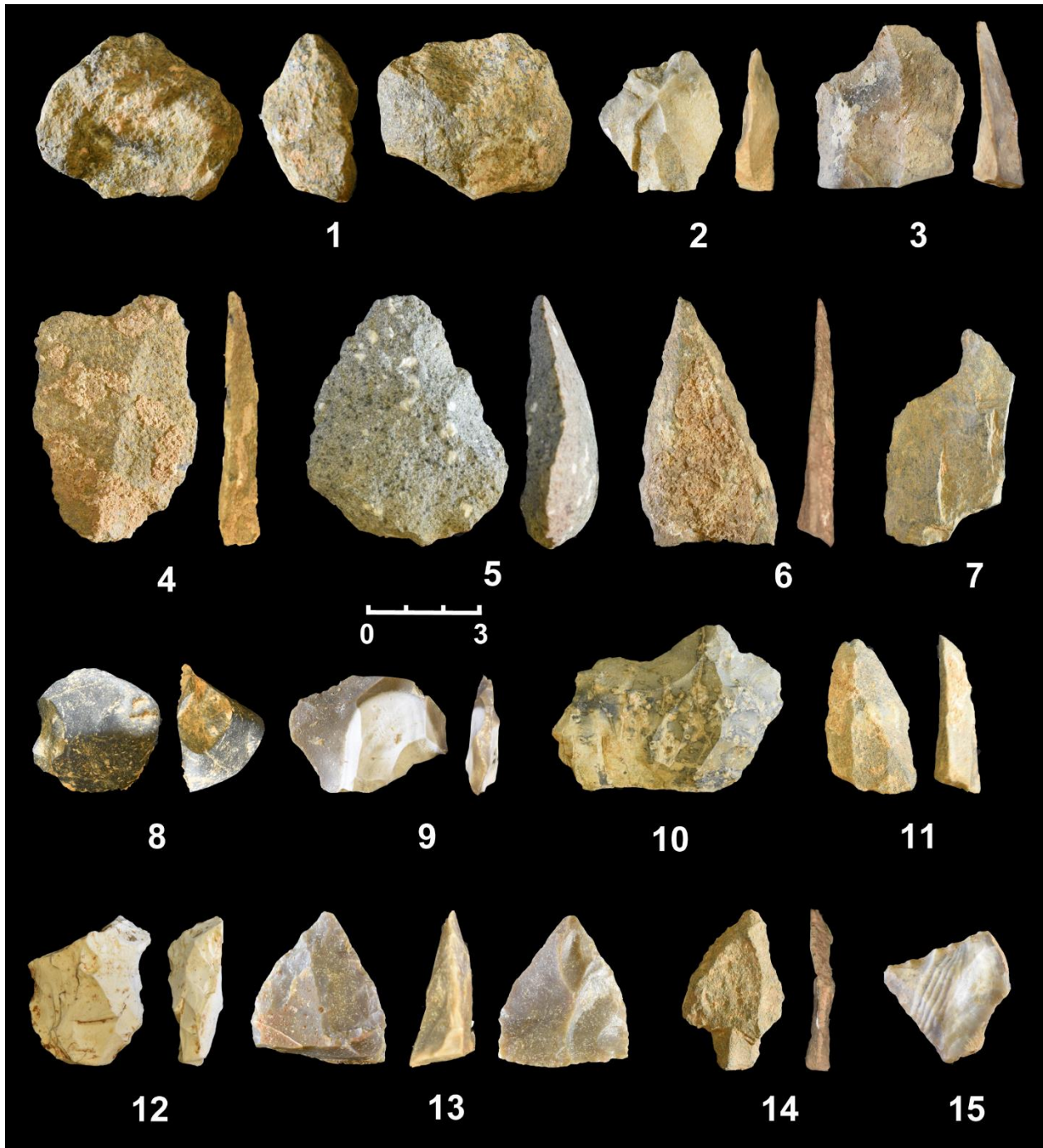


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1014 **Fig. 10:** Log transformation plot of weight and length of denticulates (D.) and notched tools (N.T.) of
 1015 sub-unit IIIb of Teixoneres Cave.

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1019 **Fig. 11:** Lithic material from sub-unit IIIa of Teixoneres Cave. 1) Levallois preferential core in hornfels;
 1020 2-3) Levallois flakes in chert; 4) Levallois flake in hornfels; 5) core-on-flake in porphyry; 6) Mousterian
 1021 point in hornfels; 7) core-edge removal flake in hornfels; 8) cortical flake in lydian stone; 9) flake in
 1022 chert; 10) flake in limestone; 11) convergent unidirectional flake in quartzite; 12) double scraper in chert;
 1023 13) Mousterian point in chert; 14) point in hornfels; 15) convergent tool in chert.

1024

	Chert	%	Hornfels	%	Limestone	%	Quartzite	%	Total	%
Levallois rec. uni.	1	2.7							1	2
Levallois rec. centr.	1	2.7							1	2
Hierarchized centr.	2	5.4	2	100					4	9
Discoid	1	2.7							1	2
Unidirectional	5	13.5			1	50			6	13
Bidirectional	1	2.7							1	2
Centripetal	2	5.4					3	50	5	11
Core-on-flake	9	24.3			1	50	2	33.3	12	26
Core fragments	15	40.5					1	16.7	16	34
Total	37	100	2	100	2	100	6	100	47	100

1025

1026 **Table 1** Total number and percentage of the core assemblage of sub- unit IIIb of Teixoneres Cave.

1027

1028

	Chert	%	Quartzite	%	Limestone	%	Hornfels	%	Lydian stone	%	Porphyry	%	Sandstone	%	Slate	%	Total	%
Cortical flake (>50%)	6	0.7	2	1.5	2	2.7											10	0.8
Cortical flake (<50%)	28	3.2	5	3.8	9	12.3	3	3.5	2	7.7					1	10	48	4
Natur. core-edge flake	19	2.2	3	2.3	4	5.5	1	1.2									27	2.2
Trim. strik. platform	58	6.6	8	6.2	5	6.8	13	15.1			1	16.7	1	11.1	2	20	88	7.3
Ordinary flake	79	9	18	13.8	3	4.1	9	10.5	2	7.7			1	11.1	1	10	113	9.3
Predeter. Lev. flake	14	1.6	6	4.6			6	7									26	2.1
Levallois rec. unid.	16	1.8	3	2.3	2	2.7	1	1.2					2	22.2			24	2
Levallois rec. centr.	13	1.5	2	1.5	2	2.7	1	1.2									18	1.5
Levallois point	1	0.1															1	0.1
Core edge rem. flake	27	3.1	4	3.1	3	4.1	1	1.2									35	2.9
<i>Dos limite</i> flake	10	1.1	3	2.3					1	3.8							14	1.2
Pseudo-Lev. point	15	1.7	7	5.4			3	3.5	1	3.8					1	10	27	2.2
Unidirectional flake	9	1	3	2.3	2	2.7	4	4.7	1	3.8							19	1.6
Bidirectional							1	1.2					1	11.1			2	0.2
Orthogonal	2	0.2															2	0.2
Centripetal	18	2.1			2	2.7	1	1.2									21	1.7
Kombewa-type flake	7	0.8			1	1.4	1	1.2									9	0.7
Re-shaping flak. surf.	18	2.1	1	0.8	1	1.4											20	1.6
Translation strik. platf.	1	0.1					3	3.5									4	0.3
Knapping accident	56	6.4	10	7.7	3	4.1	5	5.8									74	6.1
Retouch flake	15	1.7															15	1.2
Frag. with cortex	59	6.8	5	3.8	12	16.4	2	2.3	5	19.2	5	83.3			2	20	90	7.4
Frag. without cortex	327	37.5	46	35.4	20	27.4	31	36	13	50			3	33.3	3	30	443	36.5
Chips	75	8.6	4	3.1	2	2.7			1	3.8			1	11.1			83	6.8
Total	873	100	130	100	73	100	86	100	26	100	6	100	9	100	10	100	1213	100

1029

1030 **Table 2** Total number and percentage of the flake assemblage of sub-unit IIIb of Teixoneres Cave.

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1032

	Chert	%	Quartzite	%	Limestone	%	Hornfels	%	Lydian stone	%	Jasper	%	Sandstone	%	Total	%
Scraper	37	42.5	1	10							1	100			39	37.5
Double scraper	1	1.1													1	1
Point	8	9.2	2	20											10	9.6
Mousterian point	14	16.1	1	10											15	14.4
Convergent tool	2	2.3													2	1.9
1Ns	4	4.6			1	100									5	4.8
1Nc			1	10											1	1
2N			1	10			1	100							2	1.9
2-N															0	0.0
1N1n	6	6.9	1	10											7	6.7
1N-1n	1	1.1													1	1
1N2n	2	2.3							1	50					3	2.9
1N-2n													1	50	1	1
Nc	7	8	3	30									1	50	11	10.6
Fragment	5	5.7							1	50					6	5.8
Total	87	100	10	100	1	100	1	100	2	100	1	100	2	100	104	100

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1034 **Table 3.** Total number and percentage of the retouched tools assemblage of sub-unit IIIb of Teixoneres Cave.

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	Chert	%	Hornfels	%	Limestone	%	Porphyry	%	Total	%
Lev. preferential			1	100.0					1	12.5
Lev. rec. centr.	1	20							1	12.5
Unidirectional									0	0.0
Centripetal	1	20							1	12.5
Core-on-flake	1	20			1	100	1	100	3	37.5
Core fragments	2	40							2	25.0
Total	5	100	1	100	1	100	1	100	8	100

1041

1042 **Table 4** Total number and percentage of the core assemblage of sub-unit IIIa of Teixoneres Cave.

1043

IIIa	Chert	%	Quartzite	%	Limestone	%	Hornfels	%	Lydian stone	%	Gabbro	%	Porphyry	%	Sandstone	%	Slate	%	Total	%
Cortical flake (>50%)	1	1.3			1	5.6			1	25	1	33.3							4	3.3
Cortical flake (<50%)	9	12	1	7.7															10	8.2
Natur. core-edge flake	2	2.7																	2	1.6
Trim. strik. platf.	2	2.7			2	11.1													4	3.3
Ordinary flake	8	10.7	4	30.8	1	5.6	1	20											14	11.5
Predeter. Lev. flake	1	1.3																	1	0.8
Lev. rec. unidire.							1	20											1	0.8
Lev. rec. bidire.	2	2.7																	2	1.6
Lev. rec. centr.	1	1.3																	1	0.8
Core-edge rem. flake	3	4			2	11.1	2	40					1	50					8	6.6
Unidirectional flake	1	1.3			1	5.6													2	1.6
Centripetal flake	3	4													1	100			4	3.3
Re-shaping flak. surf.	1	1.3	1	7.7	1	5.6													3	2.5
Knapping accident	2	2.7	1	7.7	1	5.6					1	33.3							5	4.1
Frag. with cortex	5	6.7	2	15.4	4	22.2			3	75									14	11.5
Frag. without cortex	32	42.7	4	30.8	5	27.8	1	20			1	33.3	1	50			1	100	45	36.9
Debris	2	2.7																	2	1.6
Total	75	100	13	100	18	100	5	100	4	100	3	100	2	100	1	100	1	100	122	100

Table 5 Total number and percentage of the flake assemblage of sub-unit IIIa of Teixonerés Cave.

	Chert	%	Quartzite	%	Limestone	%	Lydian stone	%	Sandstone	%	Total	%
Scraper	5	27.8			1	100					6	27.3
Double scraper	1	5.6									1	4.5
Point	4	22.2									4	18.2
Mousterian point	2	11.1	1	100					1	100	4	18.2
Convergent tool	1	5.6					1	100			2	9.1
1N1n	2	11.1									2	9.1
1N-2n	1	5.6									1	4.5
Nc	1	5.6									1	4.5
Fragment	1	5.6									1	4.5
Total	18	100	1	100	1	100	1	100	1	100	22	100

Table 6 Total number and percentage of the retouched tools assemblage of Unit IIIa of Teixoneres Cave.