

1 **Main Manuscript for:**

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3 **The Three Waves: Rethinking the Structure of the first Upper**
4 **Paleolithic in Western Eurasia**

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15

16 **Abstract**

17 The Neronian is a lithic tradition recognized in the Middle Rhône Valley of Mediterranean France
18 now directly linked to *Homo sapiens* and securely dated to 54,000 years ago (ka), pushing back
19 the arrival of modern humans in Europe by 10 ka. This incursion of modern humans into
20 Neandertal territory and the relationships evoked between the Neronian and the Levantine Initial
21 Upper Paleolithic (IUP) question the validity of concepts that define the first *H. sapiens* migrations
22 and the very nature of the first Upper Paleolithic in western Eurasia. Direct comparative analyses
23 between lithic technology from Grotte Mandrin and East Mediterranean archeological sequences,
24 especially Ksar Akil, suggest that the three key phases of the earliest Levantine Upper Paleolithic

25 have very precise technical and chronological counterparts in Western Europe, recognized from
26 the Rhône Valley to Franco-Cantabria. These trans-Mediterranean technical connections suggest
27 three distinct waves of *H. sapiens* expansion into Europe between 55-42 ka. These elements
28 support an original thesis on the origin, structure, and evolution of the first moments of the Upper
29 Paleolithic in Europe tracing parallel archaeological changes in the East Mediterranean region
30 and Europe.

31

32

33 **Main Text**

34 **Introduction**

35 The recent attribution of the Neronian industry to *Homo sapiens* at around the 54th millennium
36 (56.8-51.7 ka cal. BP 95.4% prob.) at Grotte Mandrin in France not only indicates a 10,000-year
37 push back of the arrival modern humans in Europe [1]; for the first time, concrete evidence of
38 interactions between Neanderthals and modern populations are demonstrated in a specific
39 territory. Five stratigraphic levels overlie the Neronian that have revealed Mousterian artifacts and
40 Neanderthal teeth documenting the only occurrence of interstratification between modern and
41 archaic hominins currently recognized in the world and a strict contemporaneity between these
42 two populations. At Mandrin one year at most separates the preceding Neanderthal settlements
43 and the arrival of modern humans (2-4], allowing us to approach the nature of potential
44 interactions between these two populations. But the question of the first Upper Paleolithic (UP) is
45 obviously not limited to only these exceptional archaeological records. This remarkable
46 chronological and geographical overturning of our previously held theories about the first UP
47 invites us to rethink the very structure of these human societies in Europe and, more broadly, in
48 western Eurasia between 55 - 40 ka. This modern human incursion into Neanderthal territory and
49 the relationships evoked between the Neronian and the Levantine Initial Upper Paleolithic – IUP-
50 [1, 5, 6] question the validity of concepts that define the first *H. sapiens* migrations and the very
51 nature of the first UP in western Eurasia. It is at this scale that the data from Mandrin invites

52 rethinking the structure of the first UP, a period for which the most salient traits have stayed
53 unchanged since the first half of the 20th century.

54 This study discusses the structure of the connections that are now possible to establish
55 between the banks of the eastern and western Mediterranean and underlines the unexpected
56 technological connections and the remarkable cultural homogeneity of *H. sapiens* societies when
57 they colonized Europe, which now seems likely to indicate the existence of three distinct waves of
58 migration into the continent. I therefore hypothesize here that all of the first Upper Paleolithic
59 industries recognized in the Ksar Akil sequence of coastal Lebanon have precise technical and
60 chronological counterparts in Western Europe. I also posit that the almost unanimously hailed
61 correlation that the Northern Early Ahmarian industries of Ksar Akil were a counterpart of the
62 Protoaurignacian is false. The precise analysis of the technical successions of Ksar Akil allows us
63 to defend a much broader position affecting the entire technical and historical structure of the first
64 Upper Paleolithic and the articulations of a significant part of the so-called transitional industries
65 of Western Europe.

66 The attribution of the Neronian to *H. sapiens*, its early chronology, and its insertion in the
67 middle of the Western European Mousterian sequence raises fundamental questions about the
68 anthropological framework that allows us to grasp such historical complexity. Among these
69 questions immediately emerges inquiries about the origin of the Neronian. Apart from Grotte
70 Mandrin, few other Neronian sites exist (Moula IV, Néron I, Maras, and Figuier 1 and 1'), all
71 having small assemblages that were excavated long ago with pickaxes [7, 8], and all occurring
72 within a restricted portion of the middle Rhône valley.

73 However, locally and diachronically, a rather remarkable technological continuity is
74 documented in the Mandrin sequence between the Neronian and overlying Protoaurignacian, in
75 Levels E and B1 respectively. Technologically, this process of continuity is clearly marked and
76 could be summarized by the change from the use of hard (mineral) to softer organic percussion in
77 the production of lithic artifacts [5-10] and from the use of a faceted striking platform to one that
78 is straight and abraded. Thus, no other technological peculiarity makes it possible to
79 fundamentally distinguish these two sets; they are remarkably similar in their technological

80 structures, their production objectives, specific features of the transformation of the materials
81 involving ventral and alternating retouch created by pressure retouching into the palm, and the
82 function of the obtained tools. The Neronian, carried by *H. sapiens*, can therefore be understood
83 technically and historically as a Pre-Protoaurignacian or a Protoaurignacian 0. There is however
84 no evidence for technological continuity between the underlying Rhodanian Quina Mousterian
85 from Level F and the Neronian from Level E, the only strata where the two industries are
86 superimposed and stratigraphic mixing can be excluded (Supplementary Note 1). This proposition
87 questions the origins of the Neronian and Protoaurignacian, and the processes documenting the
88 structuring of these technical traditions. While we note connections between the Neronian and the
89 Protoaurignacian, precise modalities of such evolution remain unclear and no local origin for
90 Neronian can be discerned from the middle Rhône valley.

91

92 **Rethinking of the origin of the Upper Paleolithic: a Mediterranean Odyssey**

93 The Ksar Akil sequence occupies a key position in the understanding of Paleolithic societies in
94 the eastern Mediterranean. The site is located 10 km northeast of Beirut and overlooks the
95 coastal plains on the foothills of Mount Lebanon. Numerous archaeological excavations have
96 been undertaken there, revealing 22.6 m of archaeological deposit from the Middle Paleolithic to
97 the Epipaleolithic, and the site constitutes one of the most complete records currently recognized
98 in Eurasia regarding the transition between the MP and UP. These archaeological levels were
99 reached during two excavation phases held in 1937-1938 and 1947-1948 led by Ewing [11, 12].
100 Tixier's operations from 1969 to 1975 encountered only the upper part of the sequence and a few
101 subsequent phases of the UP that are not directly relevant here [13]. The sequence has been
102 subdivided into 36 main archaeological units; I restrict my discussion here to the 31 MP and UP
103 archaeological units. From base to summit:

104 -Levels XXXVI to XXVI are from the Middle and late MP;
105 -Levels XXV to XXI involve the IUP;
106 -Levels XX and XVI relate to the initial phases of the Early Upper Paleolithic.

107 These stratigraphic successions form part of a unique context where technological and biological
108 aspects of the origin of the UP can be concretely addressed [14, 15].

109 Connections between the European and the Mediterranean Levantine archaeological
110 records have been considered since the early 20th century. When it was recognized that the
111 Aurignacian represented the first European UP, the same Aurignacian was simultaneously in the
112 Levant area [16-17], as exemplified when during a conference in London in 1969, Bordes
113 employed the term "Aurignacian in its strict sense" for the assemblages from Ksar Akil's levels IX
114 and X of the 1937-38 excavations (Xc-Xia levels of the 1947-48 excavations) [13, 18]. If, in
115 Europe, a component prior to this form of the Aurignacian was proposed in the 1960s [19-21], its
116 many detractors questioned the very existence of such industries until the almost definitive
117 abandonment of these ideas at the end of the 1970s [22]. This hypothesis did not gain
118 momentum again until the turn of the 1990s [23-26]. The recognition of this Protoaurignacian and
119 its chronological position prior to the early Aurignacian finally helped produce correlations
120 between the eastern and western shores of the Mediterranean. These quickly became
121 formalized, suggesting the existence of a strict technological and cultural unity between the
122 European Protoaurignacian and the Levantine Early Ahmarian [27-32]. These correlations were
123 again based largely on the Ksar Akil reference sequence, the only to document all phases of the
124 first UP in the Eastern Mediterranean (Supplementary Note 2), but one excluded from the most
125 recent series of formalized comparisons between Levantine and European UP assemblages [33-
126 35]. These historiographic details are essential to understand the viability of these proposed
127 connections across the Mediterranean.

128 The use of the term IUP groups together collections from varied origins recognized over a
129 vast territory ranging from North Africa to the highlands of Central Asia, and therefore
130 encompasses quite diverse technical realities. In this regard, it is necessary to differentiate the
131 generic term IUP, which does not have precise techno-cultural value [36], from the IUP of Ksar
132 Akil which refers to a very precise technical reality. And because of Ksar Akil's place in the history
133 of research, it should be used as a type-sequence for the determination of an IUP *stricto sensu*,
134 as compared to a IUP *lato sensu*, a name therefore grouping together a large fraction of the first

135 UP industries of the Old World with no suggestion of a precise technical or cultural connection.

136 My use of the term IUP hereafter is *stricto sensu*, as it is documented in the Ksar Akil sequence.

137 To position Mandrin's archaeological record in the larger Eurasian context, analyses of
138 Ewing's 1947-1948 collections at Harvard University's Peabody Museum of Archaeology and
139 Ethnology were undertaken from 2016 to 2019. The stratigraphic subdivisions of this specific
140 collection are notably more precise than from the 1937-1938 excavations (which are mainly
141 curated by the British Museum in London), and include the full stratigraphic sequence, therefore
142 making this collection the most important here. For example, layer IX from the 1937-1938
143 excavation, nearly 2 meters thick, was subdivided into 6 subunits (a-f) during the 1947-1948,
144 detailing technological changes recorded between each archaeological unit. Although not
145 corresponding to current standards, great attention was nevertheless paid regarding the smallest
146 archaeological elements during excavation [37]. Compared to the 1937-1938 series which was
147 relocated various times resulting in loss of part of the collection, Harvard's 1947-1948 collection
148 has been much less handled [37]. Despite being the most precise stratigraphically and the most
149 accurate regarding excavation methods, the Harvard collection has been less studied.

150 This research focused on 31 units, ranging from the MP to the first UP, levels XXXVI to
151 XIII. A total of 17,809 lithic pieces were analyzed and integrated into a database distinguishing
152 138 distinct technical and typological categories to account for the main specificities of these
153 industries. These collections were also photographed, technically drawn, and functionally
154 analyzed by Laure Metz (U. Connecticut, UMR LAMPEA). The aim of presenting the elements
155 here is to put these data into qualitative perspective with what has been proposed regarding
156 relations between Europe/Levant, essentially on bibliographic bases, concerning the first
157 moments of the UP. This presentation therefore focuses primarily on layers XXV to XIII. The
158 qualitative analysis gives a clear impression of continuity within these 13 stratigraphic units,
159 illustrating technical evolution expressed gradually from one unit to another, as noted by Ohnuma
160 and Bergman [38]. Based on technical systems, it thus seems impossible to distinguish a IUP unit
161 superimposed by a completely EUP unit. However, technical peculiarities appear very clearly if
162 we compare the XXIII-XXII units of the IUP with the XVI-XVII units of the EUP. The low artifact

163 count (n=33) and combination of typical MP and UP technologies in layer XXV suggest that it is
164 the product of mixing during excavation.

165 The image that emerges from these quantitative analyses of Ksar Akil's technical record
166 is that of an abrupt break between layers XXVI and XXIV, precisely between the MP and UP
167 assemblages (Figs. 1-6). We can deduce that not only no serious mixing between stratigraphic
168 units can be documented but also that, from the point of view of technical lithic systems, the
169 sequence locally shows no possibilities of continuity between the MP and UP. At the same time,
170 the technical breaks visible between the end of the MP and the beginning of the UP mean that
171 the question of the emergence of the IUP cannot be documented from this sequence. These data
172 suggest either that Ksar Akil presents an absence of archaeological deposit over a relatively long
173 period of time, separating units XXVI and XXIV (the time required for the emergence of the IUP
174 from a local technical substrate), or that the IUP was intrusive in this region [39-40]. If the Ksar
175 Akil sequence can be considered fundamental to understanding the beginnings of the UP in
176 Eurasia, the sequence, however, may not record all of the phases of its development. In this
177 geographic area, sequences like Boker Tachtit may illustrate some of the first phases of this
178 emergence. These early stages could have been structured around obtaining massive points
179 from bipolar debitage, the technical affinities of which with the Bohunician of Central Europe have
180 already been noted [33-35]. These data suggest the possibility of a fourth technical time, prior to
181 the oldest phases recorded at Ksar Akil, putting into question the origin, in time and space, of the
182 points systems at the beginning of the UP, whose source could be sought after more broadly in
183 the geographic areas between the Mediterranean Levant and Central Asia [36, 41]. At the same
184 time, within the Ksar Akil type sequence, we immediately notice that the clear processes of
185 continuity that we evoked from the IUP to the EUP are inscribed here in concrete technical and
186 stratigraphic realities. This should make it possible to understand, with unique resolution on the
187 scale of Eurasia, the structure of the first moments of the UP and the evolution of these technical
188 processes over time.

189

190 **Fig. 1.** Summary of interpretations from the Ksar Akil sequence from 1947 to 2017 (11, 37, 38,
191 52, 77-79). The columns on the right present the keys to the technical and cultural readings
192 based on my analyses and interpretations.

193 **Fig. 2.** Sequence from Ksar Akil, 1947-1948 excavations. Representation of Levallois debitage
194 between the Middle Paleolithic units, layers XXVII-XXVI, and the sequence of the beginnings of
195 the Upper Paleolithic until layer XIII. Even though Levallois debitage represents more than 25% of
196 the assemblage in the last units of the Mousterian (blue), they are virtually absent or anecdotal
197 from the very start of the Upper Paleolithic (green). These representations illustrate a clear and
198 abrupt rupture between the Middle and the Upper Paleolithic. Layer XXV, the first IUP unit,
199 documents the highest proportion of these Mousterian debitage. This XXV unit is only composed
200 of a few lithic pieces and this lithic assemblage could well be artificial and only constitute a mix of
201 layers XXVI and XXIV.

202 **Fig. 3.** Sequence from Ksar Akil, 1947-1948 excavations. Representation of laminar blanks
203 (blades and bladelets) and points within the Mousterian sequence (blue) and the first three
204 phases of the Upper Paleolithic (green). Blades and points abruptly appear in the sequence with
205 no possibility of continuity between the end of the Mousterian and the IUP.

206 **Fig. 4.** Sequence from Ksar Akil, 1947-1948 excavations, located at the Peabody Museum,
207 Harvard. Representation of microlith products -bladelets and micropoints- in the first phases of
208 the Upper Paleolithic, IUP (dark green), EUP I/NEA (medium green), and EUP II/SEA (light
209 green).

210 **Fig. 5.** Sequence from Ksar Akil, 1947-1948 excavations. Representation of bipolar productions
211 within the blade and point debitage of the IUP (dark green), the EUP I/NEA (medium green), and
212 the EUP II/SEA (layer XIII, 0%).

213 **Fig. 6.** Representation of backed retouched tools from Ksar Akil within the typological corpus in
214 the IUP (dark green), EUP I/NEA (medium green), and EUP II/SEA (layer XIII, 0%). (a) 1937-
215 1938 excavations (British Museum, Ohnuma 1988). (b) 1947-1948 excavations.

216

217 **Back to Mandrin**

218 Analysis of the Ksar Akil industries from Father Ewing's excavations allows us to recognize the
219 existence of three distinct phases at the turn of the UP. This phasing only partially overlaps with
220 previously proposed frameworks, particularly concerning the last moments of the Northern Early
221 Ahmarien (NEA) and its relationship with the overlying industries. In any case, three significant
222 phases can be clearly distinguished, beyond the processes of continuity in the structure of the
223 technical systems that can be highlighted from layers XXV to XIII at Ksar Akil (Supplementary
224 Note 4);

- 225 - a first phase, of unipolar Levallois points (IUP; Fig. 7);
- 226 - a second phase, of backed points mainly from bipolar laminar debitage (EUP/ NEA);
- 227 - a third phase, of rectilinear acute bladelets issued from unipolar convergent debitage
228 (layers XIII and above).

229 Unanimously used for close to 20 years, the correlation between this second phase of Ksar Akil's
230 Early Ahmarien and the Protoaurignacian [28, 32, 42-46] must be abandoned definitively. These
231 systems do not overlap technologically, technically, nor typologically.

232

233 **Fig. 7.** Sequence from Ksar Akil, 1947-1948 excavations, located at the Peabody Museum,
234 Harvard. Points and blades from the Initial Upper Paleolithic of Ksar Akil, layers XXV-XXII.
235 Drawings by L. Metz.

236

237 Clear East/West correlations can however be established between the Levant and
238 Western Europe. In this correlation, an equivalent of the Protoaurignacian can easily be
239 recognized in the layer XIII industries. This proposal here is close to the conclusions of Kadowaki
240 *et al.* [47], but they proposed correlations with Ksar Akil layers IX-XI and then with more recent
241 units from the Ksar Akil sequence. They also proposed that the Southern Early Ahmarien (SEA)
242 was more recent than the NEA, the two having no stratigraphic overlay, and that the
243 Protoaurignacian chronologically preceded the SEA. I propose here that, from the point of view of

244 the general technical structure of these industries, these layers IX-XI do not represent the oldest
245 industries of Ksar Akil that are technically comparable to the Protoaurignacian, which I place as
246 early as layer XIII (Supplementary Notes 2 & 4).

247 Here I propose that prior to phase 3/SEA/Protoaurignacian of this chrono-cultural
248 breakdown of Ksar Akil, the two other technical phases of this sequence also have direct parallels
249 in the European records. The Neronian, entirely based on the production of unipolar convergent
250 points and micropoints, technically represents a perfect replica of the Levantine phase 1/IUP. The
251 technical systems, the production objectives, the morphology, and even the morphometry of the
252 sought-after points are strictly identical [1, 5, 6]. In parallel, the function of the points, determined
253 in functional analysis by Laure Metz, shows that the points of Ksar Akil XXV-XX and those of
254 Mandrin E fall strictly within the same functional categories [48-49]. In both cases, they are mainly
255 projectile points used with mechanical propulsions -spearthrower and/or bow. Morphometric
256 width/thickness analysis shows that no differentiation can be made between Neronian and IUP
257 points (Fig. 8). No distinction can be made here between these technical systems, even though
258 they are located at opposite ends of the Mediterranean. We have also seen that, although
259 radiometric approaches in the Levant still provide disputable results, there is every reason to
260 believe that the beginnings of the Levantine IUP are contemporary with the Neronian of Mandrin.
261 We also know that the Neronian was created by *H. sapiens* populations who were exotic to this
262 region and who settled for some time in Neandertal territory [1]. All these data allow us to deduce
263 that the two cultural groups, the Levantine IUP *stricto sensu* (as recognized in Ksar Akil) and the
264 Neronian, actually are one. The question of the chronology of Ksar Akil's IUP has produced
265 clearly divergent models, but the data here would be compatible with the model proposed by
266 Bosch [50, 51] who concluded that the ages obtained from the IUP represent minimum ages
267 (Supplementary Note 3). Although the actual age of the beginnings of the IUP at Ksar Akil is still
268 unknown, Bosch dated layer XXII to >46 ka and the IUP begins appearing in layer XXV, thus
269 substantially older than 46 ka. If we widen the focus to other types of evidence, the presence of
270 shells for example, numerous at Ksar Akil, but absent in Mandrin E, does not allow us to
271 individualize the Neronian from the IUP, seeing that the shells of mollusks in the IUP, pierced or

272 not, are almost exclusively recognized at coastal sites [52, 53]. The transformation of bones or
273 teeth to produce objects of symbolic value is also well attested in the Neronian [1]. The evidence
274 of a *H. sapiens* tooth in the Neronian also supports the correlations between the Neronian and
275 the IUP presented here [5, 6].

276

277 **Fig. 8.** Points, micropoints, and cores from the IUP of Ksar Akil and from the Neronian of Mandrin
278 E. The technical systems and the production objectives are strictly identical. The TCSA (width
279 and thickness ratios) relate to measurements per mm and show no statistical difference.
280 Drawings by L. Metz and L. Slimak.

281

282 Recorded in Western European sequences, we then have phases I and III, from layers
283 XXV to XX, then XIII (or even XV/XIV) to XI respectively, of Ksar Akil. The two highlights of the
284 early Levantine UP thus find a direct and very precise echo in Western Europe through the
285 Neronian and then the Protoaurignacian. What about Ksar Akil's second phase from layers XIX to
286 XVI? Would there not exist, in Western Europe, an initial phase of the UP organized around the
287 debitage of small blades obtained by essentially bipolar debitage and turned toward obtaining
288 backed points? The debate on the origin of the Châtelperronian and its technical relations with
289 preceding and succeeding industries began with Breuil [54] and continued throughout the 20th
290 century [20, 55-58]. Today, it opposes two schools of thought that either consider the
291 Châtelperronian as a full UP that has no real roots in the local industries of the Mousterian [59-
292 64], or as a local product resulting from the evolution of preceding local Mousterian [46, 65-68]. In
293 this debate, the question of backed points occupies a central place, as does the supposed
294 absence of backed points or pointed blades in Mousterian collections located outside the range of
295 the Châtelperronian and other early UP complexes [68; Supplementary Note 7]. On this issue,
296 the demonstration can be considered particularly fragile since it focuses for the Mousterian on
297 "elongated backed blanks/points," a category which, through the approach of those authors,
298 technically encompasses any morphologically slender support and not specifically products
299 resulting from blade debitage *sensu stricto*. Nor do the authors typologically associate these

300 blanks to any shape of back- backed, cortical, *débordant*- in order to balance this assembly of
301 technically and typologically distinct characters (natural, cortical, and backed backs) with
302 Châtelperronian points. However, Châtelperronian points are well-circumscribed blanks as to
303 their technical and typological nature which only very partially overlap this definition. The
304 Châtelperronian point concerns true blades- technically exclusively obtained from blade
305 debitages- and then sharpened with various forms of abrupt retouching, or even true truncations.
306 This point alone highlights the fact that these comparisons between Châtelperronian and local
307 industries in the Mousterian are largely based on aspects which remain rather superficial, from
308 the point of view of the technical systems involved, mainly based on morphological properties and
309 not on the precise technical structures present (Supplementary Note 7). Meanwhile, true backed
310 points represent precisely one of the structural elements of NEA technical systems. More
311 precisely, if one is technically and typologically rigorous on the definition of the backed point
312 therefore concerning, like in the Châtelperronian, exclusively true blades associated with backed
313 backs, these technically well-circumscribed products do not structure, on the scale of Western
314 Eurasia, any other industry than the NEA, which has until now been completely interpreted as
315 one of the Levantine counterparts to the Protoaurignacian. Analysis of the Ksar Akil sets shows a
316 significant number of points that are technically and typologically undistinguishable from those of
317 Châtelperron. The craftsman of these backed point industries, *H. sapiens*, was found in layers
318 XVI/XVIII of Ksar Akil (Supplementary Note 3). It is remarkable that these sets were classified as
319 early as 1947 by Father Ewing as Châtelperronian, a classification which disappears in later
320 studies. They are stratigraphically positioned between the IUP- technically similar to the
321 Neronian, and the XIV-XI assemblages- technically similar to the Protoaurignacian. Identifying the
322 hominin makers of the Châtelperronian remains uncertain as it is still reliant on data from older
323 excavations plagued by stratigraphic uncertainties (e.g., Arcy sur Cure). *H. sapiens* are
324 biologically recognized in the Neronian/ IUP of Mandrin E [1], in the EUP of Ksar Akil [11, 15], and
325 at Bacho Kiro [69], and in the European Protoaurignacian [70, 71]. We can therefore highlight that
326 the three key phases of the first UP of Ksar Akil have clear parallels in contemporary industries in
327 Western Europe, recognized from the Rhône Valley to Franco-Cantabria.

328 These elements make it possible to posit an original thesis on the origin, structure, and
329 evolution of the first moments of the UP in Europe where we would see recorded horizontally
330 (geographically) in space, what is recorded vertically (stratigraphically) at Ksar Akil. The state of
331 the archaeological documentation does not make it possible to link, from one person to another,
332 Levantine and European spaces that would appear to be isolated in terms of the content of their
333 records. This state of affairs affects the three major phases of the division that I propose of this
334 first UP, even if ensembles such as Bacho Kiro or Temnata could be interpreted as intermediate
335 points between East and West [31, 44]. In the model proposed here, the elements of the
336 Bachokirian would not correspond precisely to the Levantine IUP as recently proposed [69], but
337 rather to one of the initial phases of the EUP, and thus to the beginning of the NEA, prior to the
338 full development of the backed points, whereas the Châtelperronian would correspond to a more
339 evolved stratum, therefore more recent, of this same phase of the EUP (Supplementary Notes 2
340 & 6). The equivalent of phases I and II of Ksar Akil, which correspond to the IUP and the full
341 development of the EUP, would thus only be currently documented at the western extremity of
342 Europe, on the Mediterranean and Atlantic façades of France and the Iberian Peninsula. One
343 should note the absence of data on the first UP coming from the Turkish peninsula outside its
344 Levantine comma of Hatay, an absence that is directly incumbent on the history of research in
345 this geographic space [72]. The significance of lack of data in this key area have long been
346 recognized, as have the implications on Mediterranean correlations which have hitherto been
347 limited to the Protoaurignacian and Early Aurignacian [29]. The northern Mediterranean does not
348 document the three articulations that we see at the eastern and western ends, suggesting the
349 existence of maritime routes linking the two sides starting at least 55 ka. Although direct evidence
350 of long-distance maritime navigation capacities are not clearly demonstrated in the Mediterranean
351 until after the Last Glacial Maximum [73], they are now little-questioned at the opposite eastern
352 end of Eurasia during the peopling of Sahul starting 65 ka [74, 75].

353 The sequence of Ksar Akil allows us to document the precise technical emergence of
354 industries identical to the Protoaurignacian of Europe (SEA), a development that can be broken
355 down into three successive technical stages resulting from a progressive evolution of the

356 technical systems of the first Levantine UP; IUP/ NEA/ SEA. These successions in the
357 stratigraphy have remarkable parallels with the western end of Europe with the Neronian/
358 Châtelperronian/ Protoaurignacian triptych. Across western Europe, from France to Iberia, we
359 would then have a technical and cultural structure identical to that recognized in stratigraphic
360 successions, through time, in the Eastern Mediterranean. Radiometric analyses show an
361 indisputable chronological anteriority of the Neronian over the Châtelperronian [1], and one can
362 also therefore reasonably posit the chronological anteriority of the first phases of the
363 Châtelperronian over the Protoaurignacian.

364 To resume, based on the analysis of the technical structures of the Ksar Akil sequence, I
365 propose that the three phases of the first Levantine Upper Paleolithic find a strict corollary across
366 Europe:

367 -Phase I, corresponding to the IUP, with points and blades, potentially begins in the middle of the
368 50th millennium and is recognized in only a few sequences in Europe, including the Neronian, the
369 Bohunician and the Kremenician, across discontinuous spaces from the Rhône valley to Ukraine.
370 The IUP *sensu stricto*, with points and micropoints and unipolar debitage, as documented in the
371 Ksar Akil sequence (XXV-XXII), is only documented in Rhône area with the Neronian. A variant of
372 this IUP, *sensu lato*, with large points and bipolar debitage is well attested in the base levels of
373 Boker Tachtit; their links with the Bohunician have precisely been approached by Tostevin. It is
374 not possible at this time to define whether we are confronted here with a synchronic cultural
375 diversity or with two evolutionary stages of this IUP.

376 -Phase II, corresponding to EUP I / NEA, is characterized by its production of small bipolar blades
377 and backed points. The NEA finds singular technical correspondence with Châtelperronian
378 productions. Its geographic distribution is clearly different from Phase I and now affects the
379 French Iberian and Atlantic areas. The Bachokirian, weakly bipolar and not characterized either
380 by the representation of points *sensu* Levallois, nor by backed points, could correspond to the
381 first stages of the NEA as documented at Ksar Akil (XIX-XX); it would then be slightly earlier than
382 the Châtelperronian in the west of the continent, before full developmental phases of the backed
383 point at Ksar Akil (XVII-XVI).

384 -Phase III, EUP II/SEA/Protoaurignacian, focuses on the production of long rectilinear bladelets
385 obtained by unipolar debitage. These industries are recognizable in all regions from western
386 Europe to the Levant, uniting for the first time all Western Eurasia.
387 These three phases from the beginning of the Upper Paleolithic can be interpreted as three
388 distinct migratory waves of biologically modern populations that systematically had their origin
389 within the Mediterranean Levant, where different sequences make it possible to document the
390 gradual emergence of phases II and III from the local cultural substrate.

391

392 **From colonization to relations with the Neandertals, what distribution models for the first**
393 ***H. sapiens* in Europe?**

394 If in the Levantine space the emergence of the SEA/ Protoaurignacian makes it possible to
395 recognize its emergence in three clear stages, this entity is structured based on a gradation of
396 technical systems originally focused on obtaining slender Levallois points from unipolar
397 debitage. Here we have indications of continuities in traditions, and probably also of biological
398 populations in the broad sense. It does not seem possible to document such continuity in the
399 Western European area. We do not recognize any sequences that allow us to perceive a
400 progressive evolution from the Neronian to the Châtelperronian then to the Protoaurignacian. We
401 do not know of any other collections that could be considered to present intermediate technical
402 indicators between these three industries. At the same time, we note that these industries differ
403 not only in time, with the Neronian/ Châtelperronian / Protoaurignacian successions, but also in
404 their spatial distributions; Middle Rhône / Atlantic France-Iberia / Western Europe (Fig. 9). This
405 spatio-temporal succession shows geographic distributions that are both disjointed and
406 increasingly vast. And for the first time, the third phase, the Protoaurignacian, culturally unites the
407 western European space and the Mediterranean Levant.

408

409 **Fig. 9.** Based on the analysis of the technical structures of the Ksar Akil sequence, I propose that
410 the three phases of the first Levantine Upper Paleolithic find strict corollaries across Europe.

411

412 Here, these temporal and spatial peculiarities have every reason to be interpreted as the
413 archaeological signature of three distinct migratory phases, all likely stemming from the same
414 Levantine cultural substrate. The first migratory phase is relatively old, prior to 54 ka, and is
415 currently recognized only in the Rhône valley. It can be noted that the Rhône is the main natural
416 artery connecting the Mediterranean area with the great steppes of northern Europe. If we start
417 from the observation that the IUP groups are familiar with Mediterranean maritime areas, as
418 evidenced from the distribution of Levantine sites, we can also note that this first migratory phase
419 does not seem to move away from the Mediterranean shores for more than a hundred kilometers.
420 At the same time, the records from Grotte Mandrin allow us to document a continuous presence
421 of these populations for around forty years in this territory [4]; the equivalent of a human
422 generation or two and no more. This first migratory phase apparently abandoned this territory
423 without leaving behind discernible biological or cultural descendants. Whatever the reason for the
424 abandonment, we can decipher important elements about this group's structure and goals. These
425 *H. sapiens* were probably not a simple group of scouts, but rather that their displacement had an
426 underlying desire to permanently settle in these lands. The length of time that the group occupied
427 this territory does not agree with a simple stop, nor with the simple desire to explore an unknown
428 territory. The Neronian level of Mandrin yielded a tooth of a very young *H. sapiens* child [1]. This
429 group was therefore made up of men, women, and young children, whether they were part of the
430 trip or were conceived within these new territories. The mastery of the two banks of the river and
431 the knowledge of all the siliceous resources over a relatively large area allow us to envisage
432 close relations either with Neanderthal aboriginal groups, or with isolated Neanderthal individuals
433 possessing prior knowledge of these territories [7].

434 The Châtelperronian would then correspond to a second migratory phase, which is only
435 archaeologically visible several millennia later, around 45 ka. The data from Cova Foradada show
436 that this second phase does not concern the French Atlantic area and the Cantabrian cornice
437 alone [76] but was also expressed as far as the Iberian Mediterranean area, far away from the
438 distribution territories of any Mousterian or Acheulean Tradition which has been sometimes
439 considered as a local antecedent to these industries [46, 65, 67, 68]. If the Châtelperronian

440 effectively corresponds to a second migratory phase by *H. sapiens*, and originated from the same
441 Levantine cultural substrate, the absence of chronological and geographical overlap between
442 phase I (IUP / Neronian) and phase II (NEA / Châtelperronian) is all the more remarkable, as the
443 territorial expansion of this phase II affected large territories- Atlantic, continental, and
444 Mediterranean- which remain quite geographically disjointed. Over this same period, the Rhône
445 valley was occupied by Neandertal groups that carried the Post-Neronian II traditions [1]. Could it
446 be that in the same geographical space that saw the first migrations of *H. sapiens* into Europe,
447 Neanderthal groups no longer allowed access to their previous territory? This would be
448 remarkable, since the Post-Neronian I and Post-Neronian II, which mark a return of Neandertal
449 populations to a large territory around Mandrin, also indicate a persistence of Neandertal
450 populations in one of the main migratory arteries of Western Europe [1]. This could well indicate a
451 refusal or a resistance from the aboriginal populations against a return of *H. sapiens* at the very
452 moment when, according to this hypothesis, these latter populations would manifest their first real
453 colonization by way of settlements, not only numerous, but also over vast territories across
454 Western Europe.

455 The Protoaurignacian, the third phase, nonetheless remains the first real layer of *H.*
456 *sapiens* populations to be expressed over all of Europe and as far as the Mediterranean Levant,
457 marking the cultural and territorial unification of these groups across the continent. It is only in this
458 phase III that the native Neanderthal populations were replaced by *H. sapiens* populations. This
459 replacement process was expressed not only over a few generations but on a Western European
460 scale and even at very geographically specific areas, such as the Rhône valley, for over at least
461 12 millennia.

462 The comparative analysis of this trans-Mediterranean documentation suggests processes
463 that are not only long, but also non-linear. This includes records of successive phases of
464 contacts, and of cultural replacements in well-defined territories. In the Rhône Valley, these
465 contact / replacement / exclusion processes are expressed precisely in 4 biological stages and 5
466 cultural stages (from oldest to youngest); Rhodanian Quina (Neanderthals) / Neronian (*H.*
467 *sapiens*) / Post-Neronian I (Neanderthals) / Post-Neronian II (Neanderthals) / Protoaurignacian

468 (*H. sapiens*) [1]. We know from the soot analysis [4] that in the two instances where *H. sapiens*
469 are present at Grotte Mandrin, the time between the Neanderthal installations and the *H. sapiens*'
470 is only a few seasons, possibly only one year. In the phases directly preceding the *H. sapiens*
471 installations, by seeing the extent of the perceptible territories of these groups and of the
472 recurrences of seasonal Neanderthal installations in the cavity over several decades, we can
473 here parsimoniously ask if, in this very particular place of the middle Rhône valley, in this very
474 cave, or in its immediate surroundings, these unique archaeological records imply the existence
475 of direct contact between populations. With the probability that the migrant populations benefited
476 from the knowledge of the aboriginal populations, we can perceive the most direct implications
477 within the *H. sapiens* groups, allowing a precise knowledge of the resources from this rather vast
478 territory [1]. The precise nature of these transmission processes from Neanderthals to *H. sapiens*
479 is not directly perceptible. The possibility of Neanderthal guides integrated within the *H. sapiens*
480 group could be seen as both minimal interpretation and universally documented in ethnography.

481 There remains the enigma of the middle valley of the Rhône, not only having recorded
482 the first migration of *H. sapiens* into Europe, 10 to 12 millennia prior to the first migrations hitherto
483 recognized, but also the only occurrence of successive biological replacements in Eurasia-
484 Neanderthal / *H. sapiens* / Neanderthal / *H. sapiens*. The structure of these replacements and the
485 first arrival of *H. sapiens* in the heart of mainland Europe's main north-south river artery can
486 hardly be considered anecdotal. The similarity with the Levantine productions suggests the
487 existence of maritime movement networks which would have already been solidly in place from
488 54 ka. The absence of the second migratory phase, NEA/Châtelperronian, from the Rhône area
489 and being framing by the southwest, the west and the north would be equally remarkable, the
490 territories that were occupied again by Neanderthal populations were no longer appearing
491 accessible to the *H. sapiens* populations.

492 This pattern of colonization in Europe and replacement of local populations accounts for
493 an important part of the cultural facts recorded in Western Europe during this 10 ka period. Along
494 with the Uluzzian in the western Mediterranean [70], the presence of *H. sapiens* groups with
495 clearly distinct traditions underlines the cultural richness of these population replacement

496 processes. This would also indicate that, whatever the relations between *H. sapiens* and
497 Neanderthals in phase II, as soon as 45 ka Western Europe would already have been largely
498 occupied by different *H. sapiens* populations. At the same time, these data indicate that the last
499 Neanderthal populations do not appear to retreat into refuge spaces, but actually occupy without
500 sharing for a few millennia, major axes of circulation on the scale of the European continent. The
501 technical structures of these societies do not allow us to document any obvious form of
502 acculturation from *H. sapiens* to Neanderthals, except perhaps the precise knowledge of certain
503 technical know-how related to point production technologies [7], which could well have been
504 acquired by the aboriginal groups during the very first migratory phase of *H. sapiens*. The last
505 Neanderthal populations would then not only be bearers of their technical traditions, relatively
506 immutable over hundreds of millennia, but would also, paradoxically, be the only heirs of technical
507 traditions long abandoned by *H. sapiens* and belonging to the first phases of settlement in Europe
508 by these populations. It is in this light of equivocal conservatism that these final Neanderthal
509 populations will definitively take their 'révérence', replaced in just a few seasons, as indicated by
510 the soot records, by a wave of a population which will finally unite Europe, reaching a tipping
511 point into the historical structures of the UP.

512

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525

526

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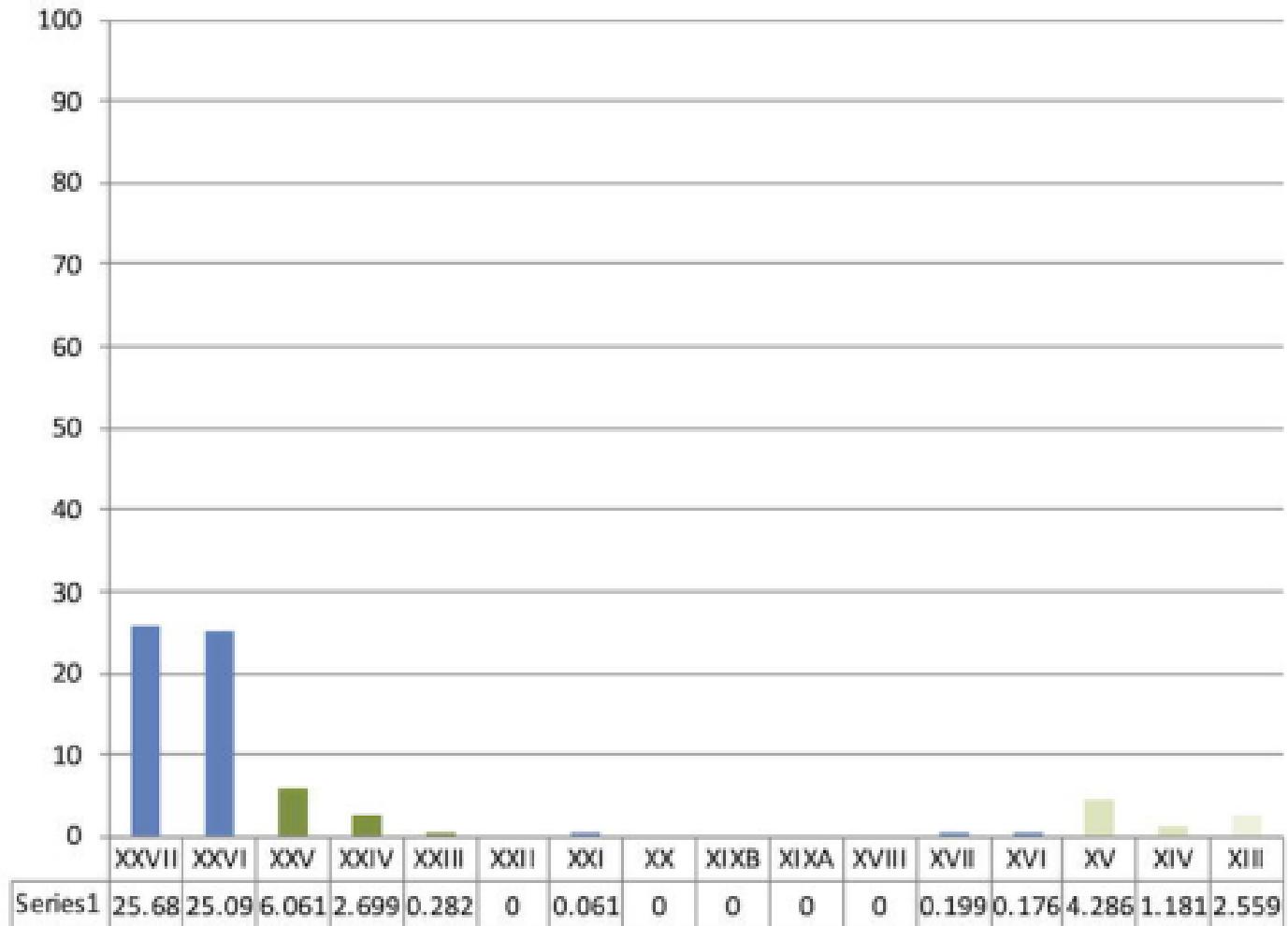
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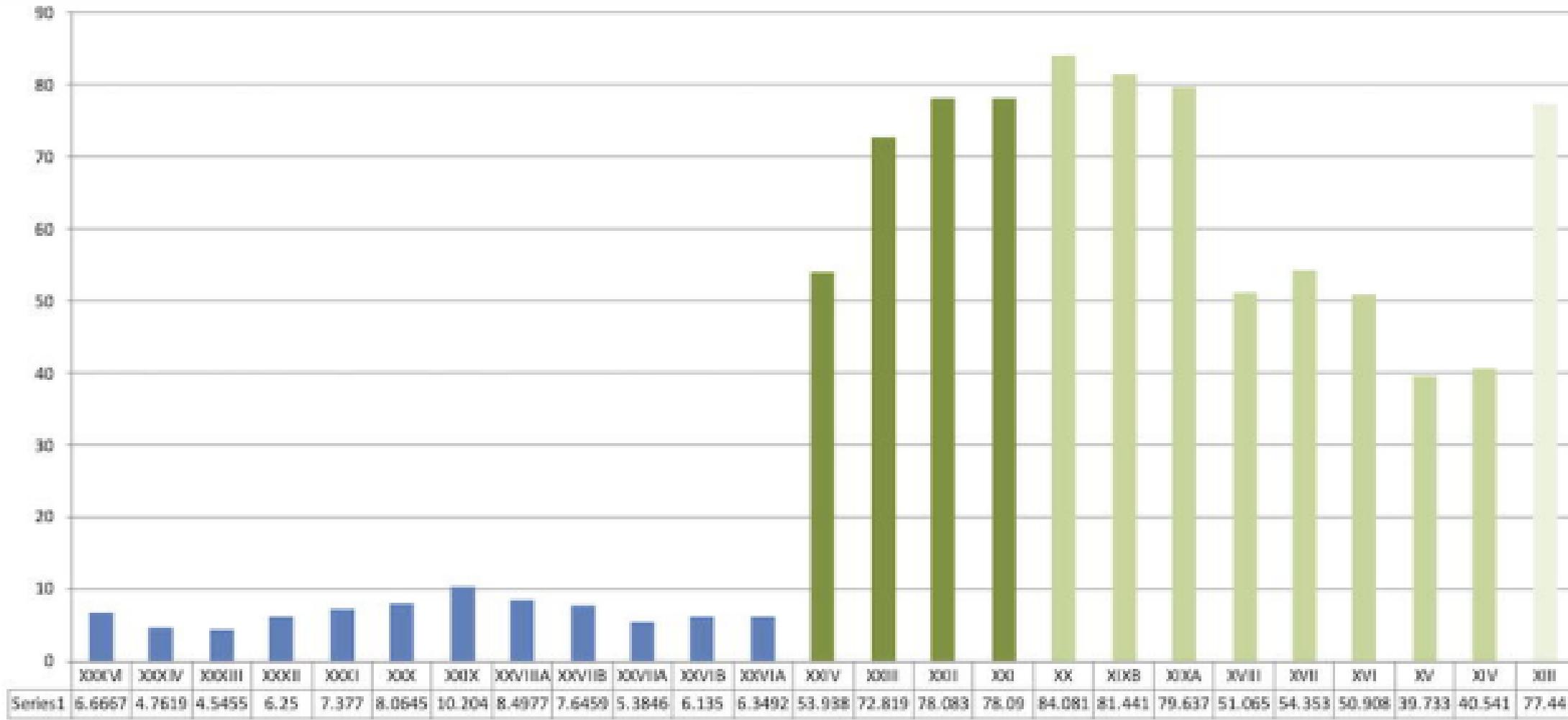
734 **Supporting Information**

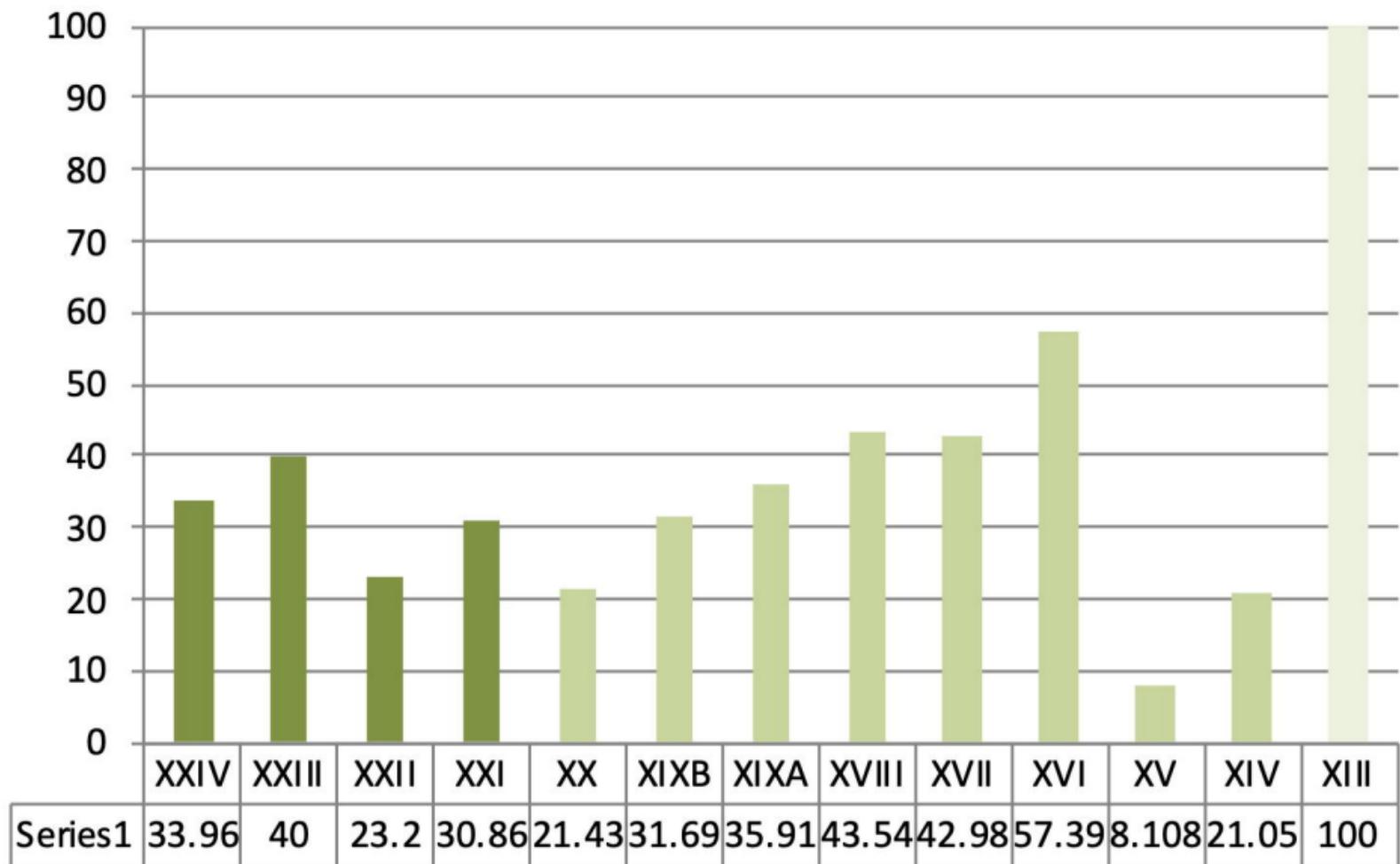
735 S1 File. Contains:
736 Supplementary Note 1. Evolving Thoughts on the Origins of the Neronian
737 Supplementary Note 2. History of Correlations between European & Levantine
738 Archaeological Sequences
739 Supplementary Note 3. Radiometric Dating of the Ksar Akil Sequence
740 Supplementary Note 4: Salient features of the Technical Structures of the IUP and EUP
741 at Ksar Akil
742 Supplementary Note 5: After the EUP of Ksar Akil
743 Supplementary Note 6: From East and West. Back to Mandrin, downgrading,
744 reclassification, pieces of the puzzle of Western Europe
745 Supplementary Note 7: The Châtelperronian Question

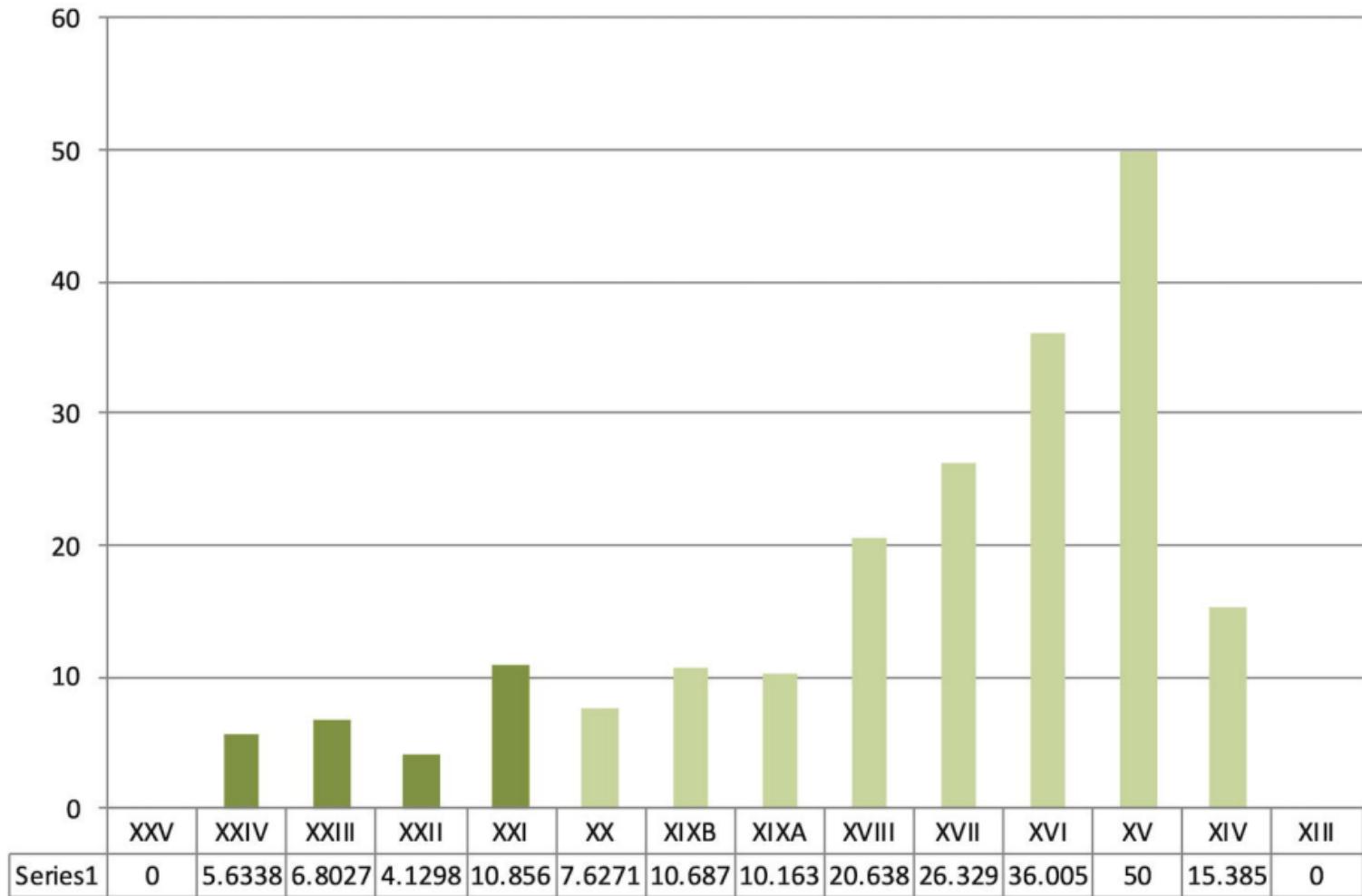
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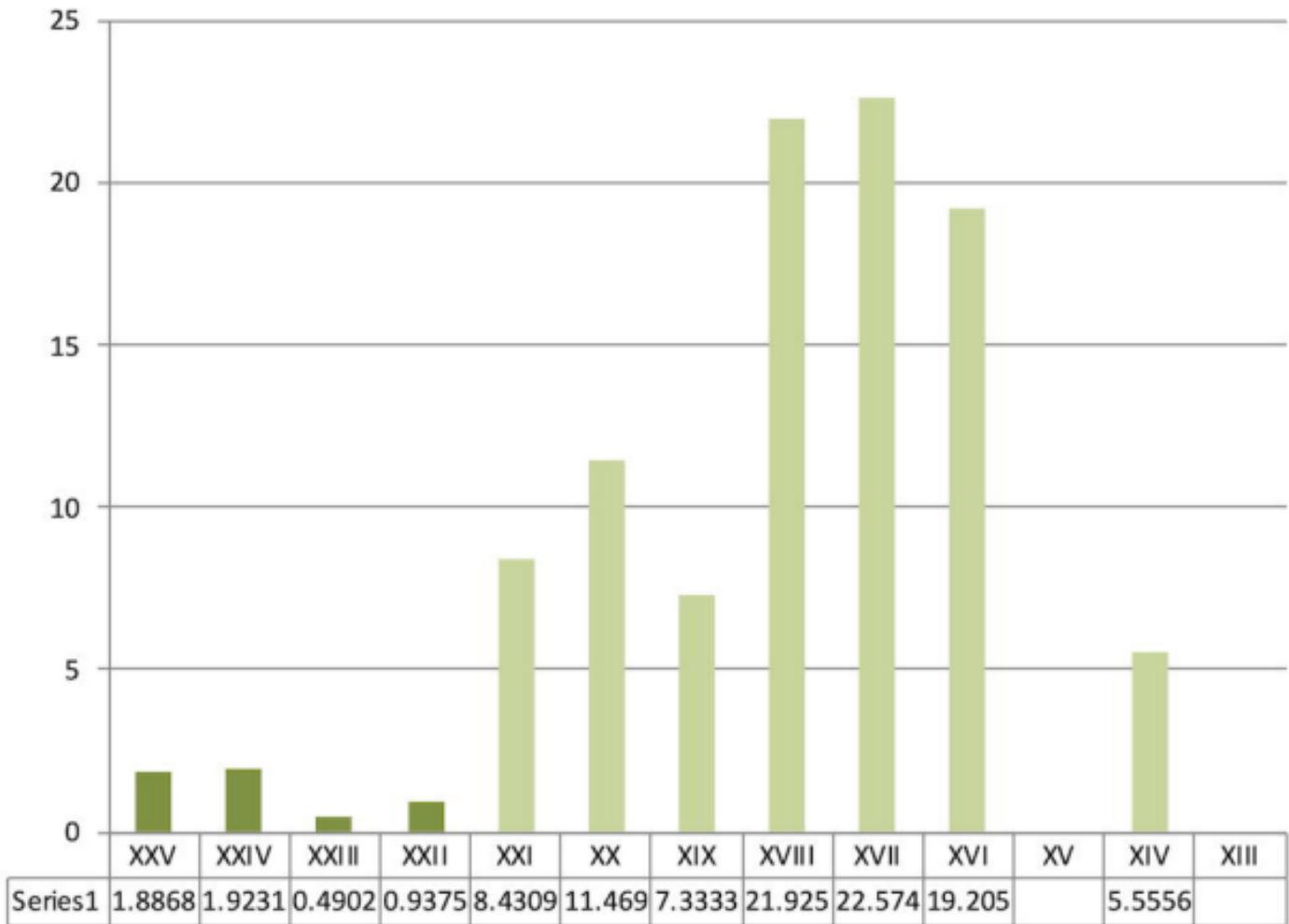
Supplementary References

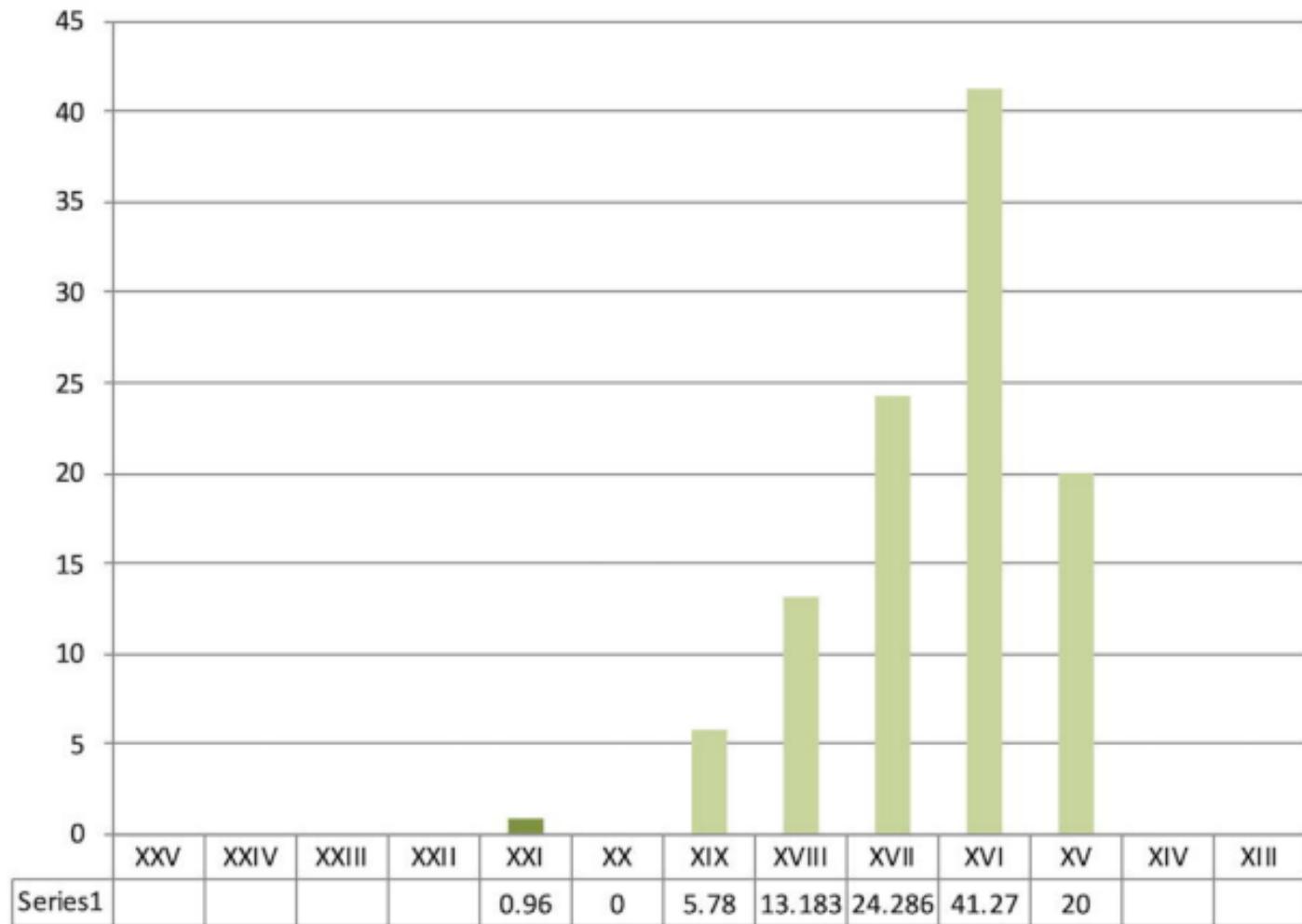


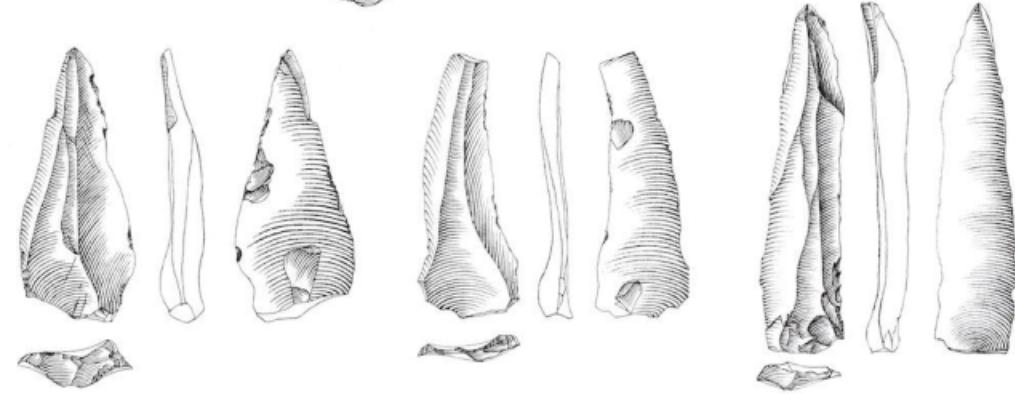
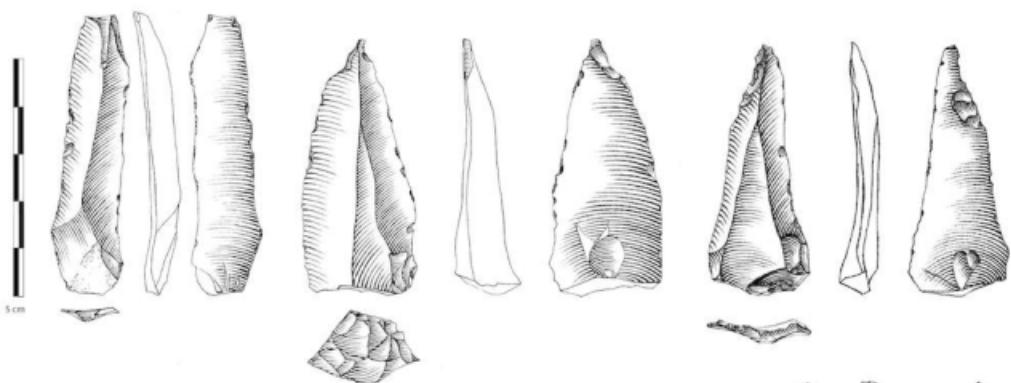
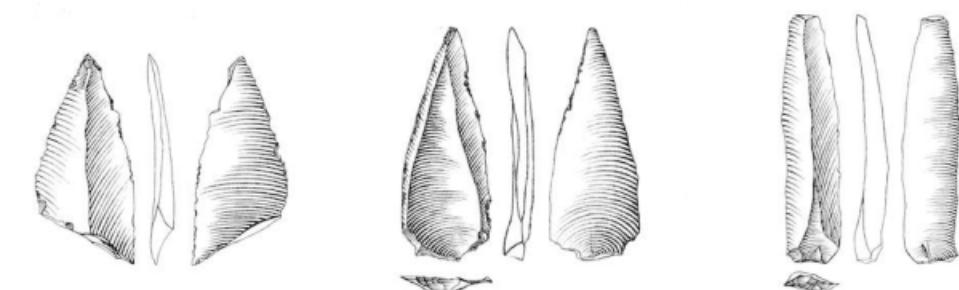
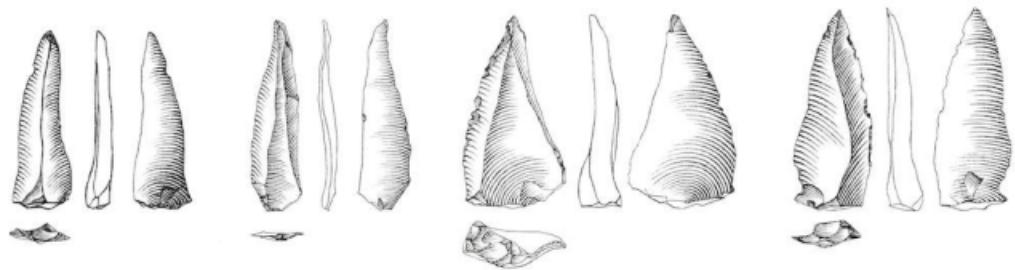






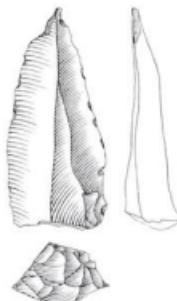
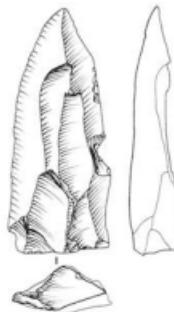
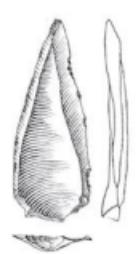
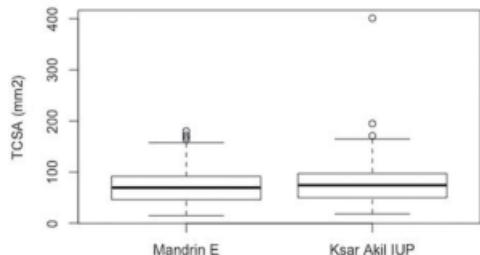






Mandrin, Neronien

Points
Ksar Akil, IUP

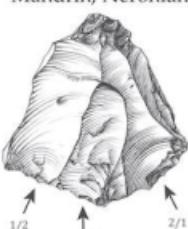


Micropoints
Mandrin, Neronian Ksar Akil IUP

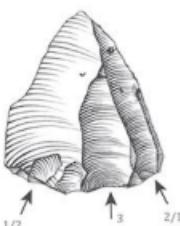
5 cm

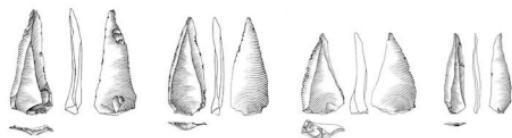
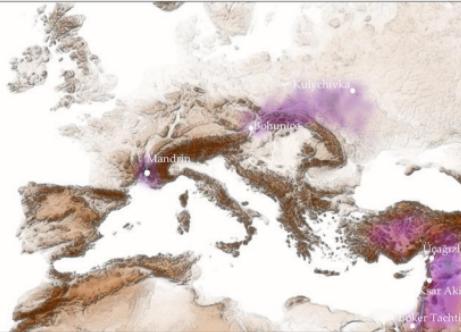


Cores
Mandrin, Neronian

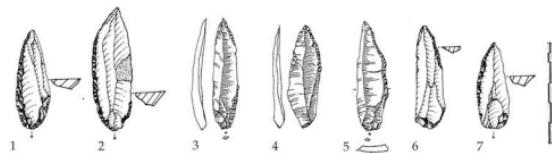
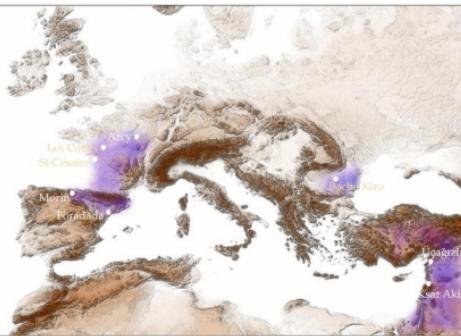


Ksar Akil IUP

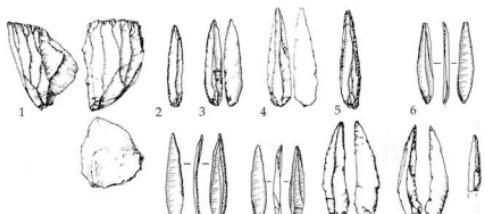




Ksar Akil phase I. Initial Upper Paleolithic/Neronian
Collections Ewing 1947-1948, Layers XXV-XXII.
Points and micropoints. Drawings Laure Metz.



Ksar Akil phase II. Early Upper Paleolithic I - Northern Early Ahmarian/Châtelperronian
1-5: Ohnuma et Bergman 1990, Couches XVII et XVI. 6-7: Azoury 1986, Couche XVI.
Backed points on bipolar little blades



Ksar Akil phase II. Early Upper Paleolithic II - Southern Early Ahmarian/Protoaurignacian.
1-8: Williams et Bergman 2010, Layers XI et Xc. 9-11: Bergman 1988, Layers XIII-XI.
Rectilinear bladelets from unipolar convergent flaking retouched by altern or pointing retouches.