

1 **The oldest Stone Age occupation of Coastal West Africa and its implications for modern**
2 **human dispersals: new insight from Tiémassas.**

3 Khady Niang ^a, James Blinkhorn ^{b,c}, Matar Ndiaye^d ,

4 a - Département d'Histoire, Université Cheikh Anta Diop de Dakar, BP. 5005 Dakar, Sénégal

5 b - Department of Archaeology, Classics and Egyptology, University of Liverpool, U.K.

6 c- Department of Archaeology, Max Planck Institute for the Science of Human History, Jena,
7 Germany

8 d - Laboratoire de Préhistoire et Protohistoire, Institut Fondamental d'Afrique Noire

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10 Corresponding Author: K. Niang (khady.niang@ucad.edu.sn)

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32 **Abstract:**

33 Examinations of modern human dispersals are typically focused on expansions from South,
34 East or North Africa into Eurasia, with more limited attention paid to dispersals within Africa.
35 The paucity of the West African fossil record means it has typically been overlooked in
36 appraisals of human expansions in the Late Pleistocene, yet regions such as Senegal occur in
37 key biogeographic transitional zones that may offer significant corridors for human occupation
38 and expansion. Here, we report the first evidence for Middle Stone Age occupation of the West
39 African littoral from Tiémassas, dating to ~44 thousand years ago, coinciding with a period of
40 enhanced humidity across the region. Prehistoric populations mainly procured raw material
41 from exposed Ypresian limestone horizons with Levallois, discoidal and informal reduction
42 sequences producing flake blanks for retouched tools. We discuss this mid-Marine Isotope
43 Stage 3 occupation in the context of the site's unique, ecotonal position amongst Middle Stone
44 Age sites across West Africa, and its significance for Later Stone Age colonization of near
45 coastal forests in the region. The results also support previous suggestions for connections
46 between Middle Stone Age populations in West Africa and the Maghreb, for which the
47 coastline may also have played a significant role.

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49 **Keywords:** Tiémassas, Senegal; West Africa; Middle Stone Age; Late Pleistocene; modern
50 human expansions

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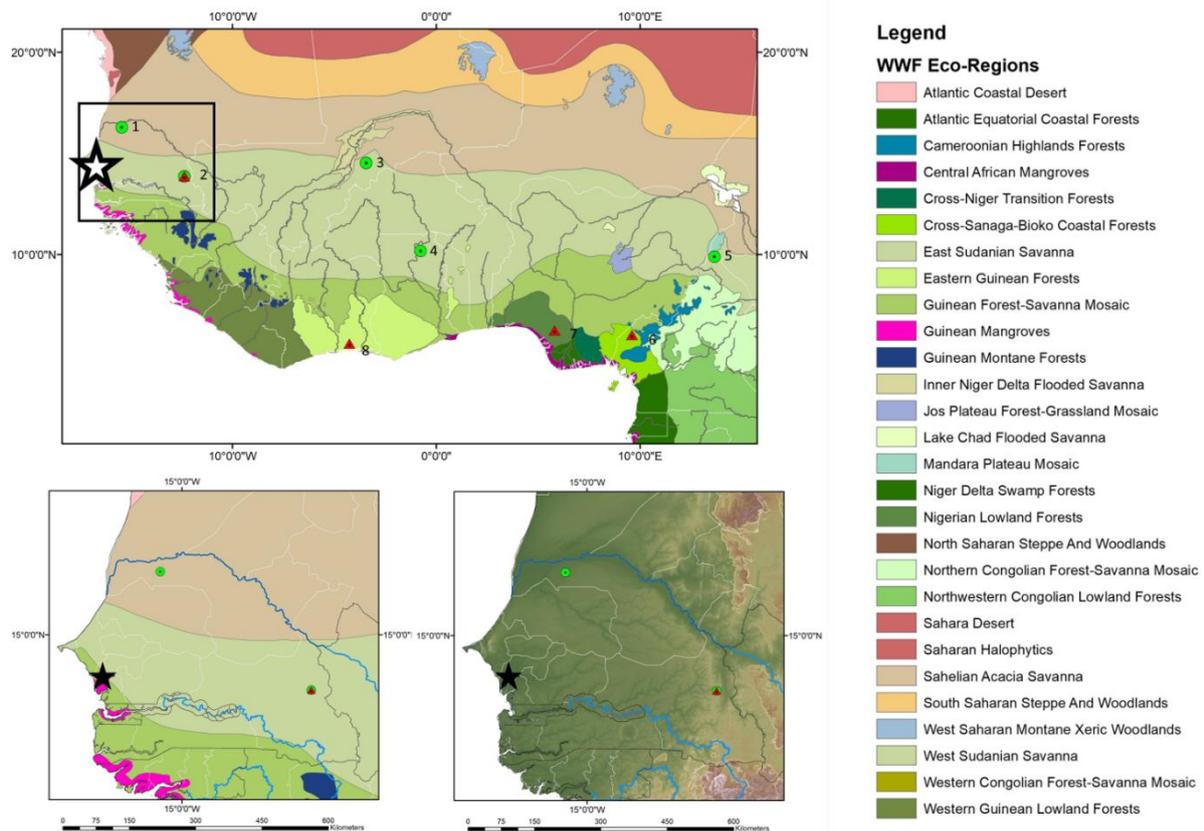
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67 **1. Introduction**

68 Human evolution within Africa increasingly appears a geographically diverse and mosaic
69 process. Recent investigations in North and South Africa have identified fossil and genomic
70 evidence for the origins of *Homo sapiens* stretching to 300 thousand years ago involving
71 multiple regions within the continent, overturning the long-held primacy of East Africa (Hublin
72 et al. 2017; Schlebusch et al. 2017). Genetic evidence also indicates significant, deep population
73 structuration within West Africa (e.g. Mendez et al. 2013), supported by the distinctly late
74 occurrence of archaic cranial morphology evident in the specimen from Iwo Eleru, dating from
75 the terminal Pleistocene (Harvati et al. 2011), but limited fossil records prevent wider
76 investigation. Examination of cultural evidence offers a complementary approach to examine
77 patterns of past population structure and inter-population interaction (Gunz et al. 2009, Scerri
78 et al. 2014). Such an appraisal in West Africa has been prohibited by the limited numbers of
79 chronometrically dated, excavated Pleistocene archaeological sites. Research over the past five
80 years has significantly enhanced chronological resolution for examining patterns of Late
81 Pleistocene behaviour in West Africa (see Scerri et al. 2017). Critically, this has included
82 evidence from a broader geographic range of sites that is necessary to begin to examine spatial
83 and ecological population structuring within West Africa and potential routes of inter-regional
84 interaction.

85 Middle Stone Age (MSA) sites in West Africa are predominately found within Sudanian
86 savannahs that stretch across the continent as a latitude bound zone, south of the Sahel (Figure
87 1). These savannahs are crosscut by extensive river systems, including the Niger, Volta and
88 Senegal rivers. Presently, all dated MSA sites occur within close association with these rivers or
89 their major tributaries that offer likely corridors for dispersal as well as the potential to structure
90 population interactions across the Sudanian savannahs. Examining how and when MSA
91 populations expanded out of the wide, contiguous Sudanian savannahs and into more
92 regionalized habitats is not only important to understand patterns of cultural change and
93 adaptation in the region, but also to explore how ecology and geography may have helped to
94 preserve or create structure within the region's population. In contrast, the oldest Later Stone
95 Age (LSA) sites in the region are predominately found within diverse lowland and coastal forest
96 habitats, for which the coastline may have offered an alternative to riverine corridors of
97 population movement. Identifying earlier occupations of the West African coastline is therefore
98 a critical step to explore how these new habitats were colonized and the patterns of behaviour
99 involved. Here, we present the first dated evidence for MSA behaviour on the West Africa
100 littoral, from the site of Tiémassas, and explore the potential role of the coastline and coastal
101 habitats in mediating population interactions across West Africa and beyond.



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103 **Figure 1:** (top) Map of modern West African ecology and the location of dated Late Pleistocene
 104 sites, illustrating Middle Stone Age sites located within Sudanian savannahs (green circles; 1:
 105 Ndiayène Pendao; 2: Toumboura, Missira and Ravin des Guepiers; 3: Ounjougou; 4: Birimi; 5:
 106 Mayo Louti) and Later Stone Age sites in distinct coastal forest habitats (red triangles; 2:
 107 Toumboura; 6: Njuinye and Shum Laka; 7: Iwo Eleru; 8: Bingerville Highway); (bottom left) close
 108 up showing the position of Tiémassas (black star) in Senegal at the ecotone between Sudanian
 109 savannah, Guinean forest-savannah mosaics and Guinean mangrove habitats; (bottom right)
 110 close up showing the physiographic position of Tiémassas in Senegal.

111 2. The Tiémassas Study Site

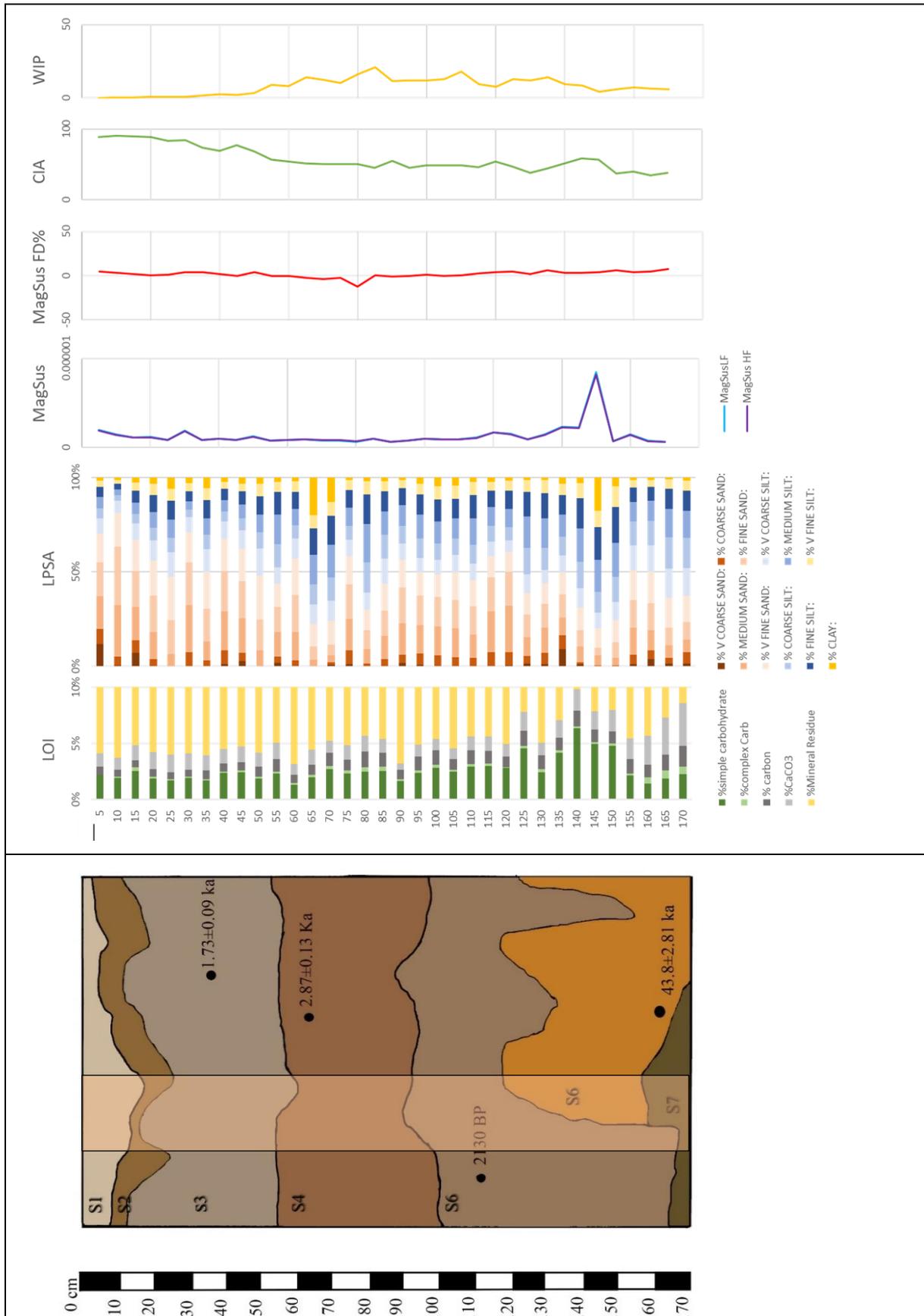
112 Tiémassas, named after a local, intermittent river, is located near Nianing, M'Bour Department,
 113 Senegal, located 85km south-east of Dakar. Having been first identified in 1952, the site has
 114 been subject to numerous surface surveys and limited excavation in the 1960's and 1970's
 115 (Descamps 1979, Guillot and Descamps 1969, Davies 1968 Diagne 1978). The combination of
 116 unsystematic surface collection methods, absence of diagnostic artefacts recovered from
 117 excavations and the lack of chronometric dating have complicated assigning the site to a
 118 particular cultural phase, and it has been variably ascribed to MSA, LSA Age or the Neolithic
 119 periods. Recent examination of artefact collections from these earlier surveys indicated that the
 120 majority of artefacts can best be described as MSA, with the mixing of small numbers of later
 121 artefact types partially resulting from methods of recovery (Niang and Ndiaye, 2016).
 122 Considering the presence of typological elements suggestive of inter-regional contacts in the
 123 MSA, renewed examination at Tiémassas has focused upon resolving site formation processes,
 124 chronology and the nature of the lithic technology.

125 Survey of a 1600x850m area, split into four quadrants labelled A-D, surrounding the seasonal
 126 stream identified 19 sites, all yielding surface artefacts. At site B1 a rich surface collection was
 127 made and an 8x8m grid was set out over the gently eroding surface. Four 1x1m squares (G2;
 128 G8; E4; C8) were excavated to depths varying between 1.57 to 2.1m and revealed a common
 129 stratigraphic sequence (Figure 2). Sediment samples were recovered at 5cm intervals in trench
 130 G2, and subject to standard analyses (LPSA, LOI, ICP-OES and magnetic susceptibility; see SI1
 131 for methods) to supplement field descriptions of the stratigraphic sequence.

132 The top three horizons (1-3) comprise upward coarsening muddy sands, with geomorphology
 133 of 2 potentially indicating weak, localized fluvial incision disrupting a fairly homogenous
 134 depositional pattern. The lower four horizons (4-7) comprise sandy muds, suggesting a lower
 135 energy depositional environment than the overlying sediments. Each lower unit marked
 136 discrete changes in colour, particularly evident between 5 (blueish grey) and 6 (red), suggests
 137 a change from an oxidizing to reducing environment, with an erosional disconformity also
 138 apparent at this interface. Comparison of magnetic susceptibility results with the mineral
 139 portion of sediment offer no evidence for a change of sediment source. Loss-on-ignition
 140 studies indicate higher proportions of organic matter within 6, paired with a small mean particle
 141 size and high clay content. This could indicate a relatively stable and vegetated sediment
 142 horizon formed from overbank deposits. The calculation of common indices from ICP-OES data
 143 (CIA; WIP) suggests two broad phases in patterns of chemical weathering of sediments. High
 144 CIA and low WIP values in levels 1-3 suggest enhanced chemical weathering and point to more
 145 humid conditions. Low CIA values and high, fluctuating WIP values in 4-6 suggest more limited
 146 weathering, humidity and more environmental variability.

147 Samples for Optically Stimulated Luminescence dating were recovered from horizons 3, 4 and
 148 6. Coarse quartz grains were dated at a single aliquot level, and samples provided well bleached
 149 quartz grains with good characteristics for OSL dating. The levels of potassium in two samples
 150 fell below the level of detection that may mean slight under-estimation of ages (see SI2 for full
 151 methodological details). In addition, a single sample of charcoal was subject to AMS
 152 radiocarbon dating. The results of dating are presented in Table 1.

Method	OSL	OSL	AMS	OSL
Lab. Number	Shfd 16166	Shfd 16167	Beta 445822	Shfd 16166
Depth from surface	0.36m	0.62m	1.11m	1.57m
Horizon	3	4	5	6
De (Gy)	3.25±0.12	3.98±0.06		158.8±5.32
OD (%)	23(19)	9(7)		17(16)
DoseRate (µGy/a-1)	1877±69	1388±59		3625±198
Age (Ka)	1.73±0.09	2.87±0.13	2.16±30	43.8 ±2.81



155 **Figure 2:** Excavated section in trench G2, illustrating the numbered sediment units with
 156 associated dates and sediment sampling profile (shaded), with results of geoarchaeological
 157 studies including (from left to right): Loss on ignition (between 0-10%; in all sample mineral
 158 residue >=90%); Laser particle size analysis; High (4.6kHz; χ_{HF}) and Low (0.46kHz; χ_{LF}) frequency
 159 magnetic susceptibility; percentage frequency dependent magnetic susceptibility; chemical
 160 index of alteration (CIA); and weathering index of Parker (WIP).

161 3. Stone Tool Assemblages

162 A collection of 1125 artefacts was recovered from four 1x1m excavations (Table 2), with a
 163 further 688 artefacts recovered from surface. Raw material in both surface and excavated
 164 assemblages comprised sandstone and chert, the latter of which is most common and is
 165 available as cobbles or plaquettes in the immediate vicinity of the site from exposed Ypresian
 166 basement formations. In contrast, sandstone is not locally available and appears in low
 167 frequency, suggesting it has been imported. The material recovered from excavation is
 168 characterized by a high frequency of fragmentation (74.4%), whereas the appearance of flakes
 169 in vertical positions in level 5 at G2 suggests some may have resulted from animal trampling.
 170 Elements from throughout the reduction sequence are present, including cortical flakes, cores,
 171 flaking debris and retouched pieces, suggests a range of knapping practices were conducted
 172 on site.

Category	S1	S2	S3	S4	S5	S6	Surface
Core	-	-	-	3	8	6	9
Levallois Core	-	-	-	-	6	2	17
Discoidal core	-	-	-	-	-	-	4
Core on flake	-	3	-	2	3	2	3
Total Cores	0	3	-	5	17	10	37
Flake	8	30	10	22	72	24	150
Levallois flake	-	3	-	1	2	2	21
Discoidal flake	-	3	1	6	23	7	19
Retouched flake	2	9	3	1	18	3	119
Retouched Levallois flake	-	-	-	-	1	1	8
Retouched Discoidal flake	-	1	-	1	1	-	5
Total flakes	10	46	14	30	117	37	322

173 **Table 2:** Lithic technological categories from test –trenches and surface.

174 Levallois cores were recovered from horizons 5 and 6, as well as in greater numbers in surface
 175 collections, and present either unidirectional or centripetal preferential flaking surfaces.
 176 Levallois flakes and retouched Levallois flakes are both found in levels 5 and 6, with the latter
 177 also appearing in level 2 and in surface collections, although their low occurrence suggest
 178 Levallois products were selectively removed from the site. Discoidal cores only appear in the

179 surface collection, whereas discoidal flakes are found in levels 2-6, with retouched variants
180 appearing in horizons 2, 4 and 5. Retouched artefacts are concentrated in levels 5 and 6.
181 Retouch is generally short, continuous and located on the dorsal face of flakes, predominately
182 used to produce scrapers with rare examples of bifacial retouching and the production of
183 limaces. Remaining evidence for reduction practices predominately comprises single or
184 multiplatform reduction strategies, with average flakes dimensions ranging from 38.27 to
185 34.37mm for length and 29.30 and 26.67mm for width, which is comparable with surface
186 material. The rare sandstone elements are consistently larger.

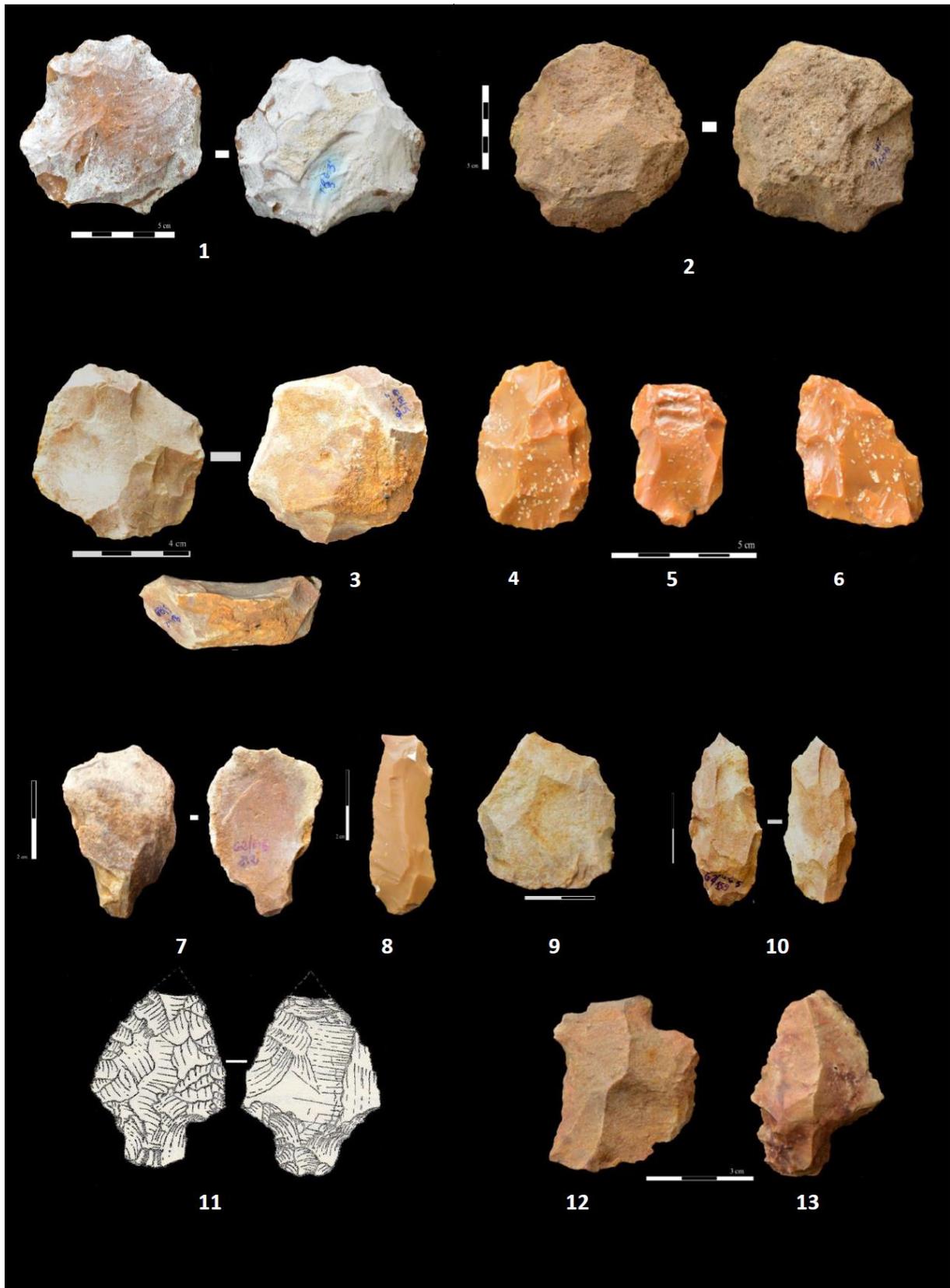
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193 **Figure 3:** 1-Levallois centripetal core from surface, 2- Levallois centripetal core from G2 (unit
 194 6), 3- Levallois centripetal core (G2 / Unit 5), 4-Levallois preferential core with centripetal
 195 preparation (C8/ unit 5) ,5-core on flake (C8/ unit 6), 6- Levallois preferential core with
 196 centripetal preparation (C8 /unit 6), 7- roughout of pedunculated flake (G2/ unit 6), 8. Levallois

197 blade **9**- Levallois flake, **10**. bifacially retouched flake, 11. Pedunculated point from Tiémassas
198 (Descamps 1979); 12. Levallois flake and 13. Aterian point from Richard Toll.

199 The stone tool assemblages from Tiémassas are consistent with regional descriptions of MSA
200 technologies. Combining studies of stone tools with the sedimentary context suggests an *in-*
201 *situ* occupation horizon in level 6 dating to ~44ka. The broadly homogeneous nature of stone
202 tools from all excavated horizons and surface collections suggests that they likely derive from
203 the same source which have since been dispersed by localized erosion and redeposition of MIS
204 3 sediment deposits. Notably, the excavated deposits lack any material culture from later
205 periods (e.g. Neolithic) commensurate with the dating of these horizons.

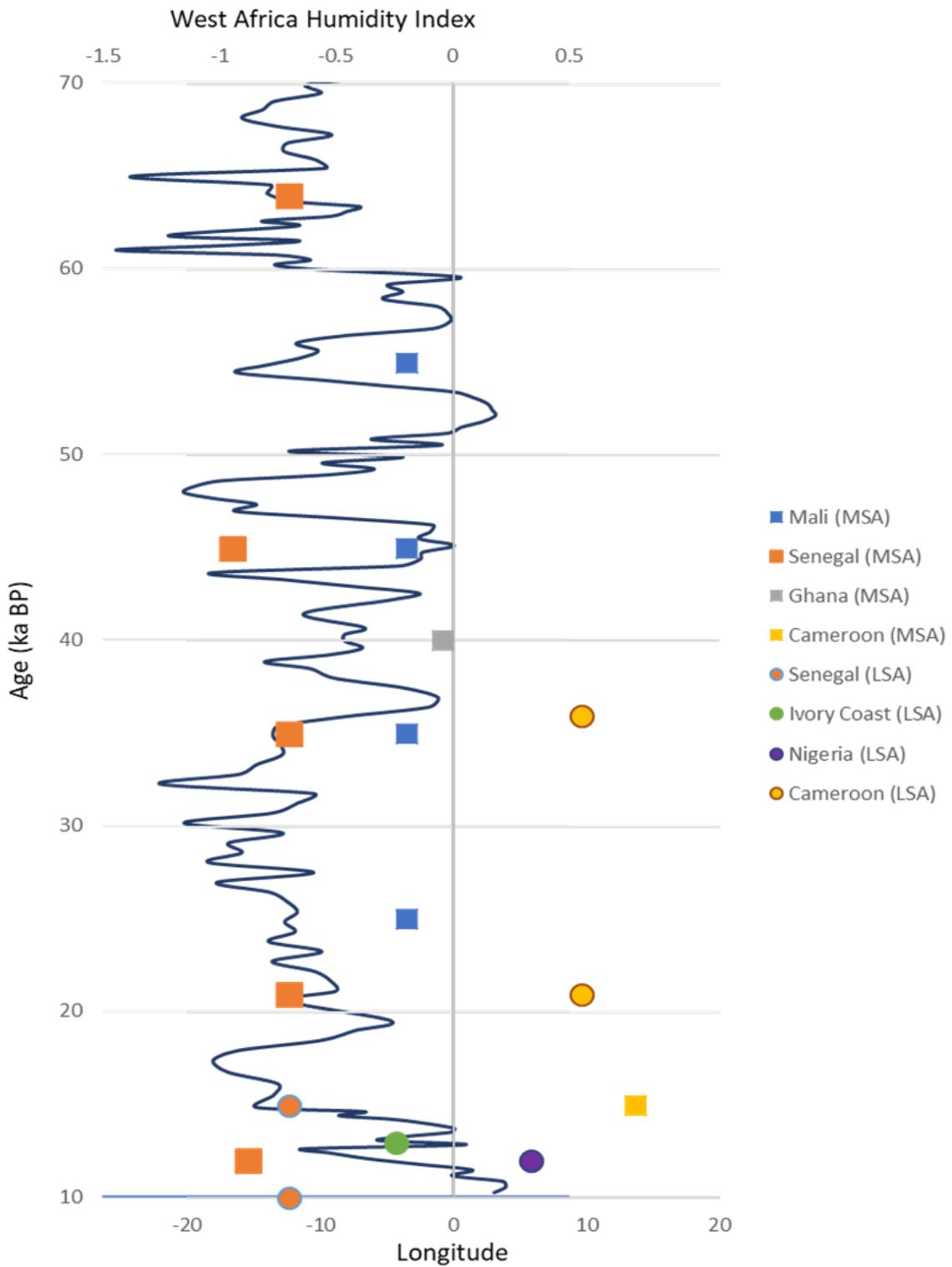
206 **4. Discussion**

207 Our results show Tiémassas is the oldest known Stone Age occupation of the West African
208 littoral in mid MIS 3, located at the interface of Sudanian savannahs, Guinean forest-savannah
209 mosaics and Guinean mangrove habitats. Figure 5 places this finding in the context of regional
210 marine records for humidity in West Africa and other dated West African Late Pleistocene Stone
211 Age sites. Occupation at Tiémassas coincides with a peak of humidity, comparable to
212 contemporary conditions. Earlier MSA occupations in Senegal are known from a single
213 retouched point in MIS 4 deposits at Missira (Lebrun et al. 2016), with further mid MIS 3
214 occupations are known from Ounjougou in Mali (Tribolo et al 2015), and continued occupation
215 of Sudanian savannahs and Sahel across Senegal (Scerri et al. 2017; Chevrier et al. 2016; Lebrun
216 et al. 2016), Mali (Tribolo et al. 2015) and Cameroon (Marliac and Gavaud 1975) extending into
217 the latter stages of MIS 2. Within the MSA of West Africa, the ecotonal position of Tiémassas
218 appears unique. Our results suggest that by the middle of MIS 3, Middle Stone Age populations
219 had expanded across the breadth of Sudanian savannahs of West Africa and had begun to
220 engage with the new ecologies encountered.

221 The occupation at Tiémassas~44ka marks the earliest occupation of the West African littoral.
222 LSA occupations in West Africa occur in closer proximity to the coast than MSA sites and occur
223 in forested habitats, first appearing in Cameroon in late MIS 3 and in MIS 2 (Cornelissen 2003).
224 Near coastal occupations in Ivory Coast and Nigeria follow in the terminal Pleistocene
225 (Chenorkian 1983; Shaw 1973). Although geographically dispersed, these occupations share a
226 common environmental signature of coinciding with peaks of regional humidity identified in
227 marine records. A significant change in resource exploitation between MSA and LSA in West
228 Africa can therefore be inferred given the shift from open, savannah habitats to diverse forested
229 ecologies. Colonisation of mangrove habitats, such as occur in close proximity to Tiémassas,
230 may have been part of this process, including exposure to new faunal and floral resources with
231 distinct patterns of interconnection from either savannah or forest habitats. Elsewhere,
232 mangrove habitats have been identified as potential hotspots for Pleistocene populations as
233 well as for the innovation of watercraft, enabling both effective exploitation of mangrove
234 resources and population expansions (Erlandson 2017). Two discrete mangrove habitats are
235 found in West Africa, one in stretching from Senegal down through to Sierra Leone, and a
236 second along the coasts of Ghana and Nigeria, which may offer alternate routes of expansion

237 along the coastline. Engagement with the coastline, beginning with occupations of Tiémassas,
238 may have offered new routes of population movement across West Africa compared to the
239 regions riverine network, facilitating engagement with different forms of forest habitats (Figure
240 1). While detailed examination of this is premature, the disjunct distribution of mangrove
241 habitats on the West African coast, in contrast to more contiguous habitats along rivers, may
242 have contributed to new forms of geographic isolation of past populations, which could give
243 rise to patterns of behavioural, and potentially biological, structure.

244 Contacts along the coast have previously been suggested between Senegal and the Maghreb
245 (Tillet 1997), but examination of this is similarly challenged by the scarcity of research.
246 Nevertheless, Aterian assemblages have been identified on Mauritanian littoral, including the
247 sites of Baie du Levrier and Boulanour (Hugot 1972; Vernet 1979). Although rare, pedunculated
248 artefacts, including tanged points, are known from elsewhere in Senegal, including specimens
249 from the Senegal Valley, near Richard Toll (Scerri et al. 2016). To date, no direct technological
250 comparisons have been conducted between Senegalese (or West African) and Aterian
251 assemblages to establish whether they share anything more than common typological MSA
252 characteristics, such as the use of Levallois technology. Our results present a firm basis to
253 attribute previous MSA collections from Tiémassas to mid MIS 3, including tanged points
254 (Descamps 1979), augmented by the recovery of additional pedunculated specimens from our
255 excavations, which are also distinctive features of Aterian assemblages. This maintains the
256 potential for cultural connections between North and West Africa during the Late Pleistocene
257 focusing on the coastline, consolidating our appraisal of Tiémassas occurring in a key, ecotonal
258 position with significant implications for inter-regional population interactions.



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260 **Figure 5:** Late Pleistocene Stone Age sites plotted by central age range and latitude against
 261 the West Africa Humidity Index (following Tjallingii et al. 2008).

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