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

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Abstract:

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

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

1. Introduction

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

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

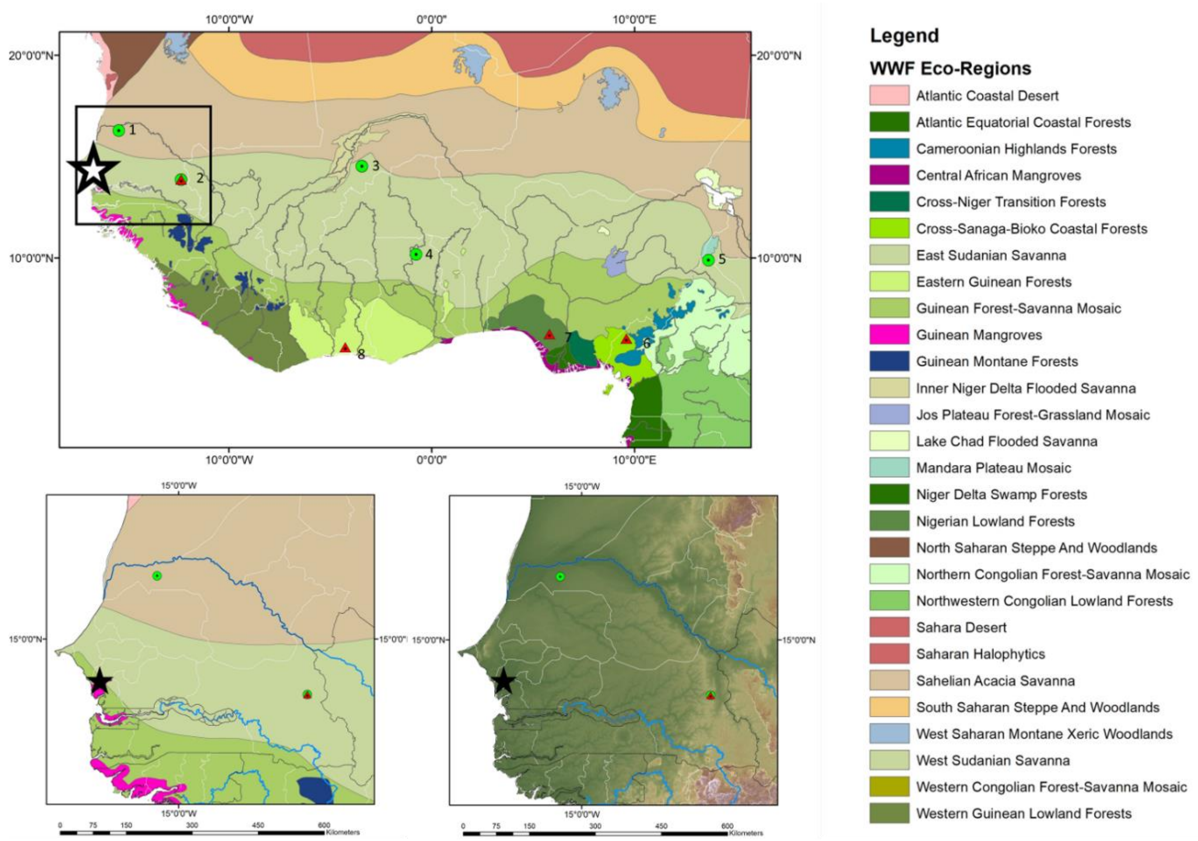


Figure 1: (top) Map of modern West African ecology and the location of dated Late Pleistocene sites, illustrating Middle Stone Age sites located within Sudanian savannahs (green circles; 1: Ndiayène Pendao; 2: Toumboura, Missira and Ravin des Guepiers; 3: Ounjougou; 4: Birimi; 5: Mayo Louti) and Later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

2. The Tiémassas Study Site

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

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

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

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

Table 1: Results of OSL and AMS dating from horizons 3, 4 and 6 at B1/G2 Tiémassas.

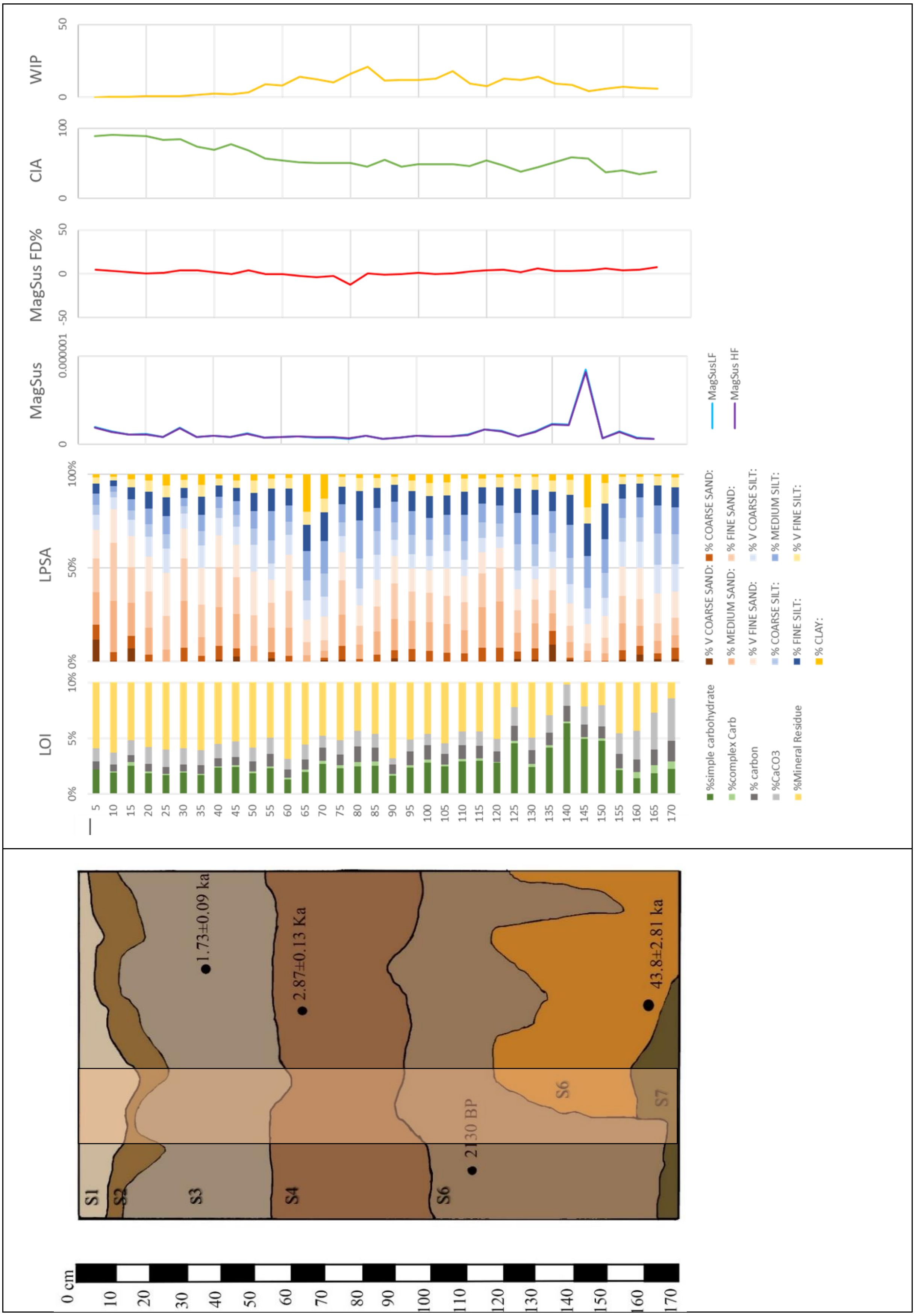


Figure 2: Excavated section in trench G2, illustrating the numbered sediment units with associated dates and sediment sampling profile (shaded), with results of geoarchaeological studies including (from left to right): Loss on ignition (between 0-10%; in all sample mineral residue >=90%); Laser particle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

3. Stone Tool Assemblages

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

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

Levallois cores were recovered from horizons 5 and 6, as well as in greater numbers in surface collections, and present either unidirectional or centripetal preferential flaking surfaces. Levallois flakes and retouched Levallois flakes are both found in levels 5 and 6, with the latter also appearing in level 2 and in surface collections, although their low occurrence suggest Levallois products were selectively removed from the site. Discoidal cores only appear in the surface collection, whereas discoidal flakes are found in levels 2-6, with retouched variants appearing in horizons 2, 4 and 5. Retouched artefacts are concentrated in levels 5 and 6. Retouch is generally short, continuous and located on the dorsal face of flakes, predominately used to produce scrapers with rare examples of bifacial retouching and the production of limaces. Remaining evidence for reduction practices predominately comprises single or multiplatform reduction strategies, with average flakes dimensions ranging from 38.27 to 34.37mm for length and 29.30 and 26.67mm for width, which is comparable with surface material. The rare sandstone elements are consistently larger.

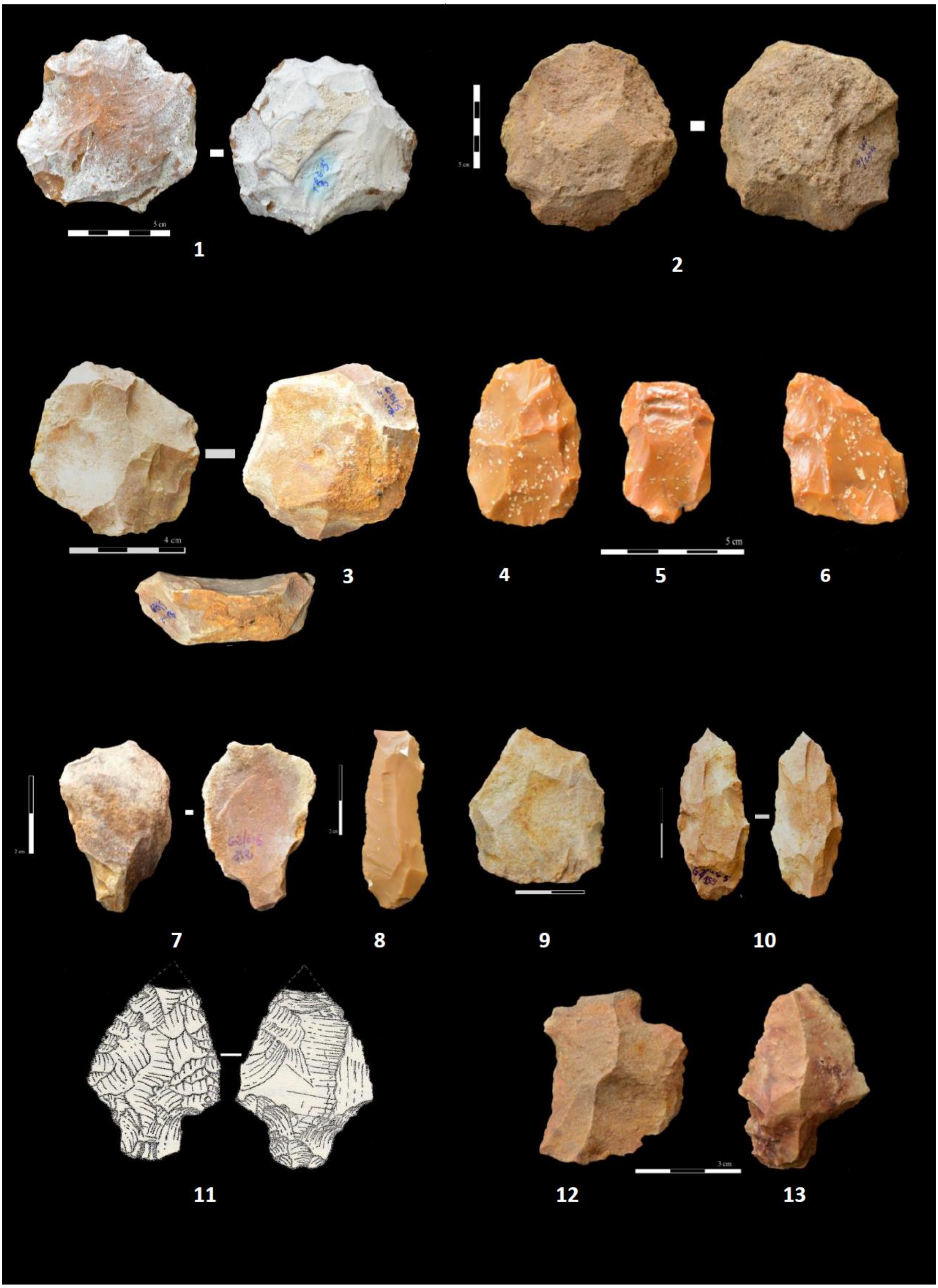


Figure 3: 1-Levallois centripetal core from surface, **2-** Levallois centripetal core from G2 (unit 6), **3-** Levallois centripetal core (G2 / Unit 5), **4-**Levallois preferential core with centripetal preparation (C8/ unit 5) ,**5-**core on flake (C8/ unit 6), **6-** Levallois preferential core with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

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

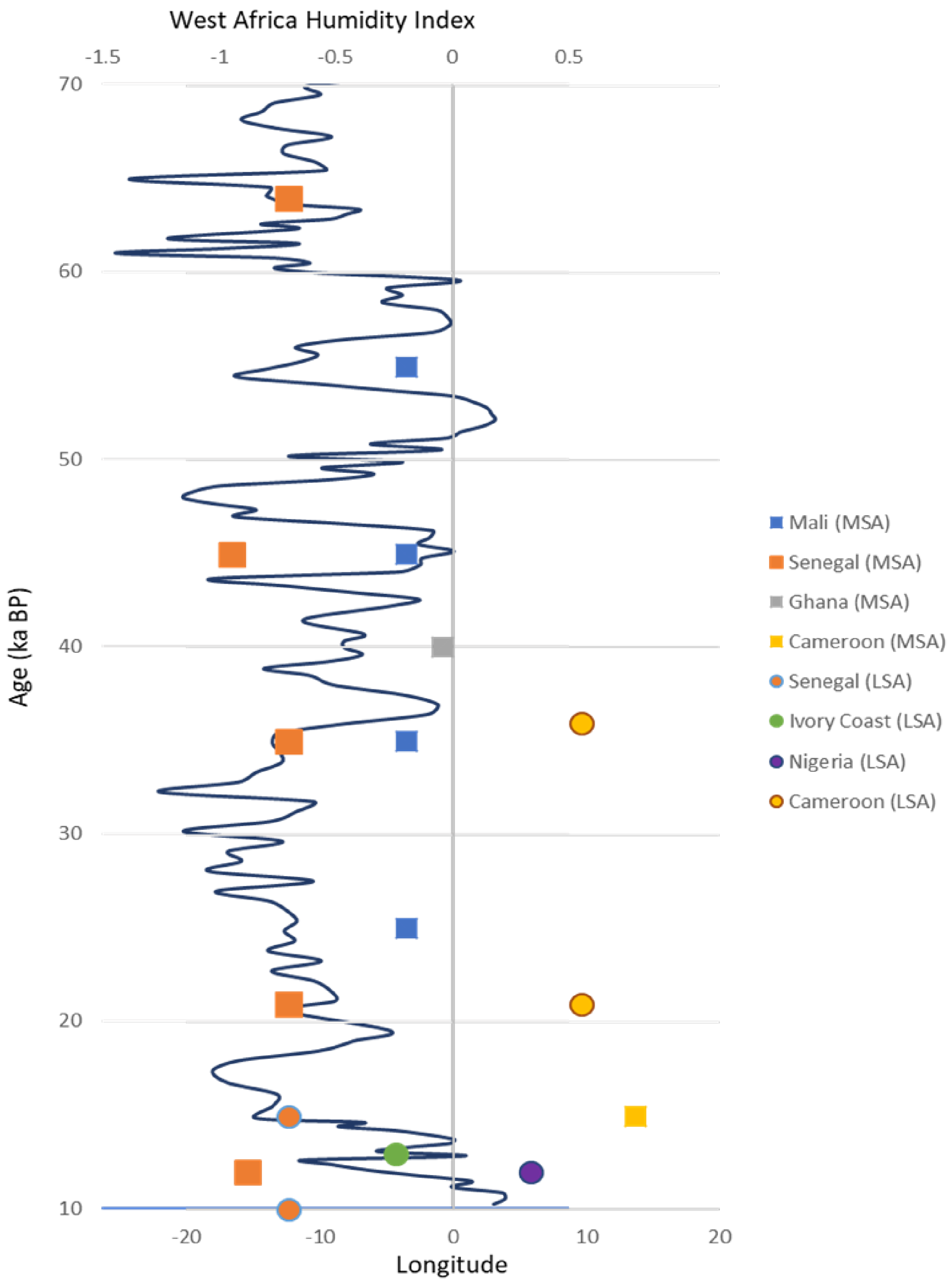
The stone tool assemblages from Tiémassas are consistent with regional descriptions of MSA technologies. Combining studies of stone tools with the sedimentary context suggests an *in-situ* occupation horizon in level 6 dating to ~44ka. The broadly homogeneous nature of stone tools from all excavated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

4. Discussion

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

The occupation at Tiémassas~44ka marks the earliest occupation of the West African littoral. LSA occupations in West Africa occur in closer proximity to the coast than MSA sites and occur in forested habitats, first appearing in Cameroon in late MIS 3 and in MIS 2 (Cornelissen 2003). Near coastal occupations in Ivory Coast and Nigeria follow in the terminal Pleistocene (Chenorkian 1983; Shaw 1973). Although geographically dispersed, these occupations share a common environmental signature of coinciding with peaks of regional humidity identified in marine records. A significant change in resource exploitation between MSA and LSA in West Africa can therefore be inferred given the shift from open, savannah habitats to diverse forested ecologies. Colonisation of mangrove habitats, such as occur in close proximity to Tiémassas, may have been part of this process, including exposure to new faunal and floral resources with distinct patterns of interconnection from either savannah or forest habitats. Elsewhere, mangrove habitats have been identified as potential hotspots for Pleistocene populations as well as for the innovation of watercraft, enabling both effective exploitation of mangrove resources and population expansions (Erlandson 2017). Two discrete mangrove habitats are found in West Africa, one in stretching from Senegal down through to Sierra Leone, and a second along the coasts of Ghana and Nigeria, which may offer alternate routes of expansion along the coastline. Engagement with the coastline, beginning with occupations of Tiémassas, may have offered new routes of population movement across West Africa compared to the regions riverine network, facilitating engagement with different forms of forest habitats (Figure 1). While detailed examination of this is premature, the disjunct distribution of mangrove habitats on the West African coast, in contrast to more contiguous habitats along rivers, may have contributed to new forms of geographic isolation of past populations, which could give rise to patterns of behavioural, and potentially biological, structure.

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