Aterian

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Summary

The Aterian is a North African late Middle Stone Age techno-complex. It is spread from the Atlantic coast in Morocco to the Middle Nile Valley in Sudan and from the Mediterranean hinterland to the Southern Sahara. Chronologically, it covers the period between *c*. 145,000 years BP and 29,000 BP, spanning across discontinuous, alternating dry (end of MIS 6 and MIS 4) and humid (MIS 5 and MIS 3) climatic phases. Few, but significant human remains indicate that the makers of the Aterian complex belong to early *Homo sapiens*. Their osteological features show affinities with the early anatomically modern human record in the Levant (Skhul and Qafzeh), suggesting that Aterian groups may have taken part in the initial dispersals out of Africa by *Homo sapiens*. Toolkits consist of a variety of implements not only made of stone but also of bone (points, spatulas, knives, and retouchers). They include tools that were lacking in earlier or other North African contemporary contexts, namely bifacial foliates, blades, perforators, burins, endscrapers, and particularly tanged pieces. Overemphasis on tanged tools often obscured the complexity of the Aterian, which instead displays a wide range of cultural and behavioral innovations. New mobility patterns and intra-site organization, as well as early symbolism with the use of Nassariidae shells and ochre, corroborate early fully complex behavior by these populations. Given the broad geographic and chronological extension of the Aterian, differences are evident at both local and regional scales. They suggest the development of a flexible and variable techno-complex mirroring considerable adaptive cognitive and behavioral plasticity derived from nonlinear processes. Such diversified behavioral experiments result from multiple and noncumulative trajectories due to different internal and external stimuli but are still part of a single cultural entity.

Keywords: Aterian, African Middle Stone Age, North Africa, Out of Africa, early Homo sapiens, tanged tools, early complex behavior

Subjects: Archaeology

The Aterian Techno-Complex

Aterian stone assemblages were first recognized across North Africa in the early 1900s and described according to typological and morphological criteria. As research continued and investigation methods improved, a set of technological (reduction sequences, use of different raw materials) and behavioral features (early symbolism, intra-site organizations, settlement systems) were added to the characterization of the Aterian techno-complex (Garcea 2010). Given its vast geographic and chronological extension, not all the Aterian's attributes occur at the same time and in every site, revealing considerable regional variability between different, often isolated, human groups. Because of its intrinsic adaptability, complex archaeological features with key innovations appear within specific geographic and temporal limits. Although its entire existence has been occasionally questioned (Dibble et al. 2013), the Aterian should be retained as a characteristic late Middle Stone Age (MSA) techno-complex circumscribed to North Africa.

At stratified sites, the occupational layers including Aterian assemblages may overlie those with Early MSA industries and are occasionally separated by a sterile deposit, such as at El-Khenzira, Rhafas (Wengler 1997), Adrar Bous (Clark et al. 2008), Jebel Gharbi (Barich et al. 2006; Garcea 2016), and other sites (see Garcea 2001). Contrebandiers is another example where Aterian layers overlie Early MSA (here called “Maghrebian Mousterian”) (Jacobs et al. 2011), but the two stone assemblages were considered as the result of internal variability of a single industry (Dibble et al. 2013) in spite of the stratigraphic evidence and technological differences (larger, wider, and thicker flakes, notches/denticulates, other tools, and cores in the Aterian and larger, wider, and thicker scrapers in the “Maghrebian Mousterian”). Conversely, interstratified Early MSA and Aterian occupations were postulated when the two techno-complexes were discriminated because of the presence or absence of tanged tools, arguably considered as the *fossile directeur* of Aterian assemblages (e.g., Nami and Moser 2010; Richter et al. 2010; Aouadi-Abdeljaouad and Belhouchet 2012).

Geographic Extent of the Aterian

Aterian sites extend over a vast area in North Africa and appear at different altitudes (Figure 1).

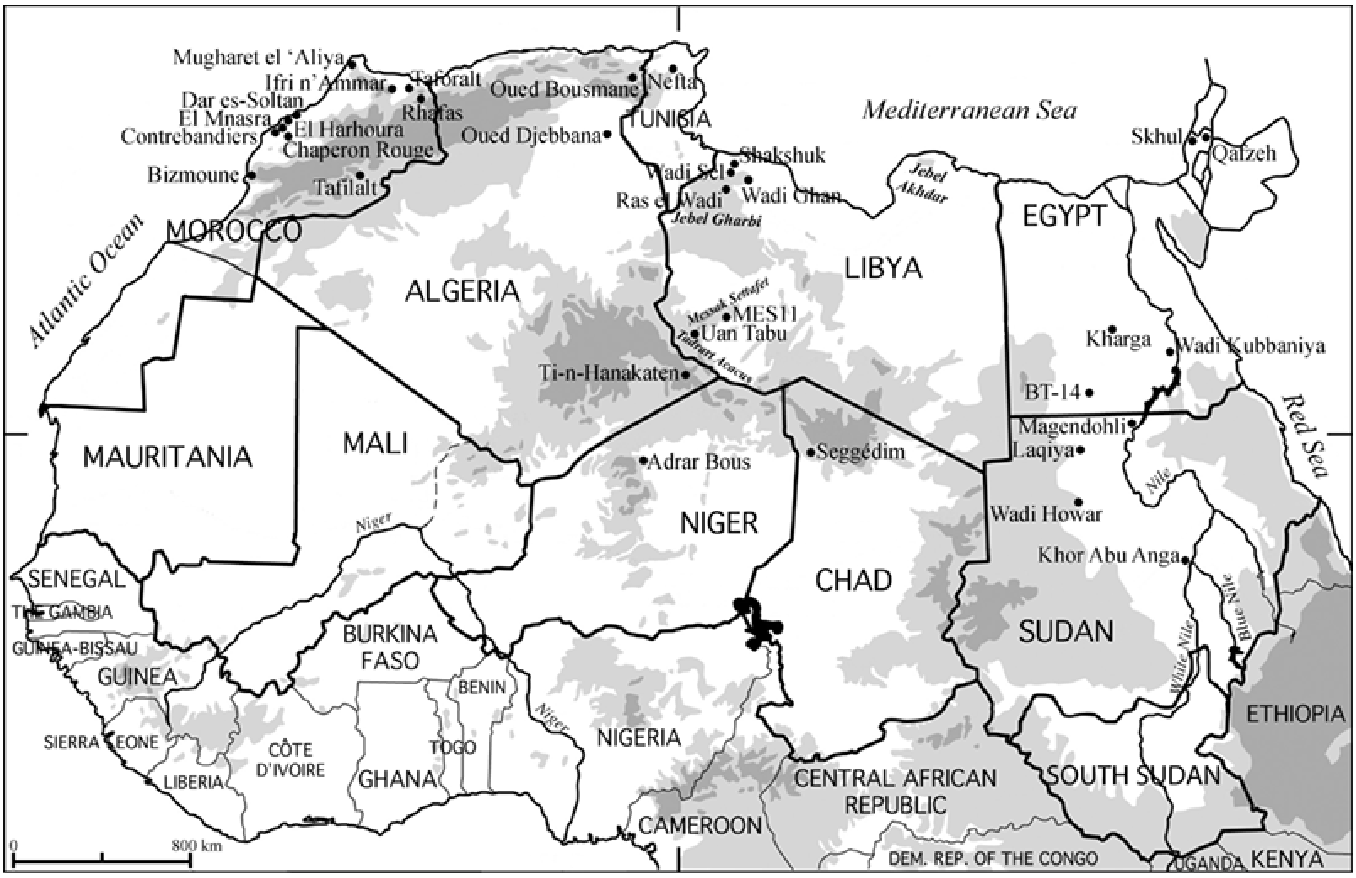

Figure 1. Map of the sites cited in the text.

Source: Public domain.

They are well represented on the Moroccan Atlantic coast and the Maghreb, and, in the Mediterranean hinterlands, they are spread eastward up to the Jebel Gharbi in northwestern Libya. While they are extremely rare in Egypt's Lower Nile Valley, where only one displaced surface assemblage was found at Wadi Kubbaniya (Schild et al. 2020), they are common further south in Sudan's Middle Nile Valley, particularly at Magendohli and Khor Abu Anga (Garcea 2020a, 2020b). Aterian finds occur in the Eastern Sahara, in both the Egyptian Western Desert, at Kharga oasis and BT-14 in the Bir Tarfawi basin (Churcher et al. 1999; Schild et al. 2020), and in large quantities in western Sudan, in the Laqiya region and Wadi Howar, corroborating interactions between the Sahara and the Middle Nile Valley (Garcea 2020a, 2020b).

The Central and Southern Sahara features extensive Aterian evidence. A residential occupation was excavated at Uan Tabu (Figure 2), on the Tadrart Acacus massif in southwestern Libya (Garcea 2001), and sparse evidence was found in the lowlands surrounding the massif and on the Messak Settafet plateau (Garcea 2010; Cancellieri et al. 2016), including a stratified site, MES11 (Foley et al. 2013).

Figure 2. Aterian deposit at Uan Tabu, Tadrart Acacus.

Source: Elena A. A. Garcea.

A deposit containing Aterian lithics was found at the bottom of the stratigraphic sequence at Ti-n-Hanakaten, in the Algerian Sahara (Hachi 1987), together with numerous other sites in the same region (Garcea 2001). In the Southern Sahara, Aterian sites were recorded in Niger, at Adrar Bous (Clark et al. 2008) and on the Air mountain range (Garcea 2001), and in the Chad Basin (Tillet 1983).

Chronology and Environmental Context: From MIS 6 to MIS 3

Consistent high precision dating records, including Optically Stimulated Luminescence (OSL), Thermoluminescence (TL), Uranium-series (U-series), Electron Spin Resonance (ESR), Accelerator Mass Spectrometry (AMS) radiocarbon, place the Aterian over a long period, spanning from the end of MIS 6 (*c*. 145,000 BP) until the end of MIS 3 (*c*. 29,000 BP), although such a prolonged duration was not recorded at any single site. While the Early MSA dates from *c*. 300,000 BP also in Morocco (Hublin et al. 2017), no dates earlier than the end of MIS 6 exist for the Aterian. Datings show two main peaks, one between 120,000 and 80,000 BP, the other between 70,000 and 30,000 BP (Table 1). The contraction around 80,000–70,000 BP may have been related to the 74,000 BP super-eruption of the Toba volcano in Sumatra, which caused a severe cooling and desiccation episode also in Africa (Williams et al. 2009).

Table 1. Radiometric Dates of Major Aterian Sites (AMS Radiocarbon Dates Calibrated with OxCal 4.4, 95.4 Percent Probability)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Témara	Chaperon Rouge 1	28,200±3300	TL	Sediment	Texier et al. (1988)
Morocco		Wadi Noun	30,900±2500	OSL	Quartz grains	Weisrock et al. (2006)
Morocco	Témara	El Harhoura, level 1	32,150±4800	gamma TL	Sediment	Campmas (2017)
Morocco	Rif	Taforalt (Grotte des Pigeons), sector 8, layer Y12	34,509–33,297 (29,160±1600 uncal.)	AMS	Charcoal	Barton et al. (2013)
Morocco	Rif	Taforalt (Grotte des Pigeons), sector 8, layer Y12	34,567–33,422 (29,310±1600 uncal.)	AMS	Charcoal	Barton et al. (2013)
Morocco	Rif	Taforalt (Grotte des Pigeons), base of sector 9	37,570±3420	OSL	Quartz grains	Barton et al. (2013)
Morocco	Témara	El Harhoura, level 1	41,160±3500	TL	Sediment	Débenath et al. (1986)
Morocco	Tangier	Mugharet el ‘Aliya, layer 6	44,000±5000–39,000±4000 (EU)	ESR	Tooth enamel	Wrinn and Rink (2003)
Morocco	Tangier	Mugharet el ‘Aliya	46,000–21,000 (EU)	ESR	Tooth enamel	Millard (2008)
Morocco	Témara	El Harhoura 2, level 3	51,600±3600	OSL	Single-quartz grains	Jacobs et al. (2012)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Libya	Jebel Gharbi	Shakshuk, geological profile	52,430–43,095 (43,530±2110 uncal.)	AMS	Charred material	Garcea (2012a)
Morocco	Témara	El Harhoura 2, level 3	52,600±3300	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Dar es-Soltan 1, G4.7	52,800±3200	OSL	Quartz grains	Ben Arous et al. (2020)
Libya	Jebel Gharbi	Wadi Sel, SJ-02-68	52,832–44,395 (44,600±2430 uncal.)	AMS	Organic sediment	Garcea (2012a)
Morocco	Tangier	Mugharet el ‘Aliya, layer 9	56,000±5000–47,000±5000 (LU)	ESR	Tooth enamel	Wrinn and Rink (2003)
Morocco	Rif	Rhafas, layer S5	56,900±3500	OSL	Single-quartz grains	Doerschner et al. (2016)
Morocco	Tangier	Mugharet el ‘Aliya	57,000–27,000 (LU)	ESR	Tooth enamel	Millard (2008)
Morocco	Témara	El Harhoura 2, level 3	57,300±4200	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	El Harhoura 2, level 3	57,700±4200	OSL	Single-quartz grains	Jacobs et al. (2012)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 8 (Roche 1976)	59,000	OSL	Quartz grains	Schwenninger et al. (2010)
Libya	Jebel Gharbi	Ain Zargha, 27G N-trench	<60,000	U/Th	Calcrete	Garcea (2012a)
Morocco	Rif	Taforalt (Grotte des Pigeons), layer R16	60,100±3900	OSL	Quartz grains	Turner et al. (2020)
Libya	Tadrart Acacus	Uan Tabu, level 21	61,000±10,000	OSL	Quartz grains	Cremaschi et al. (1998)
Morocco	Témara	Dar es-Soltan 1, G4	61,000–52,000	OSL	Quartz grains	Schwenninger et al. (2010)
Morocco	Témara	El Harhoura 2, level 3	61,900±3500	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Tangier	Mugharet el ʻAliya, Layer 10	62,000±6000 (EU)	ESR	Tooth enamel	Wrinn and Rink (2003)
Libya	Jebel Gharbi	Ain Zargha, 27E N-trench	64,000±21,000	U/Th	Calcrete	Garcea (2012a)
Morocco	Témara	Contrebandiers (El Mnasra 1), sector IV, layer 1b	65,200±6300 (RU)–52,500±5400 (LU)	ESR	Tooth enamel	Dibble et al. (2012)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Rif	Taforalt (Grotte des Pigeons)	73,400	U-series, TL, OSL	Various	Bouzouggar et al. (2007)
Morocco	Témara	El Harhoura 2, level 4a	73,700±4100	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Dar es-Soltan 1, G3.1	78,400±4000	OSL	Quartz grains	Ben Arous et al. (2020)
Morocco	Tangier	Mugharet el ‘Aliya, Layer 10	81,000±9000 (LU)	ESR	Tooth enamel	Wrinn and Rink (2003)
Morocco	Rif	Ifri n’Ammar, Upper *occupation supérieure (OS)*	83,300±5600	TL	Heated artefacts	Richter et al. (2010)
Morocco	Rif	Taforalt (Grotte des Pigeons), layer R22	84,500±4400	OSL	Quartz grains	Turner et al. (2020)
Morocco	Rif	Rhafas, layer 3a	85,400±4500	OSL	Single-quartz grains	Doerschner et al. (2016)
Morocco	Rif	Rhafas, layer S6	86,400±4900	OSL	Single-quartz grains	Doerschner et al. (2016)
Morocco	Témara	Dar es-Soltan 1, G3	87,000–68,000	OSL	Quartz grains	Schwenninger et al. (2010)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Témara	Contrebandiers (El Mnasra 1), sector IV, layer 2	87,000±10,000	TL	Heated artefact	Dibble et al. (2012)
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 11b (Roche 1976)–layer 5b (Dibble et al. 2012)	89,000±14,000	TL	Heated artefact	Dibble et al. (2012)
Morocco	Rif	Taforalt (Grotte des Pigeons)	91,500	U-series, TL, OSL	Various	Bouzouggar et al. (2007)
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 11a (Roche 1976)–layer 5a (Dibble et al. 2012)	92,000±14,000 89,000±16,000	TL	Heated artefact	Dibble et al. (2012)
Morocco	Témara	El Mnasra 2, layer 4 (base)	94,600±9700	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 11a/b (Roche 1976)–layer 5a/b (Dibble et al. 2012)	94,400±7800 (RU)–67,400±6000 (LU)	ESR	Tooth enamel	Dibble et al. (2012)
Morocco	Témara	El Harhoura 2, level 4 (upper)	95,400±9300	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Contrebandiers (El Mnasra 1), sector IV, layer 2	96,000±4000	OSL	Single-quartz grains	Dibble et al. (2012)
Morocco	Rif	Rhafas, layer 3a	98,500±19,800	OSL	Single-quartz grains	Doerschner et al. (2016)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Témara	El Harhoura 2, level 4b	99,900±5800	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Dar es-Soltan 2, layer 5	101,000	OSL	Quartz grains	Schwenninger et al. (2010)
Morocco	Témara	El Mnasra 2, layer 4 (base)	103,500±7500	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	El Mnasra 2, layer 5	105,500±12,000	OSL	Quartz grains	Schwenninger et al. (2010)
Morocco	Témara	El Mnasra 2, layer 5a	106,500±6500	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	El Harhoura 2, level 8	106,700±6600	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	El Mnasra 2, layer 4 (base)	106,700±9600	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 9 (Roche 1976)–layer 4 (Dibble et al. 2012)	107,000±4000	OSL	Single-quartz grains	Dibble et al. (2012)
Morocco	Témara	El Mnasra 2, layer 6a	107,400±5800	OSL	Single-quartz grains	Jacobs et al. (2012)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Témara	El Mnasra 2, layer 5b	107,500±6600	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	El Mnasra 2, layer 7	107,600±9600	OSL	Quartz grains	Schwenninger et al. (2010)
Morocco	Témara	El Mnasra 2, layer 11 (upper)	108,300±6600	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Rif	Rhafas, layer 3b	108,500±9900	OSL	Single-quartz grains	Doerschner et al. (2016)
Morocco	Témara	El Mnasra 2, layer 7b	108,800±6600	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Dar es-Soltan 1, G2.1	109,900±9800	OSL	Quartz grains	Ben Arous et al. (2020)
Morocco	Témara	Contrebandiers (El Mnasra 1), sector V, layer 1a	110,500±8300 (RU)–91,400±7700 (LU)	ESR	Tooth enamel	Dibble et al. (2012)
Tunisia		Nefta	98,000–72,000	OSL	Quartz grains	Bouzouggar et al. (2020)
Morocco	Témara	El Mnasra 2, layer 6	111,600±7300	OSL	Single-quartz grains	Jacobs et al. (2012)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Témara	Dar es-Soltan 1, G1.7	112,100±8100	OSL	Quartz grains	Ben Arous et al. (2020)
Morocco	Témara	Contrebandiers (El Mnasra 1), sector IV, layer 2	115,000±11,000	TL	Heated artefact	Dibble et al. (2012)
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 11c (Roche 1976)–layer 5c (Dibble et al. 2012)	116,000±13,000	TL	Heated artefact	Dibble et al. (2012)
Morocco	Témara	El Harhoura 2, level 6	116,400±6600	OSL	Single-quartz grains	Jacobs et al. (2012)
Morocco	Témara	Dar es-Soltan 1, G2 (Ruhlmann's layer 1)	119,000–106,000	OSL	Quartz grains	Schwenninger et al. (2010)
Morocco	Témara	Contrebandiers (El Mnasra 1), layer 13d/14 (Roche 1976)–layer 6c (Dibble et al. 2012)	122,000±5000	OSL	Single-quartz grains	Dibble et al. (2012)
Morocco	Rif	Rhafas, layer S7	122,500±8800	OSL	Single-quartz grains	Doerschner et al. (2016)
Egypt	Western Desert	Kharga	125,000±1600	U-series	Tufa	Churcher et al. (1999)
Morocco	Rif	Ifri n'Ammar, Lower *occupation supérieure (OS)*	130,000±7800	TL	Heated artefacts	Richter et al. (2010)

Country	Locality	Site	Years BP	Method	Dated Material	Reference
Morocco	Rif	Rhafas, layer 4c	135,300±10,300	OSL	Single-quartz grains	Doerschner et al. (2016)
Morocco	Rif	Ifri n'Ammar, Upper *occupation inférieure (OI)*	145,000±9000	TL	Heated artefacts	Richter et al. (2010)
Niger	Adrar Bous	Adrar Bous	between ≤150,000 and ≥45,000	Geological sequences		Clark et al. (2008)

Source: Compiled by Elena A. A. Garcea.

Aterian populations lived within a patchwork of different biomes, expanding through ecological corridors during moist phases, and contracting and taking refuge on the mountain ranges or by permanent water springs when bottlenecks formed during semi-arid periods (Scerri et al. 2014). At the end of MIS 6, when the makers of Aterian industries first appeared, forest cover declined and the Sahara expanded, with only a short humid period around 135,000 BP. At the beginning of MIS 5, a series of mega-lakes with interconnecting rivers formed across the Sahara, providing a network of routes for human spread. Large river systems, including the Nile and Niger with their headwaters in Sub-Saharan Africa, supported these migration routes (Drake and Breeze 2016). During MIS 5e, 5c, and 5a interstadials, Mediterranean C_3 vegetation with open grassland and wooded areas in coastal and hinterland regions expanded, mixed C_3/C_4 savanna vegetation developed along the Sahara borders, and C_4 vegetation penetrated into the Sahara (Campmas 2017). Conversely, MIS 5d and 5b featured a reduction of forest cover.

The cool and dry conditions of MIS 4 lasted until the onset of MIS 3 or later in the Sahara and broke exchange networks across North Africa. Human groups abandoned the Central and Southern Sahara during this period. The Aterian occupation at Uan Tabu, dating to MIS 4 and associated with dry environments, confirms that the refugia in the Central Saharan mountain ranges were abandoned thereafter.

Brief humid peaks occurred in the Northern Sahara during MIS 3 around 44,000 BP and only in the northern margins of the Moroccan Sahara around 37,000 BP (Drake and Breeze 2016). In the Jebel Gharbi, underground aquifers formed perennial springs (Figures 3 and 4) that offered critical water resources and locally favorable conditions in the Upper Pleistocene, including MIS 3, when the area seemingly became a refugium for late Aterian groups (Garcea and Giraudi 2006). Also on the Atlantic coastal areas, Aterian groups appeared during semi-arid moister phases, when grassland habitats expanded, and moved out when grassland contracted (Jacobs et al. 2012).

Figure 3. Ain Zargha, Jebel Gharbi.

Source: Elena A. A. Garcea.

Figure 4. Water spring at Shakshuk, Jebel Gharbi.

Source: Elena A. A. Garcea.

Settlement Systems and Spatial Organization

Aterian groups developed settlement systems based on seasonal low mobility within long-distance exchange networks. They had long and short occupations, with hunting stands (e.g., Mugharet el Aliya), ephemeral camps (e.g., Contrebandiers), and residential sites (Scerri 2017).

The caves on the Atlantic Moroccan coast, featuring low density of archaeological materials, fragmented stone reduction sequences, and small numbers of exploited terrestrial vertebrates, were occupied on a short-term basis. They were particularly attractive for the abundance of marine malacofauna during humid MIS-5 periods, but not during arid MIS-4 and MIS-3 oscillations, when carnivores replaced humans (Campmas et al. 2015). While occupations on the Atlantic coast lasted until *c.* 40,000 BP, the upland sites facing the Mediterranean coast, such as Taforalt, continued to be frequented until *c.* 29,000 BP (Barton et al. 2016). In the Jebel Gharbi further east, Aterian groups established a logistic land use with a few residential sites, workshops, and special-use areas concentrated in three main areas, Ain Zargha, Jefara (Wadi Sel and Shakshuk), and Wadi Ghan (Spinapolice and Garcea 2014).

Away from the coast, during less favorable climatic conditions, human populations retreated in refugia on the mountain ranges of the Central and Southern Sahara until *c.* 60,000 BP, when they moved away. The location of the sites in both northwestern and southwestern Libya indicates a consistent relationship between settlement choices and water and raw material availability, revealing a notable level of adaptability according to a geographic gradient in terms of latitude and altitude (Garcea 2012a). Almost complete reduction sequences performed on different types of raw materials suggest that the Uan Tabu rockshelter on the Tadrart Acacus massif was a residential occupation surrounded by a number of brief camps in the plateaus and lowlands (Garcea 2001).

Intensive exploitation of a variety of local raw materials—available in the range of 15–20 km—and rare use of nonlocal materials support low mobility in northwestern Africa (e.g., Nespoulet et al. 2008b; Arzarello et al. 2013; Campmas et al. 2016; Bahra et al. 2020), Central Sahara (Garcea 2001), and Southern Sahara (Clark et al. 2008). At the same time, high quality nonlocal materials, such as exotic fine-grained rocks at the Atlantic coastal sites (Campmas 2017), quartzite in the Tadrart Acacus (Garcea 2010), or greenstone, a silicified vitric tuff, at Adrar Bous (Clark et al. 2008), substantiate occasional long-distance movements of more than 50 km, which seemingly occurred during environmental ameliorations. Ethnographic comparisons with hunter-gatherers in arid regions describe comparable settlement systems with seasonal patterns of fragmentation and contraction in surviving water sources during dry episodes (Scerri 2017).

Spatial organization within Aterian sites demonstrates a structured use of domestic space, corroborating low-mobility settlements and increased consideration for residential spaces. Habitation structures including slabs, wedging elements, postholes, and fences were found at different sites in Morocco (Debénath 1992), and stone-walled structures were recovered at Dar es-Soltan 2, El Harhoura 1, and Chaperon Rouge (Nespoulet et al. 2008b). Structured hearths appeared in the upper Aterian layers at El Mnasra (Debénath 1992). Different types of combustion features include closed fireplaces demarcated by limestone slabs, oval and circular open hearths, dug-out hearths in consolidated clayey sediments, and combustion features with no delimited edges. Other hearths were observed at Taforalt, Dar es-Soltan 2, El Harhoura 1, and Chaperon Rouge (Nespoulet et al. 2008b). Regular cooking practices imply that food consumption involved longer preparation at the advantage of better food digestion and assimilation.

Subsistence Economy

Aterian populations had a broad diet based on nonselective hunting-gathering strategies and opportunistic systems of meat procurement, i.e., scavenging of large game such as rhinoceros, giraffes, and buffalos. Ungulates, mainly gazelles, but also aurochs and hartebeest were common prey (Nespoulet et al. 2008b; Dibble et al. 2012; Campmas et al. 2016). The entire butchering sequence of ungulates, comprising evisceration, skinning, disarticulation, meat removal, and marrow extraction, could be reconstructed at some sites (Campmas 2017). Terrestrial tortoises and mollusks (*Helix* sp.) were integrated in the diet (Campmas et al.

2016). Hippopotamus, rhinoceros, and warthog were also present at El Mnasra (Nespoulet et al. 2008b). At Taforalt, faunal remains include large mammals (aurochs), small mammals (*Hystrix cristata*), turtles, and marine mollusks (Bouzouggar et al. 2018). In the mountainous regions, Barbary sheep, gazelles, and equids were the prevalent prey (Campmas 2017).

The groups settled along the Moroccan Atlantic coast intensively exploited marine resources, particularly mussels and limpets (Mytilidae and Patellidae), and rarely fish. Preservation conditions of the limpet shells (little taphonomic degradation of mineral and organic components) show that these mollusks were collected alive on the seashore by means of a tool that chipped the edges of the shells when used (Nouet et al. 2015). Finally, ostrich eggshell fragments were found at several sites, such as Rhafas, and El Harhoura 1 and 2, and may have been used for water storage (Scerri 2017).

Lithic Assemblages

The available data on Early MSA industries is scantier than that on Aterian assemblages, making it difficult to substantiate a technological relationship (continuity?) between these two complexes (Bouzouggar and Barton 2012). At any rate, compared to the Early MSA, Aterian toolkits introduce novel attributes, comprising a wider range of tool categories designed to serve multiple purposes. They exhibit opportunistic and flexible systems with stylistic, geographic, and chronological variations.

A large range of minerals (quartz) and rocks were used as raw materials, including sedimentary (limestone, calcarenite, sandstone, flint, and chalcedony), metamorphic (quartzite), and igneous (lava, basalt, and diorite) types. Local raw materials were primarily used even in places where they were of poor quality. However, contrary to the Early MSA, imported high-quality materials occasionally appeared and circulated over larger areas in the form of (semi)finished products. At El-Khenzira, exotic fine-grained chert used to make finely retouched tools suggested specific curation of these tools. Greenstone was recorded at Adrar Bous, 80 km away from its closest source (Clark et al. 2008), and quartzite was found at Uan Tabu, which also came from a distance of 80 km (Garcea 2001).

Tanged tools (Figure 5.1–5) are typical components of Aterian toolkits, but their presence (or absence) has been too often overemphasized to the detriment of other tool categories or reduction methods and has even used to discriminate between “Mousterian” (Early MSA) and Aterian assemblages.

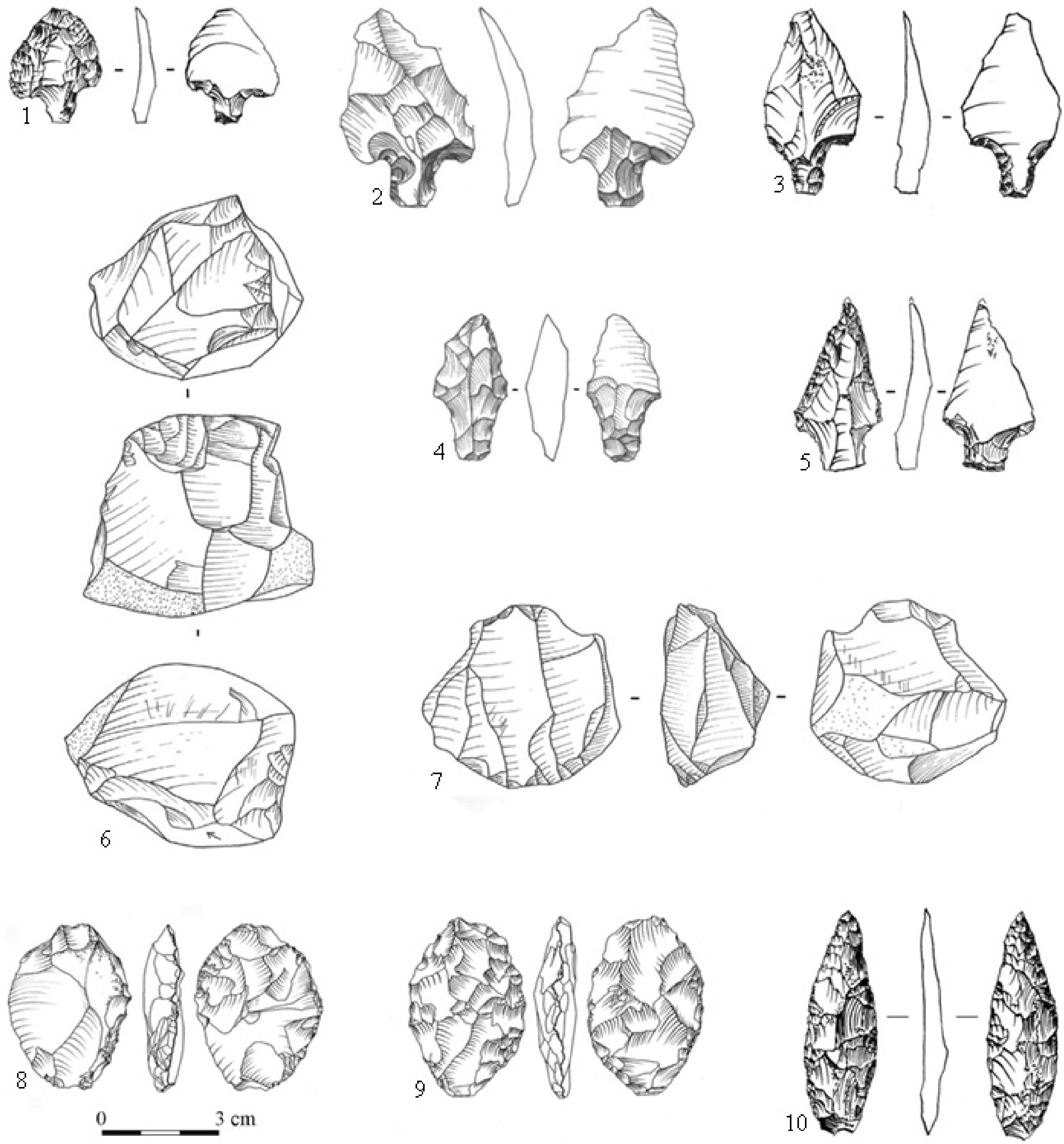

Figure 5. 1–5. Tanged tools; 6. Volumetric blade core; 7. Taramsa core; 8. Ovoid partial bifacial flake; 9. Ovoid bifacial flake; 10. Bifacial foliate. 1–5, 10. From Contrebandiers; 6. From Shakshuk; 7. From Ras el Wadi; 8–9. From Wadi Ghan.

Source: 1–5, 10. Modified from Dibble et al. (2012), with permission by PaleoAnthropology. figs. 14, 19. 6–9. Elena A. A. Garcea.

The risk of taking tanged pieces alone as cultural markers may lead to the extreme postulation that the Aterian is not an independent cultural complex but rather the evidence of special site activities (Linstädter et al. 2012). While Dibble et al. (2012) separate Aterian and "Maghrebian Mousterian" layers at Contrebandiers for the presence (in layers 8–10, according to Roche 1976) or absence (in layers 11–14) of tanged points, Schwenninger et al. (2010) ascribe the entire lower stratigraphic sequence (layers 8–14) to the Aterian. Similarly, tanged pieces were not found in every layer at El Harhoura 2, but the entire sequence was still assigned to the Aterian in consideration that other Aterian attributes are represented and are comparable to those recorded at El Mnasra (Jacobs et al. 2012).

Instead of a single tool type, a combination of features characterize Aterian assemblages, including a variety of core reduction methods, production of bifacial points, and employment of hafting techniques. In addition to tanged tools, other hafting devices comprise basal thinning and shouldering. These different hafting methods could be applied to tools made for the same tasks (Tomasso et al. 2020). Ultimately, notched tools and "pseudo-tanged" tools are equally as typical as tanged tools (Falzetti et al. 2017).

The Levallois technique displays different reduction methods: unipolar, bidirectional, centripetal, and convergent. Levallois and discoidal cores of small sizes are one of the representative components throughout the Aterian period in northwestern Africa and only in the Late Aterian further east (Garcea and Giraudi 2006). Small Levallois cores could be made on pebbles that were initially halved by the anvil technique before applying the Levallois method (Bouzouggar and Barton 2012). The Nubian technique is also present but is not a geographic-specific indicator of relations with Nubia (Garcea 2001).

Blades are another distinguishing Aterian feature. True prismatic laminar cores are rarely found in northwestern African assemblages but exist in northeastern Africa and derive from laminar Levallois, volumetric (Figure 5.6), and Taramsa cores (Figure 5.7). The Taramsa method features a volumetric exploitation of cores prepared according to the Levallois blade method (Spinapolice and Garcea 2014). Bladelets are more unusual than blades, although exceptions exist, for example at Bizmoune, Morocco, where they occur together with bladelet cores (Bouzouggar et al. 2017).

The bifacial flake technique by either percussion or pressure retouch was employed to produce ovoid partially or fully bifacial flakes (Figure 5.8–9), and thin foliate points (Figure 5.10). Bifacial foliates seem to occur in inverse proportion to tanged tools (Bouzouggar and Barton 2012), although both types were recorded since the earliest levels at Ifri n'Ammar (Mikdad et al. 2004).

Sidescrapers (Figure 6.1–3), notches (Figure 6.4), and denticulates (Figure 6.5) represent a major component of toolkits. Conversely, endscrapers (Figure 6.6), truncated-faceted pieces (Figure 6.7), perforators (Figure 6.8), and backed knives (Figure 6.9) occur in low frequencies, particularly in the early Aterian. Endscrapers are often inversely proportional to sidescrapers.

Figure 6. 1–3. Sidescrapers; 4. Notch; 5. Denticulate; 6. Endscraper; 7. Truncated-faceted piece; 8. Perforator; 9. Backed knife; 10. Pseudo-tanged tool. 1–9. From Contrebandiers, with permission by PaleoAnthropology; 10. From Wadi Ghan.

Source: 1–9. Modified from Dibble et al. (2012), figs. 17–19. 10. Elena A. A. Garcea.

Tanged Tools

Given the exaggerated significance of tanged tools, selective collections performed in the early days of research probably falsified their incidence. In fact, later systematic collections revealed that these tools may have extremely variable frequencies and may even be occasionally lacking in Aterian assemblages (Bouzouggar and Barton 2012).

Retouch on tangs may occur anywhere: only on the dorsal or on the dorsal and ventral surfaces, and on only one side or on both, left and right (Garcea 2020b). While some tangs are worked with bulbar thinning by invasive retouch, others are the thickest part of the implement. They were not only manufactured on points but on a variety of tools (Figure 5.1–5), including sidescrapers, endscrapers, and even unretouched or cortical blanks, and were used to perform a variety of tasks (Garcea 2012a).

With respect to the assemblages from Adrar Bous, Clark et al. (2008) claimed that many tanged pieces were the working parts of hand-held tools. Functional analysis confirmed that not all tanged tools served as projectiles, and that hafting did not entirely replace the production of hand-held tools. Macro-wear traces showed few signs of impact fractures and micro-wear on samples from Rhafas and Contrebandiers demonstrated that tanged tools were mostly employed for working hard animal material (bones?) and softer material, but rarely for hafting projectiles. A study on Aterian points from Taforalt confirmed that they were used for cutting and working a range of organic materials, including soft and hard animal materials (Bouzouggar and Barton 2012).

Iovita (2011) observed that distal ends of tanged tools could be resharpened over a long period of use and reshaped into other tools while in the haft, serving different tasks as knives or sidescrapers, and not as projectiles. Tomasso and Rots (2017) demonstrated that most (about two-thirds) but not all tanged tools were hafted. While tanged sidescrapers and endscrapers were repeatedly resharpened for hide working and possibly butchering and had a long use time, tanged projectiles were not modified and had a short use life (Tomasso et al. 2020). Experimental and functional analysis on use-wear of Aterian tanged and notched tools confirmed that notching or shouldering was not always intended for hafting but could also be related to longitudinal or transversal actions practiced for either cutting or scraping (Falzetti et al. 2017). Furthermore, real tangs were distinguished from "pseudo-tangs" (Figure 6.10), which create an apparently similar but technologically and functionally distinct morphology. While pseudo-tangs are produced by two juxtaposed notches on one end of the tool (Falzetti et al. 2017), real tangs intended for hafting are made by invasive or covering bifacial retouching with a soft hammer, and their blanks may show burin-like and transverse snap fractures (Tomasso and Rots 2017). By contrast, pseudo-tangs are usually made by stepped or, more rarely, scalar retouching to be hand-held and show clear cutting and scraping use-wear (Falzetti et al. 2017). Both tangs and pseudo-tangs characterize Aterian toolkits.

Regional Variability of Lithic Assemblages

Aterian human groups had small population sizes and were partially isolated by distance and/or ecological barriers due to challenging climate oscillations. These conditions resulted in the development of technologically distinct regional traditions. Scerri (2013) distinguished two main variations, concentrated in northwestern and northeastern Africa, respectively. Among hafting modifications, basally thinned tools, which are correlated with lightweight, highly retouched points, are more frequent in northeastern than northwestern Africa (Table 2). In addition, small cores and small flakes are frequent at all times in the northwest but not in the northeast, which features laminar flakes, true blades, and other attributes instead (for details, see Scerri 2013; Scerri et al. 2014; Garcea 2016).

Table 2. Summary of Major Technological Differences of Aterian Complexes in Northwestern and Northeastern Africa

	Northwestern Africa	Northeastern Africa
Cores	Small sizes	Medium and large sizes
	Irregular shaping	Higher Levallois and Nubian technologies
	Intensive exploitation	Reduced exploitation
Blanks	Small sizes	Medium sizes
	Frequent plain platforms	Frequent faceted platforms
	Unidirectional and bidirectional flaking	Centripetal and subcentripetal flaking
	Ovoid flakes	Ovoid and elongated flakes
	Rare blades	Blades
Tools	Common basal thinning	Frequent basal thinning
	Rare heavy tools	Common heavy tools, usually with plain platforms
	Common retouched tanged tools	Common unretouched tanged tools
	Invasive retouching	Noninvasive retouching
	Bifacial foliates	Bifacial lanceolates

Source: Modified from Scerri (2013); Scerri et al. (2014); Garcea (2016, with permission by Elsevier).

Beside these two broad clusters, numerous other smaller localized cultural entities are likely to have existed within the extensive Aterian techno-complex, although the available lacunose sets of data only allow sensing but not description of them. Such regional variability may have derived from the emergence of anatomically modern human cognition and the interaction between demographic variables, learned traditions, and adaptability to diverse environmental conditions (Scerri et al. 2018).

Bone Tools

Specialized bone technology is among the innovations of complex behavior introduced in the Aterian and represents the earliest unambiguous evidence for bone tool utilization in North Africa, dating from 107,000–105,000 BP at El Mnasra (layer 5) (Nespoulet et al. 2008b). Its occurrence suggests the need to expand the range of raw materials other than stone in order to accomplish new tasks.

A variety of bone and ivory tools were employed to make not only tools but also ornaments. Two ivory objects, a shaped point and a small plaquette, and a bone knife were reported from Dar es-Soltan 1 (Bouzouggar et al. 2020). A worked and polished piece was found at El Harhoura 1 (Nespoulet et al. 2008a). One spatula, one point, one raclette, polishers, and several bone flakes reworked into tools came from El Mnasra (Nespoulet et al. 2008b). Furthermore, longitudinally split ribs of large herbivores, thinned by scraping and grinding, were tentatively interpreted as spear points (Backwell and d'Errico 2016). However, detailed observations of a similar item from a level dated to 90,000 BP at Dar es-Soltan 1, which exhibited comparable features to other bone artefacts from El Mnasra, proved that it was used as a knife (Bouzouggar et al. 2018).

In addition, bone retouchers were discovered at El Harhoura 2, Contrebandiers, and Taforalt. The pieces from Taforalt are dated between 85,000 and 60,000 BP and were obtained from shaft bones of medium-sized animals (Turner et al. 2020). Interestingly, worked bone tools only occur in a limited area of the Atlantic coast. The only exception are bone retouchers, which also appear in the Mediterranean hinterland (Taforalt).

Ornaments and Complex Behavior

The emergence of early symbolism is the most emblematic key innovation of Aterian complex behavior. Concentrations of Nassariidae (*Nassarius* and *Tritia*) shells were located at several sites on the Atlantic coast and the hinterland. Although these mollusks had no dietary interest (Campmas 2017), they could be imported from marine shorelines over long distances, suggesting the existence of exchange networks between the coast and the hinterlands. Some shells were also intentionally perforated and colored with ochre, hinting at specific symbolic meanings. Interestingly, the sites at less than 50 km from the coast yielded both perforated and unperforated shells, while those located inland only contained perforated pieces (Bouzouggar et al. 2020).

Nassariidae shells were recovered at Bizmoune, Contrebandiers, El Mnasra, Ifri n'Ammar, and Rafhas in Morocco, and Oued Djebbana in Algeria (Bouzouggar et al. 2007; Bouzouggar and Barton 2012; Dibble et al. 2012; Campmas et al. 2016). Numerous (over 47) perforated specimens were located in a discrete area at Taforalt (layer 21, *c*. 82,000 BP). They exhibit use-wear around the holes and traces of red ochre. Some of them seem to have been heated to change their color.

The use of colorants emphasizes the rooted symbolic behavior of Aterian populations. Pigments were recorded at a number of Moroccan sites, including Contrebandiers, El Mnasra, and Rhafas. At El Mnasra (layer 7), colorants appear in the form of small polished blocks of hematite with subparallel traces of scraping. In this same layer, a quartzite nodule showed an artificially polished concavity with stains of a dark red pigment (Nespoulet et al. 2008b). Red ochre was applied to some perforated shells from Taforalt (Bouzouggar et al. 2007; Barton and d'Errico 2012), and a flake smeared in red pigment was recovered at Ifri n'Ammar (layer 32, earlier than 83,000 BP) (Barton and d'Errico 2012). Finally, pebbles used as pigment grinders were recorded at Bizmoune (Bouzouggar et al. 2017).

Personal ornaments date from about 116,000 to 70,000–60,000 BP and seem to disappear with the beginning of the MIS 4 climatic deterioration. They have been associated with the development of a new suite of technologies, also including bone tool manufacturing, which is almost contemporary (Barton and d'Errico 2012). The apparent disregard to symbolic cultural elements that rose after MIS 4 may be due to either changed behavior, demographic contraction, or unfavorable preservation conditions. Ultimately, perforated shells also appear in the Levant, at Skhul (Barton and d'Errico 2012), supporting a link between Aterian traditions and Out of Africa dispersals of anatomically modern humans (AMH).

Associated Early *Homo sapiens*

The only human fossil record of early *Homo sapiens* associated with Aterian assemblages comes from caves in Morocco. The richest site, Dar es-Soltan 2, yielded remains of five individuals from different levels. Among them, cranial fragments of an adult and an immature individual were detected above the bedrock in a marine sand deposit (layer 7) that was sealed by a slab below the lowest Aterian layer (layer 6) (Nespoulet et al. 2008a; Grine 2016).

Chronologically, human remains span almost the entire Aterian period. Isolated bones were discovered at El Haroura 2 (lumbar vertebrae, dated *c*. 110,000 BP; cervical vertebrae, dated *c*. 75,000–55,000 BP; right metacarpal, dated *c*. 50,000–40,000 BP; metatarsus and right medial wedge, undated), El Mnasra (phalanx, skull fragment, teeth, dated *c*. 80,000–70,000 BP) (Ben Arous et al. 2020), Ifri n'Ammar, layers 27a–28a (human phalange and patella) (Nami and Moser 2010), and Mugharet el 'Aliya (juvenile maxilla, isolated adult teeth), dated between 44,000–39,000 BP (Early Uptake [EU], ESR) and 56,000–47,000 (Linear Uptake [LU], ESR) (Wrinn and Rink 2003) or between 46,000–21,000 BP (EU, ESR) and 57,000–27,000 BP (LU, ESR) (Millard 2008). Other remains were recovered at Contrebandiers (mandible, occipital, and frontal fragments, juvenile skull, and partial skeleton), dated between *c*. 107,000 and 95,000 BP (Grine 2016), and Taforalt (parietal fragment) (Scerri 2017). Finally, remains dated *c*. 40,000–30,000 BP were located at El Haroura 1 (mandible and two isolated canines) (Grine 2016).

Morphologically, they seem to be in continuity with the early AMH associated with the Early MSA (Hublin 2000), showing robust features with a wide face and pronounced supraorbital relief. Large-sized teeth suggest similarities with the Upper Pleistocene specimens from Skhul and Qafzeh in the Levant, and a possible link with East African populations (Hublin et al. 2012). Nevertheless, morphological variations between these AMH exist and rule out a single origin with one dispersal scenario (Scerri 2017).

The occurrence of mostly cranial remains at Aterian sites warrant speculations about whether these individuals were the prey of large carnivores or the result of ceremonial cannibalism or other funerary practices not involving burial structures (Campmas 2017).

Out of Africa and Human Migrations

The Out of Africa dispersals of early AMH may be split into two broad, chronologically distinct events, one occurring during MIS 5, the other taking place at the beginning of MIS 3, each consisting of several small migration waves. Given their substantial differences in character and timing, the MIS-5 episode was defined "Out of Africa 2a" and the MIS-3 event "Out of Africa 2b" (Garcea 2010, 2012b). Within MIS 5, particularly during the 129,000–92,000 BP humid period, the palaeolakes with large catchments created a sequence of corridors facilitating human dispersals (Drake and Breeze 2016). Conversely, during MIS 3, climatic conditions were not as supportive in North Africa but were more favorable in the Levant and may have attracted Out of Africa 2b migrations (Garcea 2020b). At this time, a massive depopulation of the Sahara resulted in migrations into desert refugia and coastal areas along the Mediterranean and Red Seas (Larrasoaña 2012).

Multiple data support the likelihood that Aterian groups may have taken part in the initial migrations out of Africa through the northern route: (a) comparisons between the human remains associated with Aterian techno-complexes and early AMH in the Levant show morphological physical affinities; (b) climatic and environmental conditions support north-south and west-east corridors within Africa and likely out of Africa, when MIS-5 and MIS-3 favorable conditions opened pathways across the Sahara and North Africa where Aterian groups lived (Barton et al. 2009; Garcea 2012a, 2012b; Campmas 2017); (c) the distribution area of Aterian sites in North Africa, which extends as far as the Mediterranean African coasts, is contiguous to the coasts of Southwest Asia; and (d) the Aterian chronology entirely covers the timespan of the major Out of Africa expansions.

Cultural Complexity of the Aterian

The Aterian represents a flexible and variable techno-complex resulting from early complex behavior and considerable cognitive adaptability. The populations who lived in North Africa between the end of MIS 6 and the end of MIS 3 were adapted to shifting environmental conditions, different habitats, and different latitudes, ranging in time and space from Mediterranean to cool and arid environments. They developed a wide array of innovations, comprising novel technological (volumetric core exploitation, laminar technology, tanged tools, bifacial foliates, endscrapers, perforators, burins) and functional (hafting) attributes of lithic assemblages, use and curation of exotic rocks and nonlithic raw materials, increased diet breadth, symbolic behavior, long-distance exchange networks, and intra-site organization.

Such diversified behavioral responses derive from multiple, nonlinear, and noncumulative trajectories due to different internal and external stimuli, as these features may not occur all together, and some may not appear at all in certain areas. Nevertheless, although Aterian populations did not follow a single evolutionary pathway, they maintained a consistent cultural transmission of a broadly shared, unique entity.

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