

## Chapter 9

# Modern Human Desert Adaptations: A Libyan Perspective on the Aterian Complex

E. A. A. Garcea

**Abstract** The present Libyan territory extends over a large area that goes from the Mediterranean coast to the Saharan Desert. Aterian sites were found in the central Saharan mountain range of the Tadrart Acacus, the eastern Saharan massif of the Jebel Uweinat, the Maghrebi extension of the Jebel Gharbi, as well as the lowlands of Lake Shati in the central part of the country. Recent research in the Tadrart Acacus and the Jebel Gharbi has provided radiometric dates, geoarchaeological stratigraphic sequences, and lithic assemblages that call for a revision of the chronological, environmental, and functional interpretation of the Aterian Industrial Complex. In Libya, two distinct Aterian variants, one to the northwest (Jebel Gharbi), the other to the southwest (Tadrart Acacus and Messak Settafet) of the country, display specific chronological developments and site settings related to different paleoenvironmental conditions that allow one to trace geographic boundaries, with different latitudinal and altitudinal adaptational patterns. Their differences concur to show that Aterian groups developed different skills and tools to adapt to different dry environments that inevitably conditioned their behavior and settlement systems. This paper reviews the recent evidence from the Libyan Aterian sites and those that immediately preceded and followed, discusses both the general perspective and the regional variants within the Aterian, and addresses the question of the spread of anatomically modern humans in North Africa.

**Keywords** Aterian • Desert adaptation • Jebel Gharbi • Libyan Sahara • Messak Settafet • Modern humans • Tadrart Acacus

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## The Sahara: An Empty Land?

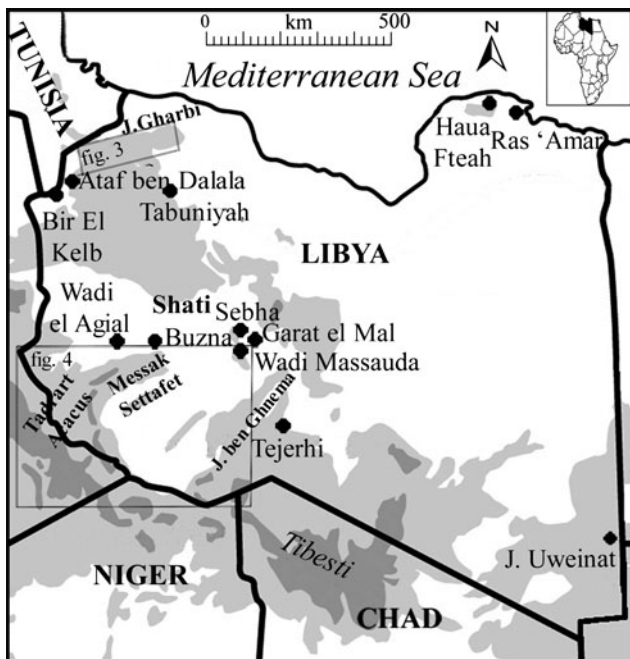
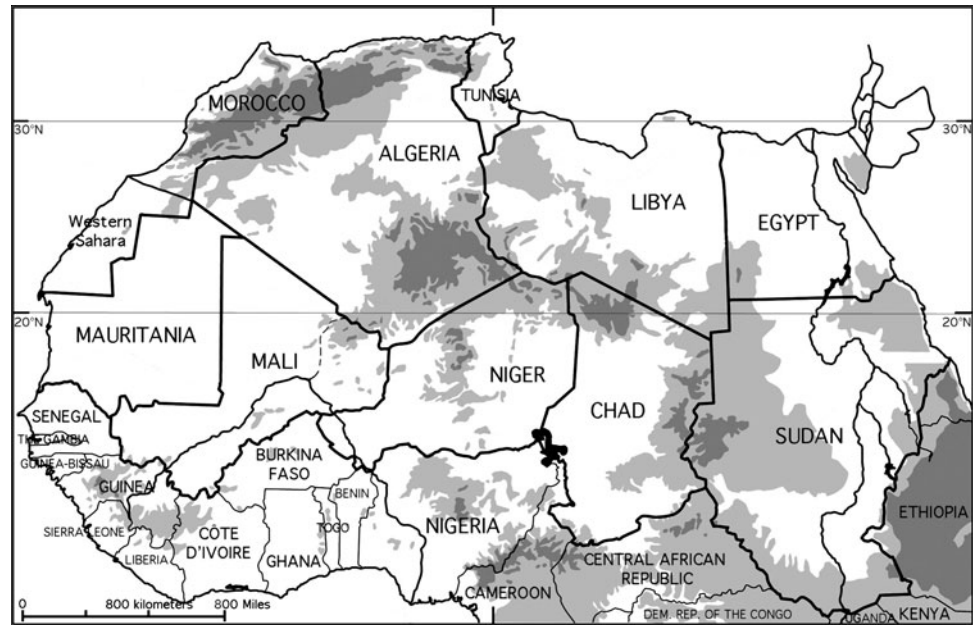
*Sahara* is an Arabic word meaning “desert” and is related to another Arabic word, *ashar*, which refers to its reddish, vegetationless sands. These terms are most appropriate as the Sahara is presently the largest desert in the world, covering 8.6 million km<sup>2</sup>. Past climatic conditions were alternately moister and drier than today, changing between semi-arid, sub-arid, and arid. According to Wilson et al. (2000), in the Late Pleistocene, the desert practically never disappeared between latitude 20° and 30° north, which is the belt that runs precisely across present-day Libya (Fig. 9.1).

Lake Shati was relatively small in size during the mid-OIS 5 (100–110 ka), although Lake Megafezzan, which incorporated Lake Shati, reached its largest extension only in the earliest Holocene, when the next humid phase after the Last Interglacial one occurred (Armitage et al. 2007).

Therefore, human populations of all times have had to cope with unstable conditions with patchy resources, sandy soils, strong winds, and large temperature fluctuations (e.g., Yellen 1977; Clark 1980; Giraudi 2005). Nevertheless, in spite of their challenging conditions, deserts can facilitate human dispersion and circulation of cultural traditions by groups in search of other resources when those in their biome are diminishing or exhausted. To put it in Smith et al.’s (2005, p. 2) words, “Deserts have a special role in human evolution and adaptation. They appear to be the major terrestrial habitat that channeled early human dispersal, representing barriers at some times, corridors at others.” This description accurately depicts the Sahara and the circumstances in which Aterian hunter-gatherers lived and alternately moved through favorable corridors, or remained isolated.

Several authors (among others, Alimen et al. 1966; Debénath et al. 1986; Tillet 1995) had inaccurately associated the Aterian with a humid climate, whereas others disagreed with this interpretation. Among the latter, Clark

**Fig. 9.1** Map showing the relatively northern position of Libya



**Fig. 9.2** Map of Aterian sites in Libya (except northwestern sites, in Fig. 9.3, and southwestern sites, in Fig. 9.4)

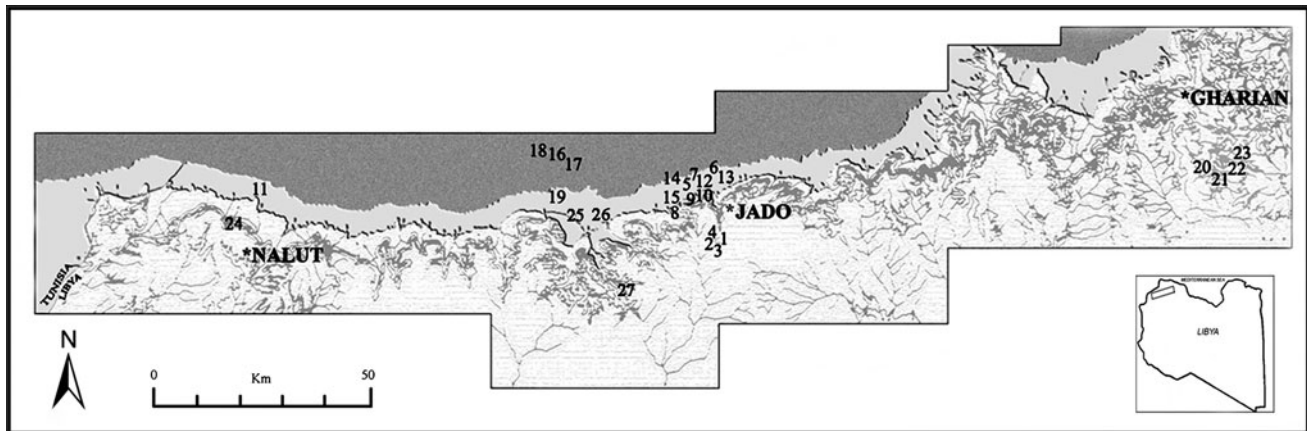
(1980, p. 547) was one of the first to recognize that the Aterian was “a desert-orientated adaptation.” As a matter of fact, the majority of Aterian sites are spread throughout the present Sahara Desert; only a few are located along the Atlantic Coast and even less are on the Mediterranean Coast (cf. Garcea 2001b; Gifford-Gonzalez et al., in preparation).

With regards to the prehistory of Libya, the Haua Fteah Cave, at the foot of Jebel Akhdar in Cyrenaica (Fig. 9.2), is probably still the first site that comes to mind. However,

although it is very often cited, the available data go back to McBurney’s excavations made in the 1950s (McBurney 1967) and are waiting to be confirmed or revised by the new excavations resumed in 2007 by Barker (Barker et al. 2007, 2008). In the meantime, research in north and southwestern Libya has provided geoarchaeological and stratigraphic sequences, radiometric dates, and technological evidence of lithic manufacture that call for a revision of the chronological, environmental, and functional interpretation of the Aterian Industrial Complex. In northwestern Libya, specific research on Late Pleistocene human cultures has been, and still is being, conducted in the Jebel Gharbi (Barich et al. 1996, 2003a, b, 2006; Garcea 2004, 2006a, 2009, 2010a; Barich and Giraudi 2005; Garcea and Giraudi 2006; Barich and Garcea 2008); in southwestern Libya, the study area includes the Tadrart Acacus mountain range, the Messak Settafet plateau, and the Edeyen of Murzuq (Garcea 1997, 2001a, b, 2004, 2010a; Cremaschi 1998; Cremaschi and di Lernia 1998; Cremaschi et al. 1998; Martini et al. 1998; di Lernia 1999b) (Fig. 9.2).

### African Versus European Nomenclature

Archaeological research in North Africa was started during colonial times by European scholars trained in European prehistory, who considered North Africa as an extension of Europe and therefore employed the terms they used in Europe to name the cultural units they found in Africa. European terms like “Middle Paleolithic” and “Mousterian” have been carelessly used to describe North African



**Fig. 9.3** Map of northwestern Libya. Early MSA site: 11 Wadi Nalut, SJ-00-60. Aterian sites: 1 Ras el Wadi, SJ-90-12; 2 Ras el Wadi, SJ-98-27; 3 Ras el Wadi, SJ-98-27A; 4 Ras el Wadi, SJ-98-28; 5 Shakshuk West, SJ-00-55/Test 2; 6 Shakshuk East, SJ-00-55 East; 7 Shakshuk West, SJ-00-56/Ext. 2; 8 Mahatta Frid, SJ-00-57; 9 Shakshuk West, SJ-00-58; 10 Shakshuk West, SJ-00-58A; 13 Ain

Soda, SJ-02-67; 14 Wadi Sel, SJ-02-68; 15 3 km W Shakshuk, SJ-02-69; 16 Wadi Ali, SJ-02-70; 17 Wadi Ali, SJ-03-71; 18 Wadi Ali, SJ-03-77; 19 East Badarna, SJ-03-78; 20 Wadi Ghan, SG-99-40; 21 Wadi Ghan, SG-99-41; 22 Wadi Ghan, SG-99-46; 23 Wadi Ghan, SG-00-61; 24 Nalut, SJ-06-89; 25 Josh, SJ-06-88; 26 Josh, SJ-06-87; 27 Josh, SJ-06-86. LSA site: 12 Shakshuk East, SJ-02-66

industries, even though more correct terms have been created for African prehistory (Early, Middle, Later Stone Age). Unfortunately, the use of the European nomenclature for African industries has implied confusing assumptions and erroneous understandings. One of the clearest examples is the past supposition that the so-called “Mousterian/Middle Paleolithic” industries from Jebel Irhoud and Haua Fteah had to be made by Neandertal peoples, as was the case in Europe. Although we now know that Neandertals never lived in Africa, some cultural techno-complexes are still called “Mousterian” or “Middle Paleolithic.” This is hardly acceptable for a variety of reasons. From a physical anthropological point of view, there is a remarkable difference between the makers of Middle Paleolithic industries of Eurasia and those of Middle Stone Age (MSA) industries of Africa. The former were Neandertals, apart from rare exceptions such as Skhul and Qafzeh in the Near East (Vandermeersch 1989), whereas the latter were anatomically modern humans. Moreover, unlike in Eurasia, anatomically modern types did not succeed Neandertal forms in Africa. Consequently, the Middle/Upper Paleolithic transition in Eurasia is usually based on comparative analysis between Neandertal and *sapiens* morphological types, whereas in Africa physical displacement or coexistence of the two types did not occur.

Also, technologically, there is a clear distinction between the Middle Paleolithic of Eurasia and the Middle Stone Age of Africa. In their review of the MSA projectile technologies, Brooks et al. (2006) argue that projectile armatures typify the MSA throughout Africa, whereas they are a common archaeological marker of the Upper Paleolithic in Eurasia. This is a logical

discrepancy, considering that tool types are the material products of human beings, not cultural units, and the human beings in question are modern humans in both the Upper Paleolithic of Eurasia and the MSA of Africa. Why then should the Middle Paleolithic of Eurasia be equated with the MSA of Africa?

Furthermore, potential connections emerge between sub-Saharan Africa, East Africa in particular, and North Africa on both environmental and technological bases (Caton-Thompson 1946; Clark 1993; Kleindienst 1998; Van Peer 1998; Garcea 2001b, 2004; Gifford-Gonzalez et al. 2004, in preparation; Clark et al. 2008). It would then be paradoxical to use the same names (Middle Paleolithic) for two unrelated cultural units, one in Eurasia, the other in North Africa, and to use two different names (Middle Paleolithic and MSA) for two related cultural units, one in North Africa, the other in East Africa. As a matter of fact, several Africanist archaeologists (e.g., McBrearty and Brooks 2000; O’Connor and Reid 2003; Marean 2005; Stahl 2005) have disapproved of this artificial separation, arguing that it “obscures the uniqueness of the MSA” (McBrearty and Brooks 2000, p. 487). Last, but certainly not least, the trans-Saharan historical divide, which has been created by Western scholars, has been reasonably defined as a racist conception (MacEachern 2007). Such a perspective is not simply a terminological issue, but has biased the scientific debate of Western and non-Western archaeologists who assign greater or lesser relevance to the cultural relations between North Africa, the Sahara, and sub-Saharan Africa.

For all the above reasons, I maintain the use of the African nomenclature to describe African cultural complexes.

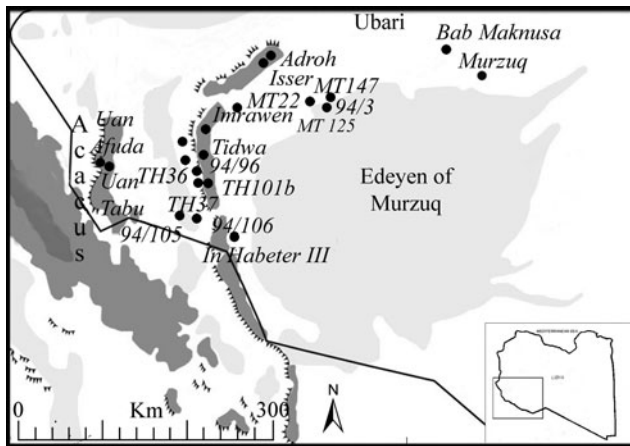


Fig. 9.4 Map of Aterian sites in southwestern Libya

### Altitudinal/Latitudinal Location of the Libyan Aterian Sites

Fifty-six Aterian sites could be located in the Libyan country. Twenty-five of them were found in the Jebel Gharbi, in northwestern Libya (Fig. 9.3) (Barich et al. 1996, 2003a, b, 2006; Barich and Giraudi 2005; Giraudi 2005; Garcea and Giraudi 2006; Barich and Garcea 2008).

Nineteen were identified in the Tadrart Acacus and in the Messak Settafet, in the central Sahara (Fig. 9.4) (Garcea 1997; 2001a, b; Cremaschi and di Lernia 1998; di Lernia 1999b; Van Peer 2001).

The Jebel Gharbi lies between the Sahara to the south and the Jefara plain to the north and is 60 km south of the Mediterranean Coast at its closest distance. Surveys have tested the archaeological potential of the geomorphological features, which were first identified on satellite images and then located in the field (Fig. 9.5) (Barich et al. 2006). Assessments of the archaeological potential refer to the availability of environmental resources, although they can also depend on archaeological visibility. Valley heads can have high archaeological potentials, and confirmed high concentrations of sites, including Ras el Wadi, which is the valley head of the Wadi Ain Zargha. The next favorable landscape unit is the alluvial fan belt at the foot of the jebel, where the areas of Shakshuk and Wadi Basina are located (Table 9.1). No archaeological sites could be detected either in the areas between the plateau and the alluvial fan belt, or in the Jefara plain.

Site altitudes are uniform in the two main landscape units: sites are located at heights just over 200 m above sea level in the alluvial fan belt, and at around 600 m on the plateau (Fig. 9.6).

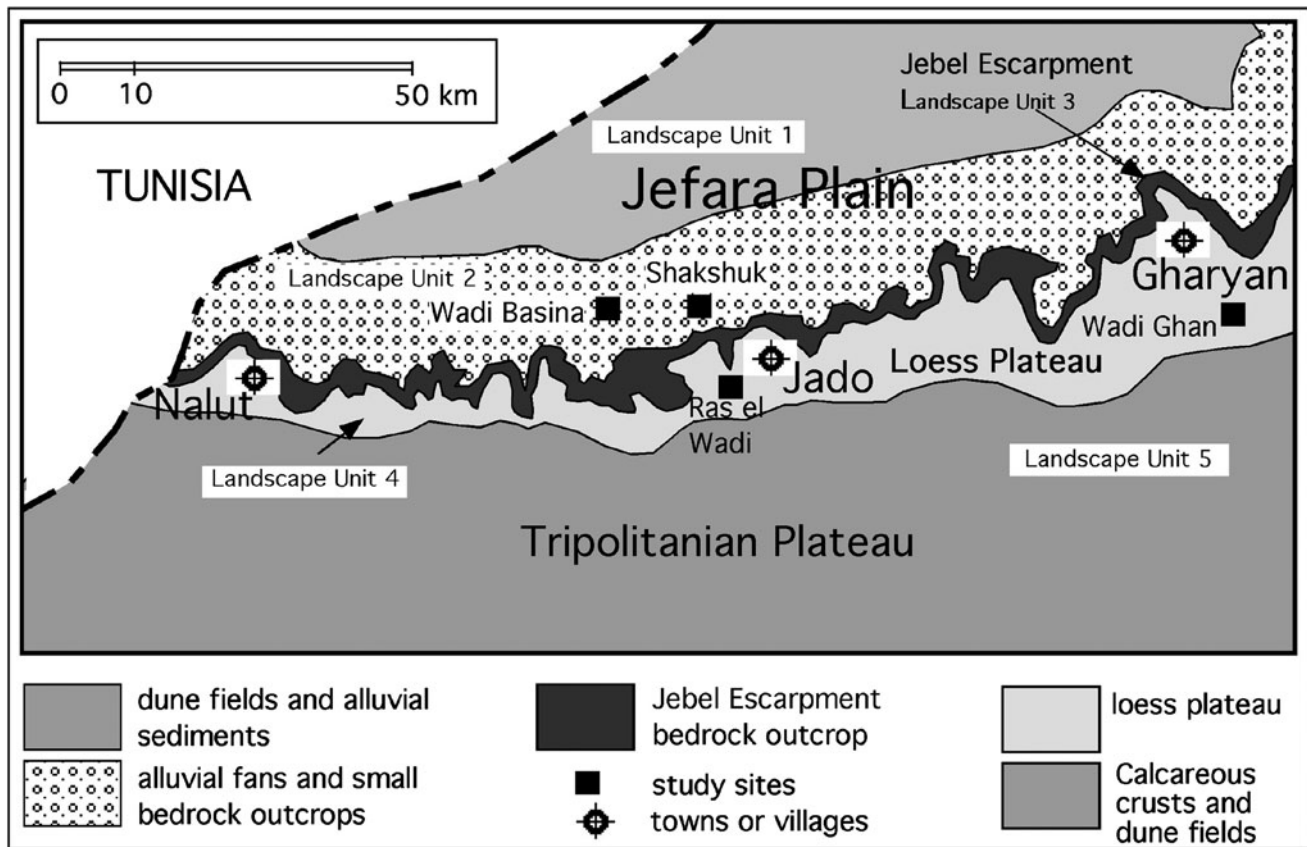
To the south, central Saharan sites from the Tadrart Acacus, Messak Settafet, Edeyen of Murzuq, and Erg Uan Kasa are at much higher elevations, with all sites in the Tadrart Acacus over 900 m above sea level (Fig. 9.7).

If all remaining sites are considered, it can be observed that site altitudes are strictly related to their latitudinal position, gradually decreasing from south to north; that is, sites in the lower latitudes, such as the Tadrart Acacus, are at higher elevations, whereas those at higher latitudes, such as the sites in Cyrenaica, including Haua Fteah and Ras 'Amar, are as low as 60 and 20 m above sea level, respectively (Fig. 9.8).

Moreover, site altitudes indicate that Aterian foragers followed an altitudinal gradient in association with the latitudinal belts that offered the most advantageous environmental conditions. In the central Sahara, drier conditions pushed human groups on higher elevations to search for more humid environments, whereas at higher latitudes they could live at lower altitudes.

### Climate, Chronology, and Stratigraphic Sequences

The Jebel Gharbi is currently a semi-arid region, but has been affected by arid spells during various expansions of the Sahara. Geostatigraphic records show that the deposits with a generalized Early MSA industry are separated from the upper layers with Aterian artifacts by a thick accumulation of aeolian sands, which correspond to a northerly expansion of the Sahara dated between 70 and 58 ka. After that major arid phase, the following dry episode only occurred around 20 ka (Giraudi 2005). Therefore, according to the geoarchaeological sequence, the Early MSA is much older than the Aterian. OSL dating gave age estimates of sand samples as early as  $146.8 \pm 11$  ka and it is likely that the Early MSA appeared before that date (Garcea et al., in preparation). The Aterian has been dated by several methods; AMS radiocarbon dates gave ages of 43–44 ka, and U/Th, which was employed to date calcretes below and on top of colluvial silts with Aterian artifacts, gave dates of  $64 \pm 21$  ka and  $<60$  ka, respectively (Table 9.2). A systematic program for OSL dating is presently in progress (carried out by Schwenninger of the University of Oxford), in order to confirm the other dating methods. In fact, both AMS and U/Th can be problematic considering that in the first case, it is close to the technical limits of radiocarbon dating, and in the second case, calcretes can contain old detrital calcite or can later recrystallize, producing an average of the ages of different events (Giraudi 2004).



**Fig. 9.5** Landscape Units (LU) of the Jebel Gharbi (modified from Garcea and Giraudi 2006, Fig. 1)

**Table 9.1** Landscape units (LU) and related archaeological potential, according to Barich et al. 2006

LU No.	Name	Archaeological potential
1	Jefara plain	Low
2	Alluvial fan belt	Very high
3	Escarpment	Low
4	Loess plateau	Low
5	Calcrete and sandsheet	Low
6	Valley heads	Low to high

Further south, in the Tadrart Acacus, the Uan Tabu rockshelter is the only stratified site with a consistent Aterian techno-complex in a sequence below an unconform erosional surface underlying an Early Holocene deposit (Garcea 2001a). This unit was formed by aeolian sand accumulated under desert conditions and was related to a large dune located outside the rockshelter (Cremaschi and Trombino 2001). The upper Aterian deposit was dated by the OSL method and provided the first absolute age of the Aterian in the Sahara of  $61 \pm 10$  ka (Cremaschi et al. 1998; Martini

et al. 1998). This date was confirmed by the TL and OSL dates from Uan Afuda, another site in the Tadrart Acacus. A further OSL date of  $90 \pm 10$  ka was obtained from the sands below the archaeological deposit (Table 9.3) (Cremaschi et al. 1998; Martini et al. 1998; di Lernia 1999a).

These dates confirm precursory hints that the age of the Aterian could go beyond or very close to the limits of conventional radiocarbon dating, as suggested by the earliest finite date at Haua Fteah, which gave a radiocarbon age of  $47 \pm 3.2$  ka (GrN-2023) (McBurney 1967).

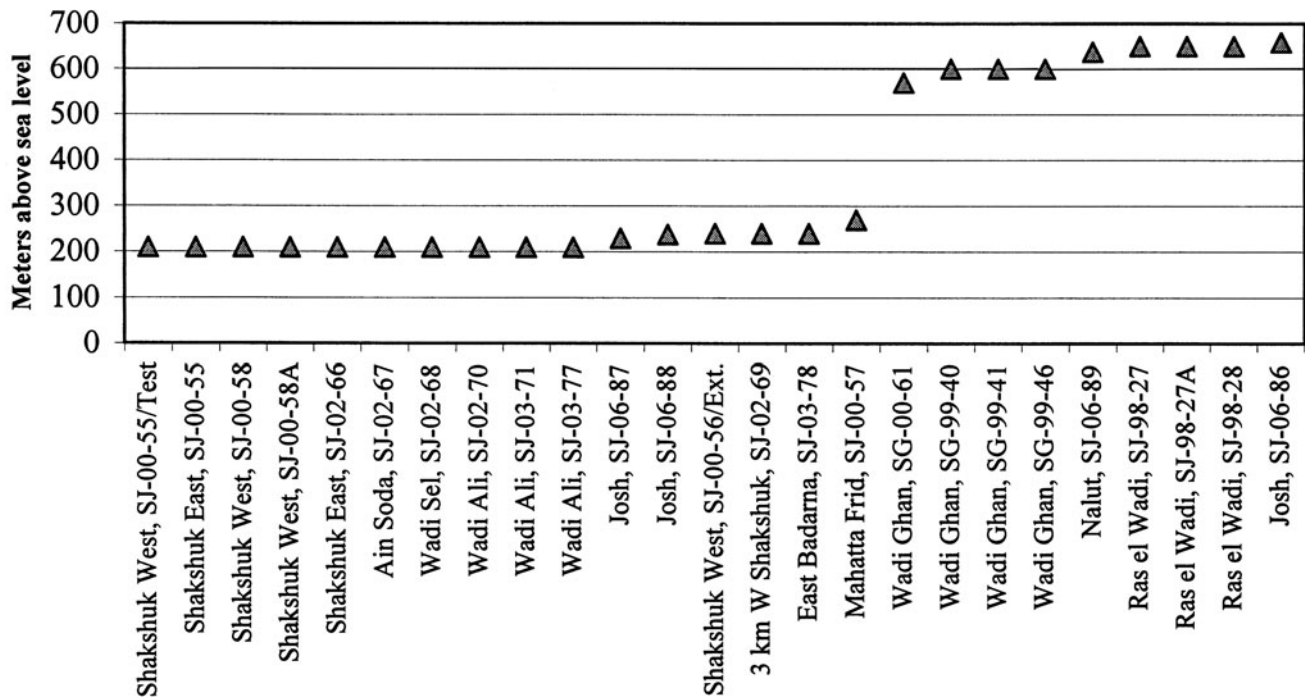


Fig. 9.6 Site altitudes in the Jebel Gharbi

## The Desert Adaptation of Aterian Foragers

The geographic location of Aterian sites suggests that Aterian foragers developed a strategy to settle by the few available water sources as a form of adaptation to arid environments. Furthermore, the Libyan record provides evidence on the various strategies of adaptation to dry and drying environments by Aterian groups across a north-south section extending from the Mediterranean Coast to the central Sahara.

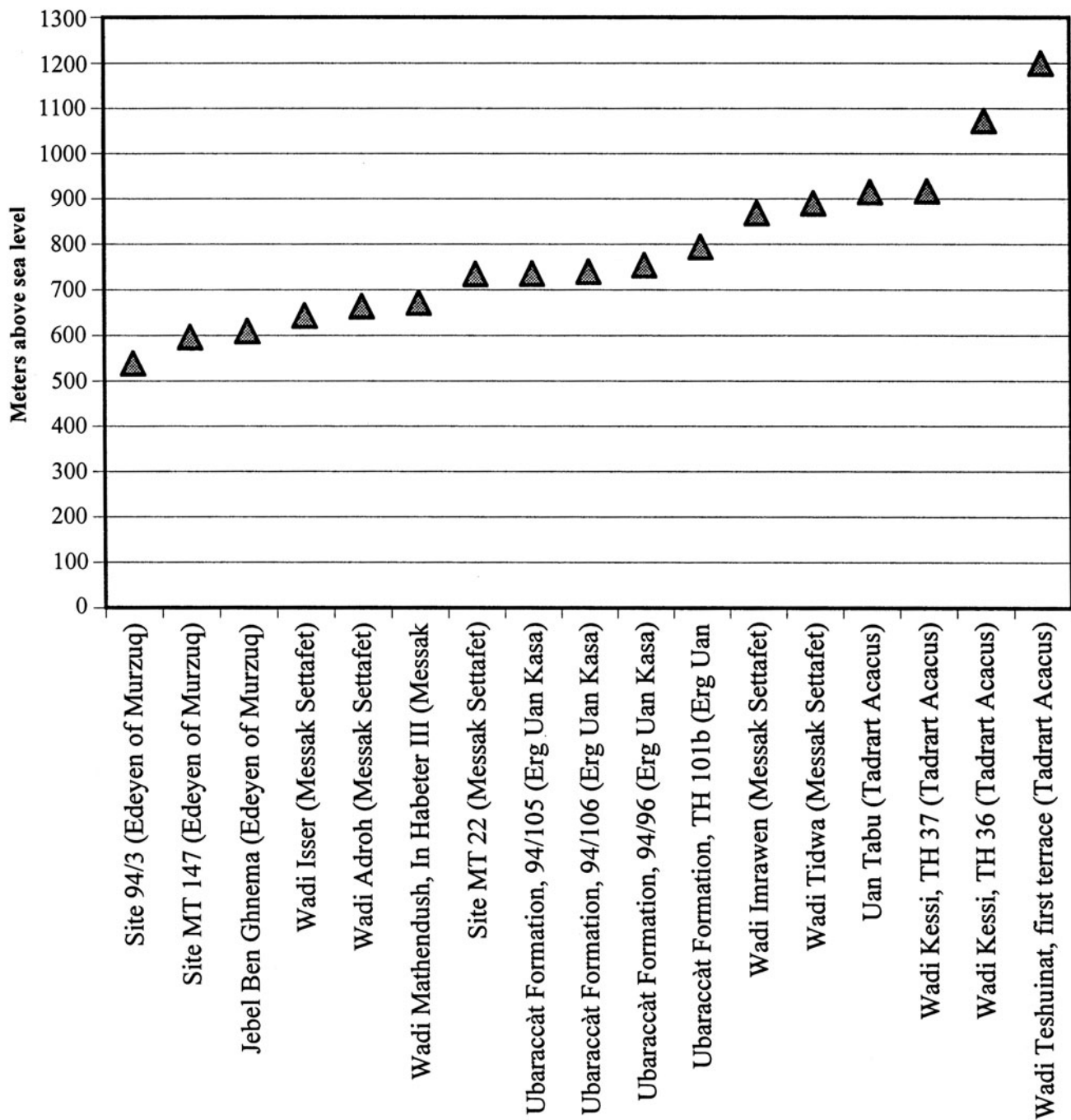
In the Jebel Gharbi, human populations concentrated near springs formed by outlets of underground aquifers that flew through fissures created by tectonic faults, which were produced by high magnitude earthquakes starting from the Late Pleistocene (Garcea and Giraudi 2006). On the mountain range at Ras el Wadi, a still active aquifer has regularly fed the outlet of the spring, which has provided constant water. In the lowlands, a series of springs between Wadi Sel and Ain Soda, in the Shakshuk area, indicates that numerous intersections of the fault system guaranteed the outlet of underground water even during arid periods. Here, an excavation at Site SJ-02-68 brought to light a fault in an archaeological sequence including: Layer 1 with charcoal and Iberomaurusian (Upper LSA) artifacts, Layer 2 with a few LSA artifacts, Layer 3 with charcoal, ashes, and a Levallois flake, and Layer 4 with several Aterian artifacts. Layer 3 was radiocarbon dated to  $44.6 \pm 2.43$  ka (Fig. 9.9). The artifacts in both Layers 3 and 4 can be attributed to the

Aterian. They correspond to two phases of occupation of the site and suggest that the date of Layer 3 is a minimal age for the Aterian occupation, which preceded the faulting and tectonic activities.

The presence of underground springs in the Jebel Gharbi should be seen as the main reason for the survival of Aterian groups until around 40 ka, a time when no evidence exists south in the Sahara, where the age of  $61 \pm 10$  ka from Uan Tabu represents the latest date for this cultural unit in the Tadrart Acacus, and no other occupation followed here until the Early Holocene. In fact, although Saharan sites were located along wadis, their subsistence depended on the very ephemeral availability of seasonal water courses.

## Technology and Function of Tanged Tools

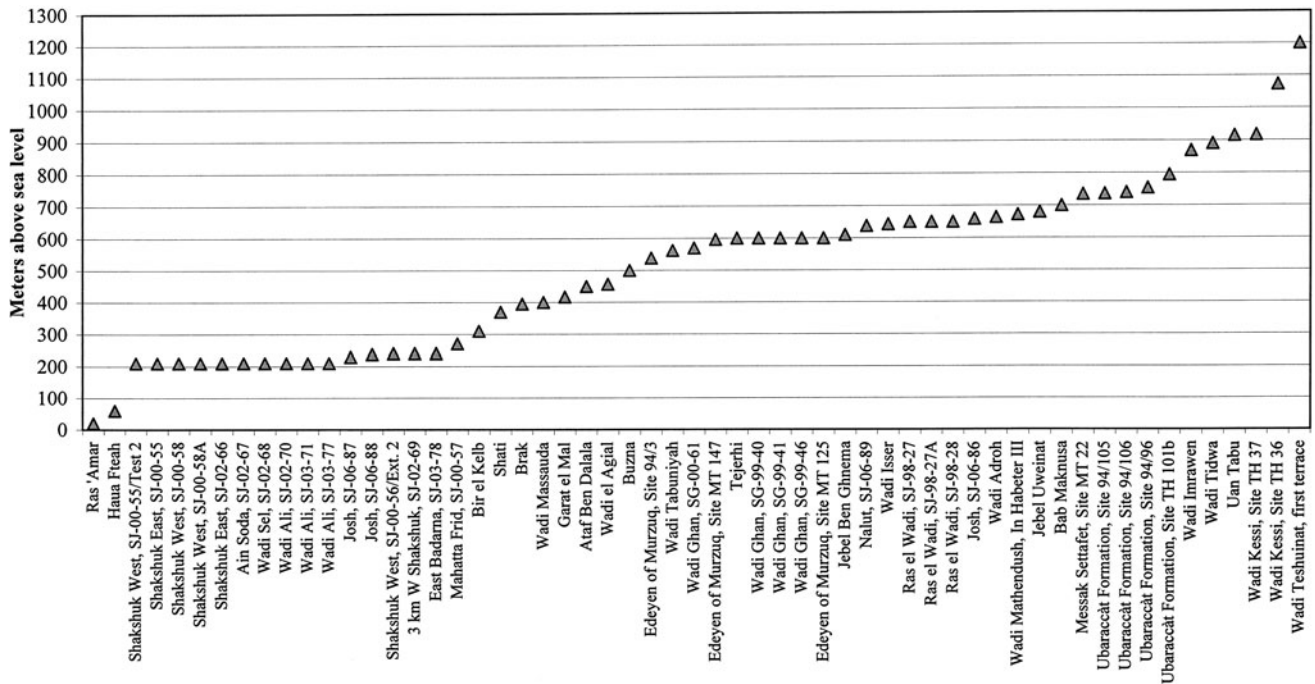
Tangs are normally the basal modification of hafted projectile points of thrusting spears (cf. Farmer 1994). Although there are also other specific technological features, tanged tools have often been regarded as the typical cultural marker of the Aterian Industrial Complex (Balout 1955; Tixier 1958–1959, 1967; Bordes 1961). The production of tangs was thought to be an effective innovation that Aterian groups devised for hafting projectile or spear points. Measurements of the tip cross-sectional area (TCSA) of a sample of Aterian points showed that none of them was a projectile point, but they were the points of



**Fig. 9.7** Site altitudes in southwestern Libya

hand-cast or thrusting spears (Shea 2006). Technological and functional analyses have suggested other explanations for the use of tangs, in addition to hafting. First of all, not all Aterian tanged tools are points; many of them have blunt edges, and some are simple unretouched flakes, the only finishing being on the tang. Second, Aterian tangs are not associated with specific classes of tools, but appear on many of them, such as side scrapers, end scrapers, denticulates,

etc. Third, tangs could have been the working parts of hand-held tools (Clark et al. 2008). Fourth, tanged tools could have also been used as digging sticks or for processing tubers (O'Connell et al. 1999; Gifford-Gonzalez et al. 2004, in preparation). Fifth, tangs are often the thickest part of the tool, whereas the thickness at the base of projectile points is usually smaller than at the midsection in order to set the points in the shaft (Knecht 1997).



**Fig. 9.8** Site altitudes of all Aterian sites in Libya

**Table 9.2** Absolute dates of Early MSA and Aterian sites in the Jebel Gharbi

Cultural unit	Locality	Site	Years BP	Method	Dated material	Sample number
Aterian	Shakshuk	Geological profile	43,530 ± 2,110	AMS	Charred material	Beta-167098
	Wadi Sel	SJ-02-68	44,600 ± 2,430	AMS	Organic sediment	Beta-167097
	Ain Zargha	27G N-trench	<60,000	U/Th	Calcrete	
	Ain Zargha	27E N-trench	64,000 ± 21,000	U/Th	Calcrete	
Early MSA	Shakshuk	C2000-10	49,200 ± 3,500	OSL	Sand	X1511
	Ain Zargha	N-trench G83	114,700 ± 7,400	OSL	Sand	X1512
	Ain Zargha	98-27B-G78	146,800 ± 11,000	OSL	Sand	X1514

**Table 9.3** Absolute dates of sites in the Tadrart Acacus

Cultural unit	Site	Years BP	Method	Dated material
Aterian	Uan Tabu	61,000 ± 10,000	OSL	Sand
	Uan Afuda	69,000 ± 7,000	OSL	Sand
	Uan Afuda	70,500 ± 9,500	TL	Sand
	Uan Afuda	73,000 ± 10,000	TL	Sand
Early MSA	Uan Afuda	90,000 ± 10,000	OSL	Sand

Preliminary techno-morphological, experimental, and functional analyses have been carried out on samples from five sites in the Jebel Gharbi (SJ-00-56, SJ-00-57, SJ-00-58, SJ-00-60, SG-00-61), including a total of 477 pieces and 11 tanged tools (Massussi and Lemorini 2004–2005; for other information on the technical features of these lithic assemblages, see Garcea 2006a). The blanks of the studied

tanged tools are mostly flakes with a modified proximal or distal end (Fig. 9.10). Two different techniques for producing tangs have been determined and experimentally tested for the two major raw materials, flint and quartzite. For flint, the notches that form the tang are made by pressure flaking with either a small hammerstone or a soft hammer, such as antler. In contrast, quartzite tangs are



**Fig. 9.9** Cross-section with fault at Site SJ-02-68, at Wadi Sel, Jebel Gharbi



produced with direct hard percussion of two bilateral basal notches that are finished by perpendicular abrasion to dull the edges.

Experiments on the ballistic performance of hafted projectile points have shown that a considerable part (up to one-third) of the tool is usually inserted in the shaft in order to be efficient and securely attached (Massussi and Lemorini 2004–2005). With regards to the tanged tools in the analyzed sample, the length of all of the stems is very short, seemingly too small to form an effective hafting device for projectile points.

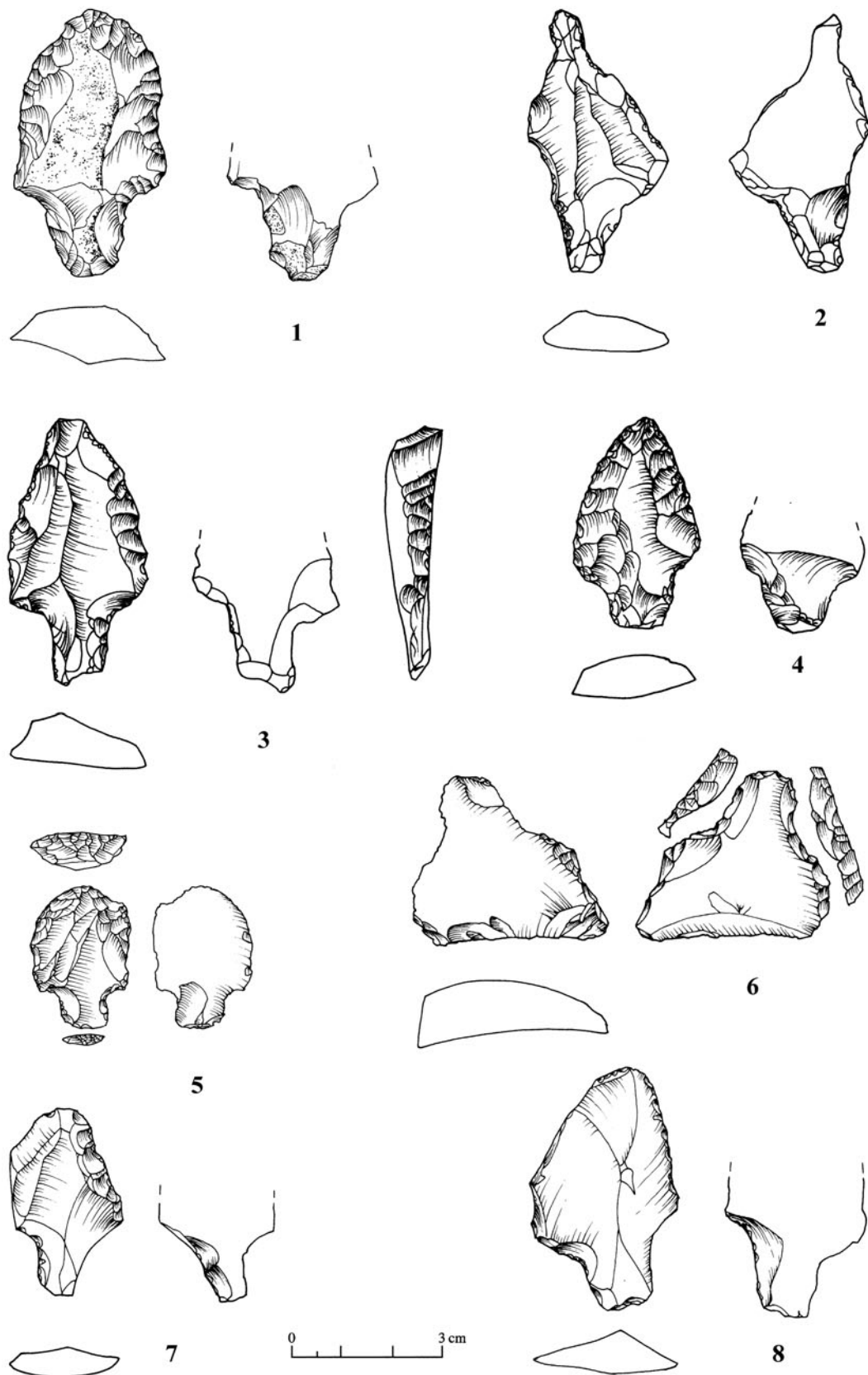
Moreover, use-wear analysis on the same sample showed remains of macro-traces of edge-damage on some of the tools. Traces of scraping were found on several notches that formed some “tang.” They could be assigned to scraping activities, and not to hafting, as they showed distinct striations located on a larger portion of the tool, which can be distinguished from those, usually on a limited part of the tool, made by friction or abrasion of the proximal part of a stone tool in a haft (Rots 2003; Lombard 2005). Therefore, use-wear corroborated the morpho-functional evidence that these “tang” were not hafted, but were the working edges of the tools. Considering manufacturing techniques, morphology, use-wear, and edge-damage of the analyzed tanged pieces, Massussi and Lemorini (2004–2005) suggested that the double notches of these Aterian “tang” are the active functional areas of the tools. Although no use-wear traces were observed on the tangs proper, macro- and micro-wear analysis of a sample of tanged pieces from Rhafas Cave and Pigeons Cave at Taforalt, Morocco, indicated that only very few of them were used as

projectiles. They mostly showed distal margins with traces of longitudinal movements and transversal movements on dry skin, hard animal materials, and soft materials (Bouzouggar et al. 2004–2005).

These preliminary results confirm that technological and functional analyses, which had never been made on Aterian Industrial Complexes, are very helpful and instructive (among others, Geneste and Plisson 1990; Plisson and Schmider 1990; Lemorini 2000). They can reveal that our knowledge is often derived from past preconceptions and suggest that other interpretations should be envisaged. This does not imply that none of the Aterian tanged points were used for hafting. Aterian people undoubtedly made some of their tanged tools to make hafted projectile points, but these first functional analyses show that they were also aware that a stem on a tool could be an effective device for performing other activities. Several of these activities, which are attested to in other past and contemporary contexts, need to be further identified in the Aterian assemblages.

## Dispersal of Modern Humans Across Libya

Human fossil remains from Libya are too scant to provide direct evidence on the dispersal of modern humans across the country. Only Haula Fteah yielded two mandibular fragments (McBurney et al. 1953; Dart 1954; Tobias 1967), which could be compared to the early modern humans of Jebel Irhoud in Morocco (Tobias 1967; Hublin 2002) and those of Skhul/Qafzeh in Israel (Howell 1999). Both



**Fig. 9.10** Variability of “tanged” tools from different sites in the Jebel Gharbi. 1–3 SJ-98-28; 4, 7–8 SJ-98-27A; 5 SJ-99-41; 6 SJ-00-58A

specimens from Haua Fteah came from Layer XXXIII and were attributed to two separate individuals. As for the archaeological artifacts from this layer, McBurney (1967) considered them to be more archaic than those in the underlying layers (XXXIV and XXXV), which he assigned to a developed stage of the “Middle Paleolithic.” Current research will hopefully confirm or revise such opinion (cf. Barker et al. 2008). For the time being, no dates are available for these layers, but they may be assigned to at least the Last Interglacial (125–75 ka) or, as the morphology of the human remains suggests, MIS 6 (186–125 ka) or even earlier (Hublin 2000).

The discussion on the dispersal of modern humans across Libya is then left to other sets of evidence. Given the revised chronology of the Aterian, the makers of this industry are the most likely candidates for the last and final out of Africa movement. But from where they came and through where they went is still open to discussion. Passageways between Africa and Eurasia are very limited. The Strait of Gibraltar has been considered a possible corridor due to the narrow distance between the Maghreb and the Iberian Peninsula. Caton-Thompson (1946) was among the first to suggest that a “current of Aterianism” affected the Gravettian and produced the Solutrean in southwestern Europe, supposing similarities between Solutrean foliate points and Aterian tanged points. However, she did recognize higher technical skills in the Solutrean and an incongruity between the blade industries in southwestern Europe and the flake industries in North Africa. Affinities between the Aterian and the Solutrean were also assumed on chronological grounds. However, as the original chronology of a 20–40 ka Aterian is no longer acceptable and the age of 40 ka indicates the end, not the beginning, of the Aterian, this industrial complex is much earlier and cannot be compared with the Solutrean. Furthermore, the natural conditions of the Strait of Gibraltar, with strong currents, must not have encouraged Aterian desert-adapted people to embark on seafaring adventures, as Erlandson (2001) has clearly stated. Therefore, I (Garcea 2004, 2010a) fully concur with those (among others, de Sonneville-Bordes 1966; Hublin 1993; Souville 1998; Kleindienst 2000; Straus 2001; Derricourt 2005) who rule out the Strait of Gibraltar as a potential passageway for Aterian people.

Northeastern Africa and the Levant seem to be a most realistic corridor for the out-of-Africa dispersal of anatomically modern humans. As Aterian hunter-gatherers adapted to live in dry lands, it is not surprising that they did not settle along the Nile Valley, although they had to cross the Nile Delta. In the Levant, they would have found the arid environment they were familiar with in North Africa (Bar-Yosef 2000; Derricourt 2005). As Aterians did not habitually occupy the Nile Valley, the river must not have been a plausible corridor for them, whereas it is likely that

they moved into the Levant from the Sahara and/or from the Mediterranean Coast.

The other unanswered question is where Aterian peoples and their technology came from. Increasing evidence indicates that East Africa is a likely region to consider for the origin of the Aterian. In fact, the Aterian bifacial technology shows some affinities with the Lupemban of East and central Africa (Clark 1993; Kleindienst 1998; Gifford-Gonzalez et al. 2004, in preparation; Clark et al. 2008). Furthermore, Aterian bifaces have been linked to the Nubian Middle Paleolithic II, which derived from the Nubian Middle Paleolithic I and the Sangoan (Arkell 1964; Guichard and Guichard 1965; Van Peer 1986, 2001; Van Peer et al. 2003). The groups that split from their East African stock and moved north and northwest later developed their adaptation skills to live in arid lands.

## The Aftermath of the Aterian

Towards the end of MIS 4, when the climate became too harsh to sustain human life in the Sahara, Aterian groups moved out, probably towards the north, whereas northern Libya continued to offer some favorable areas throughout MIS 3 (58–39 ka). In Cyrenaica, the Lower LSA is locally known as Dabban, after the type-site of Hagfet ed Dabba, in the Jebel Akhdar (McBurney and Hey 1955). Layers (from XXV to XVI) with Dabban artifacts were also found at Haua Fteah, on top of the “Middle Paleolithic” and below the “Eastern Oranian” (Iberomaurusian/Upper LSA) units (McBurney 1967). McBurney defined the Dabban as a blade industry and divided it into two phases, Early and Late Dabban, the former dating between about 40 and 30 ka and the latter between about 30 and 20 ka (Table 9.4) (McBurney and Hey 1955; McBurney, 1967). He noted a typological contrast with the underlying “Middle Paleolithic” industries and related the Dabban to the Emiran of the Levant, suggesting a cultural replacement by groups skilled in the laminar technology who supposedly came from the East.

Marks (1975) also observed that in both the Levant and Cyrenaica, blade technology followed the Middle Paleolithic within a short time. However, he pointed out specific technological differences, namely the persistence of Levallois-derived traditions, the prevalence of backed blades and opposed platform cores in Cyrenaica, and the difference of Dabban end scrapers from the finely made pieces of the Levantine Aurignacian. He remarked that the most significant affinities between the Early Dabban and the Levantine Upper Paleolithic were only burins and chamfered blades which, however, occur in coastal Lebanon, but

**Table 9.4** Absolute dates of Lower LSA sites in Libya

Cultural unit	Locality	Site	Years BP (uncal.)	Method	Dated material	Sample number
Lower LSA/	Shakshuk East	Ain Soda area	24,620 ± 400	AMS	Charcoal	Beta-167094
Late Dabban	Shakshuk West	SJ-00-55 West (Test 2, -106 cm)	24,740 ± 140	AMS	Charred material	Beta-157687
	Shakshuk	SJ-00-56 Extension 2	25,410 ± 150	AMS	Organic sediment	Beta-185497
	Shakshuk West	SJ-00-55 West (Test 2, -17 cm)	25,500 ± 400	AMS	Charred material	Beta-167099
	Wadi Basina	Lacustrine series	26,330 ± 80	AMS	Organic sediment	Beta-154555
	Jado	SJ-98-12	27,310 ± 320	Standard <sup>14</sup> C	Carbonate sediment	Beta-154576
	Shakshuk	SJ-00-56 Extension 2 (bottom)	27,800 ± 430	Standard <sup>14</sup> C	Charcoal	GdA-196 (KIA-17720)
	Jebel Akhdar	Haua Fteah	28,500 ± 80	Standard <sup>14</sup> C	Charcoal	W-86
	Ain Zargha	27B1	30,000 ± 9,000	U/Th	Calcrete	
	Shakshuk West	SJ-00-55 West (Test 2, -64 cm)	30,870 ± 200	AMS	Organic sediment	Beta-157688
Lower LSA/	Jebel Akhdar	Haua Fteah	33,100 ± 400	Standard <sup>14</sup> C	Charcoal	GrN-2550
Early Dabban	Jebel Akhdar	Hagfet ed Dabba	40,500 ± 1,600	Standard <sup>14</sup> C	Charcoal	

not in Israel, which is geographically closer to Africa. In conclusion, with regards to North Africa, as the Dabban stratigraphically and chronologically follows the “Middle Paleolithic” at Haua Fteah, direct evolution, rather than replacement, seems to be the most plausible interpretation (Garcea 2006b). On the other hand, connections between North Africa and the Levant’s Emiran have been reconsidered, suggesting that the Emiran is an indigenous innovation made by *sapiens* populations who spread to the Levant from Africa (Shea 2006).

As the Dabban is an industry peculiar to Cyrenaica, I have suggested to use the general term “Lower LSA” for the other techno-complexes succeeding the Aterian and preceding the Iberomaurusian that occur in other parts of Libya (Garcea 2006b). In the Jebel Gharbi, some Lower LSA artifacts are scattered at different sites (Barich et al. 1996, 2003a, b; Garcea 2004, 2006b, 2009, 2010b; Barich and Giraudi 2005; Giraudi 2005; Garcea and Giraudi 2006). At Ras el Wadi, near the same permanent spring used in the Aterian, a paleosol containing Lower LSA artifacts laid between two discontinuous layers of calcrete. The lower calcrete was dated to  $27.31 \pm 0.320$  ka by conventional radiocarbon and  $30 \pm 9$  ka by the U/Th method, and the upper calcrete was radiocarbon dated to  $18.02 \pm 0.190$  ka (21,610 to 20,090 cal. BP) (Giraudi, 2004). Furthermore, at Ain Shakshuk, a test excavation at Site SJ-00-55 West including Lower LSA artifacts gave AMS dates between  $30.87 \pm 0.20$  ka and  $24.74 \pm 0.140$  ka. These dates indicate that the Lower LSA occupation took place between about 30 and 18 ka (Table 9.4), suggesting a hiatus between the latest Aterian and the Lower LSA techno-complexes in the Jebel Gharbi, which are contemporary with the Late Dabban in Cyrenaica. Therefore, the Jebel Akhdar appears

to be the only region that was continually inhabited, whereas the Jebel Gharbi seems to have remained uninhabited for several millennia, between about 40 and 30 ka.

## Conclusions

Aterian sites are widespread throughout the Sahara, and occasionally occur in the Atlantic and Mediterranean Coasts, but never in the Nile Valley, suggesting that the makers of the Aterian Industrial Complex had developed successful forms of adaptation to dry environments. During the Late Pleistocene, climatic conditions shifted between arid and semi-arid in the periphery of the Sahara, but remained basically dry in its central belt, where the mountain ranges are located. Research in north- and south-western Libya has provided geoarchaeological stratigraphic sequences, radiometric dates, and technological data from two study areas, one on the periphery of the desert, and another in the central Sahara, which show different adaptational strategies, chronology, and cultural developments. In northwestern Libya, only two major dry episodes occurred, one between 70 and 58 ka (MIS 4), and the other around 20 ka (Last Glacial Maximum), with a relatively mild climate during MIS 3. Furthermore, a network of underground aquifers was identified in the Jebel Gharbi, providing constant water access to Aterian groups, who were mostly settled near permanent springs, and assuring water and food resources under any climatic condition. Consequently, in the Jebel Gharbi, Aterian foragers were able to live through the first part of MIS 3, until about 40 ka. Conversely, in the South, a very dry desert developed

during MIS 4, as indicated by the deposit at Uan Tabu, and no human occupation occurred after the last Aterian occupation at ca. 60 ka, until the Early Holocene.

Aterian groups were able to live at any altitude, spanning from almost 1,000 m above sea level to the coastal level of the Mediterranean Sea. The geographic distribution of their sites shows that they had a well-organized settlement system structured on an inversely proportional relation between altitude and latitude that recurred from the central Sahara to the Mediterranean Coast. That is, at lower latitudes, such as on the Tadrart Acacus mountain, they were settled at higher elevations, whereas at higher latitudes, such as near the coast, they occupied sites at lower elevations. Such a strict altitudinal/latitudinal ratio should be related to the local environmental conditions, which were drier in the desert to the south, but moister in the mountain range habitats.

Technological, experimental, and functional analyses on a preliminary sample of tanged tools from the Jebel Gharbi have suggested other uses, in addition to hafting. In fact, the stems of the studied sample were found to be the active part of the tools, showing scraping use-wear and edge damage. These first results do not mean to rule out that some Aterian tanged tools were actually hafted on projectile points, but suggest that some other tools could be hand-held and that other functions should also be taken into consideration.

Aterian peoples are the most likely candidates for the last out-of-Africa dispersal of anatomically modern humans into Eurasia. The Nile Valley did not play a major role in this movement, confirming that Aterian foragers were adapted to live in dry environments. Therefore, the corridor(s) leading out of the continent must have been across the Sahara and/or the Mediterranean Coast, or even the peridesertic regions between the Mediterranean and the Sahara, such as the Jebel Gharbi in Tripolitania and the Jebel Akhdar in Cyrenaica. Obviously there is no need to envisage a population exodus from Africa to southwestern Asia, but Aterian groups certainly became more mobile when they had to move out of the Sahara. It is probably during this time that their radius of expansion reached Greater Africa, which includes the Levant.

After the end of the latest Aterian occupation in northern Libya, human settlements became very dispersed and patchy. The Jebel Akhdar appears to be the only region that was continually occupied, whereas the Jebel Gharbi exhibits a chronological gap between around 40 and 30 ka, when groups with a Lower LSA industry resettled the area. The Lower LSA of North Africa, including the Dabban, shows very few similarities with the Upper Paleolithic of the Levant and it seems very unlikely that groups from the two regions were culturally similar to each other. The LSA of North Africa suggests a considerable population decrease and technological stagnation. This is the exact opposite of

what occurred in Eurasia during the Upper Paleolithic, which underwent an explosion of different and complex cultural units.

To sum up, dry regions can stimulate interesting responses in modern human behavior. As environmental conditions change, natural habitats develop, some species become extinct, and others move to less dry environments, implying a biological shift after the environmental one. The occupation of refuge areas takes place during these periods. It is at this time that humans can create new forms of adaptation as their survival is at stake and may require transformations in their diet, technology, and social relations. Adaptive strategies involve risk and stress management with a high degree of organizational and technological flexibility that is successfully performed by anatomically modern humans.

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