JRAI Journal of the Royal Anthropological Institute

A reappraisal of the Middle to Later Stone Age prehistory of Morocco

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Over the last 25 years, perceptions of the early prehistory of Northwest Africa have undergone radical changes due to new fieldwork projects and a corresponding growth in scientific interest in the region. Much of this work has been focused in Morocco, known for its extremely rich fossil and archaeological records in caves and rock shelters. Here we outline some of the critical findings concerning the Middle (MSA) to Later (LSA) Stone Age periods. We describe shifts in the understanding of the nature and chronology of human occupation in this region as well as changes in ideas concerning the evolution of human behaviour. Major behavioural changes in the MSA (~300–29,000 years ago) attributed to *Homo sapiens* seem to have occurred mainly during humid phases, though not exclusively. The article also considers the relationship between the MSA and the LSA. Previously it was believed that there was a considerable hiatus separating these two cultural units (~29,000 to ~23,000 years ago) but evidence from Taforalt cave shows a narrowing of the gap in occupation. Finally, the article examines changes in land-use behaviours in the LSA at ~15,000 cal BP resulting in increased sedentism and an intensification in the exploitation of plant foods.

Introduction: Aims and brief history of recent research

Until recently Northwest Africa played only a peripheral role in debates on human origins (Stringer & Barton 2008). Most attention instead was focused on perceived core areas in Southern and East Africa and it was assumed that, because regions like the Maghreb (modern Morocco, Algeria, Tunisia, and western Libya) lay well outside these centres, there was a significant delay in the appearance of *Homo sapiens* populations and cultural developments in these places. Such notions were also influenced by knowledge

Journal of the Royal Anthropological Institute (N.S.) **00**, *1-26*

that the Sahara would, at times, have acted as a formidable barrier to the movement of humans and other animals and that this may have left areas to the northwest significantly isolated for long periods, leading to population contraction and even abandonment (Campmas 2017; Compton 2011). These concepts also fitted the existing narrative of significant temporal gaps in human settlement and the opinion that most early cultural influences originated from exogenous contacts outside the Maghreb. Despite the long persistence of such ideas, these have gradually begun to change over the last twenty-five years, helped by a redefining of research agendas, the application of more advanced methodologies, and the publication of new scientific results, particularly relating to sites in Morocco. We will attempt to highlight some of the more important findings in the following.

At the time of publication of McBrearty and Brooks' seminal paper (2000) on the pan-African Middle Stone Age (MSA), information based on modern excavation of such material in Morocco was still largely lacking. Two of the planned archaeological projects initiated at this time in the region were therefore focused on research questions addressing the age and duration of the MSA and whether there was continuity with Later Stone Age (LSA) *H. sapiens* populations (Barton, Bouzouggar & Stringer 2001; Bouzouggar, Kozlowski & Otte 2002). These projects were directed primarily towards the re-assessment of known cave and rockshelter sites containing well-developed prehistoric archaeological sequences and with known potential for the preservation of environmental remains for dating and related palaeoecological studies. Beginning in 2000, there has been a resurgence of research excavation, particularly in eastern Morocco and along the Atlantic coast, and today there are a multitude of international collaborative projects that are working in these and other areas (Fig. 1) as reflected in some of the key results reported below.

Changes in the archaeological terminology

One consequence of the renewed spotlight on Moroccan prehistory has been to redefine the agreed terminology used by archaeologists in this region (McBrearty & Brooks 2000). Previously, historical terms derived from European Palaeolithic archaeology were widely employed across North Africa (Garcea 2004). Some of these such as 'Middle Palaeolithic' and 'Upper Palaeolithic' have now been largely discounted in favour of 'Middle Stone Age' (MSA) and 'Later Stone Age' (LSA) to better reflect the African heritage of these technologies, though use of the older labels still persists in certain parts of North Africa (see Drobniewicz & Ginter 2020; Osypiński, Osypińska & Gautier 2011; Reynolds 2018). Less successful has been a call to retire other terms such as 'Mousterian' (Shea 2014) which is still retained due to its long history of use in the Maghreb. The term Mousterian (*Moustérien*) was originally applied in the early 1890s to describe lithic industries in the Oran area of Algeria (Pallary 1891-1892). Subsequently, it was regarded as a convenient term to distinguish this industry from a second Levallois industry, characterized by pedunculate points and other tanged tools, separately identified at Bir-el-Ater in Algeria and named the 'Aterian' (Reygasse 1919-1920). Today, the two assemblage types are classified as sub-divisions of the North African MSA and are now commonly referred to as the Aterian and the Mousterian or Maghrebian Mousterian – to distinguish it from the Eurasian Mousterian (Dibble *et al.* 2013). For the LSA there is so far only one defined grouping: the Iberomaurusian, a term first coined by Pallary (1909) to describe a microlithic-backed bladelet technology that he believed reflected shared cultural traditions between southern Spain and the ancient Mauretanian region

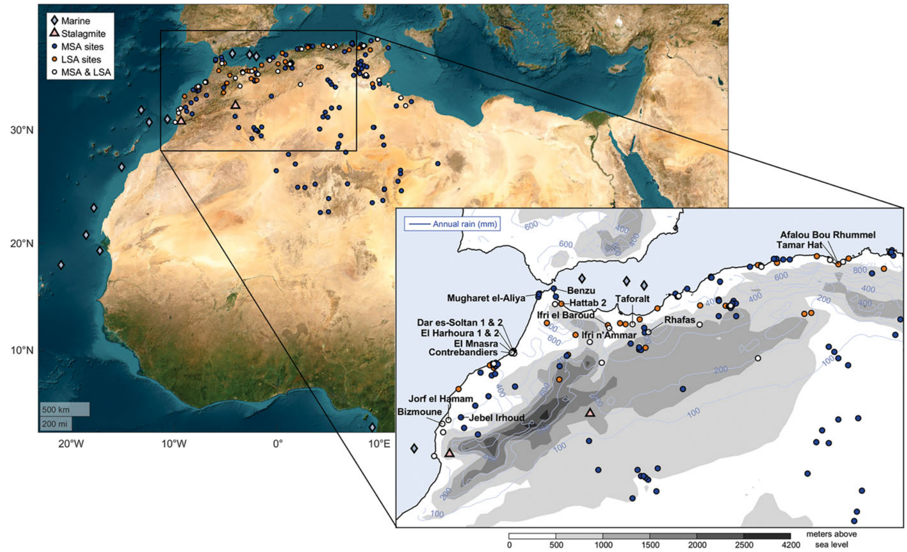

Figure 1. Distribution of Middle Stone Age (MSA) and Later Stone Age (LSA) sites with selected palaeoclimate records. Labelled archaeological sites are discussed in the text. MSA (blue dots) and LSA (orange dots) sites plotted are excavated sites listed in the Boisard and Ben Arous (2024) database. The two speleothem (triangle) sites are Wintimdouine cave (30.7 °N, 9.3 °W) (Ait Brahim *et al.* 2023) and Ksar cave (32 °N, 4 °W) (Day *et al.* 2023). The marine core (diamond) records are (single reference included for each for simplicity): in the Atlantic Ocean, listed from south to north, ODP 659 (18.0 °N, 21 °W) (Kuechler *et al.* 2013); GC68 (19.3 °N, 17.2 °W) (Kinsley *et al.* 2022); ODP 658c (20.75 °N, 18.55 °W) (Kinsley *et al.* 2022); GC49 (23.2 °N, 17.8 °W) (Kinsley *et al.* 2022); GC37 (26.8 °N, -15.1 °W) (Kinsley *et al.* 2022); GeoB 4216 (30.6 °N, 12.4 °W) (Moreno *et al.* 2001); GC27 (30.9 °N, 10.6 °W) (Tierney, Pausata & Demenocal 2017); GeoB 5559 (31.7 °N, 13.2 °W) (Moreno *et al.* 2001); and in the Mediterranean Sea, listed from west to east, ODP 976 (36.2 °N, 4.3 °W) (Combourieu Nebout *et al.* 2002); MD95 2043 (36.1 °N, 2.6 °W) (Cacho *et al.* 1999); ODP 977A (36.0 °N, 2.0 °W) (Martrat *et al.* 2004). In the inset, rainfall contours are shown in light blue (mm/year), and topography is shaded grey. The base map in the larger figure is hosted by Esri©, figure produced using MATLAB Geographic Plots. Credit: S. Carolin.

in North Africa. Although this idea has now largely been abandoned, the name Iberomaurusian is still widely favoured for describing assemblages of such type in Northwest Africa. It should be noted, however, that the Iberomaurusian is not a single uniform entity but can be divided into different sub-units on the basis of chronological and techno-typological criteria (Barton, Bouzouggar, Collcutt & Humphrey 2019; Sari 2014; 2020).

More recently another lithic assemblage type has been recognized, which occurs stratigraphically between the MSA and LSA and for want of a better term has been identified provisionally as an 'Intermediate' industry containing adzes and picks (Barton *et al.* 2016). Its distinctive qualities include the presence of large core tools made on non-local metamorphic rocks (Barton *et al.* 2013; 2016). Although it contains flake side scrapers, there is a general absence of Levallois technique in contrast to the preceding MSA, and similarly, the typical bladelet component of the LSA appears to be missing. Until now, it has only been recorded at two cave sites in Morocco (Taforalt and Ghar Cahal), so further work will be necessary to test the applicability of the newly defined assemblage type.

Towards a new chronology

Not long ago, evidence for the dating of the MSA in Morocco was based mainly on radiocarbon determinations of bulked charcoal or bone (Debénath, Raynal, Roche, Texier & Ferembach 1986; Roche 1976). Apart from potential problems of contamination and the risk of mixing material of different ages, many of the first published dates lay beyond the limits of the dating technique and were therefore minimum estimates only. The situation was not immediately improved with the limited application of thermoluminescence dating on burnt flints, as some of these results were not very different from the 'young' radiocarbon chronology (Rhodes 1988). Based on these initial estimates, Debénath and others suggested that the Aterian (MSA) probably lasted no longer than 20,000 years from about 40-20,000 years ago and that there was a gap of approximately 5000 years before the advent of the (LSA) Iberomaurusian (1986: 236). By 2000, this chronological estimate was revised slightly to the broader proposition that the Aterian had developed during the *Soltanien* (covering the last glacial stage) and that it was related to earlier antecedents in the Sahara (Cremaschi, di Lernia & Garcea 1998; Debénath 2000: 134).

The application of more advanced radiometric dating methods together with the ability to date objects and deposits at much higher resolution have demonstrated that the MSA in Morocco occupied a much greater timespan than initially reported. Two major studies undertaken early in the millennium proved especially influential in this respect. They concerned the dating of a stratified Mousterian to Aterian sequence at Rhafas Cave (Mercier *et al.* 2007) and the study of MSA Aterian deposits at Grotte des Pigeons at Taforalt (Bouzouggar *et al.* 2007*b*), both in eastern Morocco. Thermoluminescence (TL) dating on burnt cherts from Rhafas provided ages between 70 and 80 ka (thousand years ago) for the earliest Aterian while the youngest underlying Mousterian level 3b could be dated to 80-90 ka (Mercier *et al.* 2007: 312).[1] At Taforalt multiple dating of sand-sized quartz grains by optically stimulated luminescence (OSL), in combination with TL on flint and uranium-series on speleothem, indicated that the earlier MSA Aterian levels lay between 73 and 91 ka (Bouzouggar *et al.* 2007*b*) and this was confirmed by further OSL and U-series dating of underlying MSA deposits (Clark-Balzan *et al.* 2012). In addition to these studies, attention was focused on caves along the Atlantic coast near Témara. Here, OSL dating was published for cave sequences with MSA layers at Dar es Soltan 1 and 2 (Barton, Bouzouggar, Collcutt, Schwenninger & Clark-Balzan 2009), El Mnasra (Jacobs, Roberts, Nespoulet, El Hajraoui & Debénath 2012; Schwenninger *et al.* 2010), El Harhoura 2 (Jacobs *et al.* 2012) and Contrebandiers Cave (Dibble *et al.* 2013), all of which implied extensive MSA presence from at least 110 ka in the equivalent of Marine Isotope Stage (MIS) 5c and 5d. Additional OSL and combined uranium series and electron spin resonance (US-ESR) dating has been provided for El Mnasra and El Harhoura (Ben Arous, Falguères, Tombret, El Hajraoui & Nespoulet 2020; Ben Arous *et al.* 2022), while a further study at Ifri n'Ammar in eastern Morocco (Richter, Moser, Nami, Eiwanger & Mikdad 2010) showed that the MSA sequence there extended back to at least 171 ka into MIS 6, with overlying levels containing so far the earliest Aterian tanged points anywhere, dating to around 145 ka (Nami & Moser 2010).

Currently, the oldest ages for the MSA come from the re-dating of Jebel Irhoud, Morocco, using TL on fire-heated flint artefacts from new excavations. A weighted average mean age places them at around 315 ka (Richter *et al.* 2017) within MIS 8-9, making them the earliest known in NW Africa. Another early site with MSA artefacts is Benzu Rockshelter near the northern tip of Morocco where MSA finds from level 2 have been dated by TL to 254 ± 17 ka (Ramos *et al.* 2008), which would place the occupation within MIS 7.

In addition to radically revising the MSA chronology, increasing its length by up to eight-fold, much more information is now available for dating the LSA Iberomaurusian and the sequence of the MSA to LSA transition. Many of these data come from Grotte des Pigeons at Taforalt (Barton *et al.* 2013; 2016; Bouzouggar *et al.* 2008) where over 200 dates have been generated. More than sixty radiocarbon dates have so far been published for the LSA levels alone, which presently span the period from ~12.5 to 23 ka cal BP (thousand calibrated years before the present) (Barton *et al.* 2019), although slightly older dates are known for LSA deposits at sites further east in Algeria (Hogue & Barton 2016). Beneath these LSA layers at Taforalt lies the provisionally named 'Intermediate' industry, which spans a period from ~ 24.2 to 27 ka cal BP with little sign of hiatus in the occupation of the cave. The youngest MSA deposits so far recorded are stratified immediately below this industry, probably dating to ~ 27 to 29 ka cal BP, but clearer resolution of the ages of these deposits is currently a work in progress. The chronology of the MSA to LSA transition has also been discussed in relation to sites in the Rabat-Témara region but interpretation is made more difficult by apparent gaps in sedimentation (Ben Arous *et al.* 2020; Ben Arous, Boisard & Leplongeon 2025).

From the present understanding of the chronology, it would appear that a generalized North African MSA developed through various stages which began at least 300 ka ago with the introduction of Levallois flake technologies that included points and side scrapers but no obvious examples of pedunculate tools or bifacial foliates, typical of the Aterian. This can be exemplified at sites like at Ifri n'Ammar (Morocco) where levels containing points but no pedunculates can be dated to 171 ±12 ka (Richter *et al.* 2010). In contrast, small tanged Aterian points seem to have appeared at sites from about ~145 ka and from their widespread geographic distribution appear to signal a more permanent and increased presence of humans in the Maghreb from this time. Although there was considerable variation in the MSA Aterian toolkits, which sometimes displayed greater laminarity (more blades), together they indicate a regional persistence of the Levallois technology which diminished only gradually after ~30 ka cal BP and was completely replaced by microlithic bladelet assemblages of the Iberomaurusian from ~25-23 ka cal BP (Fig. 2).

Past climate and environmental change in NW Africa

Today, the NW Maghreb region including Morocco is divided into distinct climate zones by the Atlas Mountains (Fig. 1). The areas to the north and west of these mountain ranges maintain a Mediterranean climate, characterized by wet, cool winters and dry, warm summers (250-1000 mm annual rainfall). Moisture is sourced from the Atlantic Ocean and Mediterranean Sea and carried by westerly winds which originate over the North Atlantic (Knippertz, Christoph & Speth 2003). Nowadays, vegetation in this region consists of Mediterranean sclerophyllous forest (*Quercus ilex*, *Quercus suber*, *Quercus coccifera*), Mediterranean coniferous forest (*Abies*, *Cedrus*, *Cupressus*, *Juniperus*, *Pinus*, and *Tetraclinis*), and a smaller proportion of Mediterranean deciduous oak forest. Mediterranean bushland and thicket, including the characteristic *Pistacia* and *Olea*, are found in the semi-arid areas. In contrast, today the area south of the Atlas Mountains, on the leeward slopes, receives only a small amount of rainfall (100-250 mm annually) (Knippertz *et al.* 2003), and is dominated by steppe vegetation (dwarf

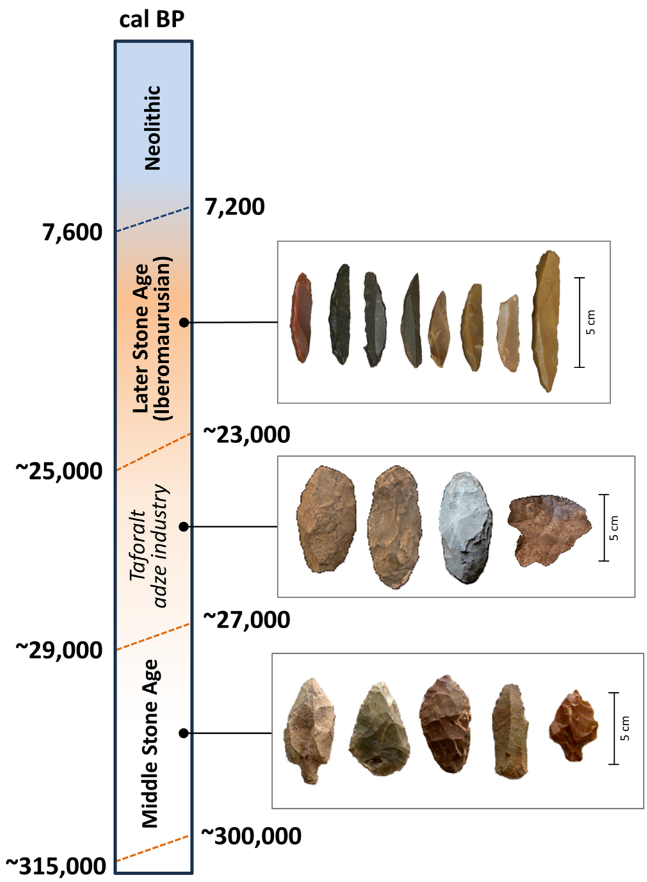

Figure 2. Timeline for the MSA and LSA for Morocco with lithic artefact associations. The dates are expressed as ka and ka cal BP (thousand calibrated years before the present, where the present is AD 1950). The dating of the end of the Iberomaurusian period and onset of the Neolithic period is based on the earliest radiocarbon dates associated with domesticated animals and plant cultivation in Morocco. Credit: L. Humphrey and S. Carolin.

shrubs and spiny xerophytic plants). Beyond this area to the south lies the hyper-arid Sahara Desert, which is mostly devoid of vegetation, apart from in the wadis, oases, and mountain areas.

Palaeoenvironmental records show that climate in all these climate zones fluctuated intermittently between drier and wetter periods through the Mid to Late Pleistocene. During African Humid Periods (AHPs), savannah landscapes expanded, major river networks developed and substantial lakes formed within today's Sahara Desert (e.g., Drake, Blench, Armitage, Bristow & White 2011; Larrasoaña, Roberts & Rohling 2013). The latest of these periods occurred in the early Holocene, ~11 ka BP to 5 ka BP uncalibrated (e.g., Lézine, Hély, Grenier, Braconnot & Krinner 2011), though AHPs have also been recognized during earlier interglacial periods (e.g., Larrasoaña *et al.* 2013). For example, in the last interglacial period (~125 ka), zoogeographical research shows aquatic animals were able to migrate along corridors across the Sahara formed by interconnected hydrographic basins (Drake *et al.* 2011). There is likewise extensive evidence for past development of megalakes in several basins in the Sahara during earlier AHPs, with the majority of megalakes dating to 70-130 ka (Drake *et al.* 2022). Additionally, cave speleothem archives in today's arid regions, which until recently have been mostly absent in the NW African palaeoclimate literature, are able to provide precisely dated evidence of when local annual rainfall rose above ~250 mm (semi-aridity), as well as information on the source of this rainfall based on oxygen isotopes. Speleothem research in areas immediately south of the Atlas Mountains, areas which likely supplied water to palaeo-rivers flowing south into the Sahara during wet periods, is now in progress, and preliminary results reveal multiple intermittent wet periods over the last ~400 ka (Day *et al.* 2023).

Information on past wetter and drier periods in North Africa is also provided by particles picked up by winds and/or transported by rivers and deposited in marine sediments on the West African margin. Plant wax-derived hydrogen (deuterium) and carbon isotopes in such deposits are a proxy for regional rainfall and savannah ecosystem expansion, respectively (Kuechler, Schefuß, Beckmann, Dupont & Wefer 2013; O'Mara *et al.* 2022). Records of increased rainfall and an expanded savannah ecosystem are negatively correlated with records of enhanced dust flux that are indirect evidence of more arid conditions (O'Mara *et al.* 2022; Skonieczny *et al.* 2019). The complete multi-proxy marine core records show dry-wet variations follow summer solar energy flux orbital cycles (at ~23 ka and 41 ka periodicities), which are more frequent than glacial-interglacial shifts (~100 ka periodicity) (O'Mara *et al.* 2022; Skonieczny *et al.* 2019). Indeed, there is further emerging evidence of the existence of AHPs, within the last glacial period, for example from 50 to 60 ka. During this period, recent evidence shows the existence of a palaeo-lake immediately south of the Anti-Atlas Mountains (Nutz *et al.* 2024), in addition to reduced dust activity off the West African margin (21°N, southern Sahara) (Kinsley *et al.* 2022), and a stronger monsoon in the Sahel region (Weldeab, Lea, Schneider & Andersen 2007).

In addition to orbital-scale climate variations, important insights into past 'abrupt' shifts in climate (decadal-scale onset, millennial-scale duration) are provided by marine core, lacustrine, and speleothem records. Marine core records from the Alboran Sea in the western Mediterranean show several rapid sea surface temperature (SST) warmings followed by gradual cooling events over the past 250 ka (Cacho *et al.* 1999; Martrat *et al.* 2004). The Alboran Sea SST events of the last glacial period (~11-115 ka) mirror abrupt polar temperature changes inferred from Greenland ice core records (e.g., Dansgaard *et al.* 1993). Pollen assemblages from the Alboran Sea (Combourieu Nebout *et al.* 2002; 2009) and from a handful of lacustrine records in the Atlas Mountains (Cheddadi *et al.* 2021; Rhoujjati, Cheddadi, Taïeb, Baali & Ortu 2010) further suggest abrupt changes in vegetation in response to these abrupt climate events. Similarly, a stalagmite from southwest Morocco shows distinct millennial-scale isotopic shifts coincident with Alboran Sea cold SST excursions, which the authors interpret as cooler and potentially drier conditions (Ait Brahim *et al.* 2023). At lower latitudes, dust records from marine cores along the NW African margin (19°N to 27°N) (Fig. 1) suggest surface winds along this margin increased and the West African summer monsoon strength decreased during these North Atlantic cooling events (e.g., Kinsley *et al.* 2022; McGee, deMenocal, Winckler, Stuut & Bradtmiller 2013; Skonieczny *et al.* 2019).

Cave sediment sequences can also provide a broad range of proxy evidence for former environmental conditions and climate change, sometimes in association with archaeological evidence. These include studies of large and small vertebrate remains including isotopic signatures (e.g., Bougariane, Zouhri, Ouchaou, Oujaa & Boudad 2010; Stoetzel, Marion, Nespoulet, El Hajraoui & Denys 2011; Stoetzel *et al.* 2014; Uzunidis *et al.* 2023; Worthey 2024), as well as studies of dust particles, pollen, phytoliths, and charcoals. As an example, isotopic analysis of small rodent teeth is an emerging methodology used to track local site-specific environmental information (Fernández-García *et al.* 2022; Freudenthal *et al.* 2014; Leichliter *et al.* 2017). Advantages of the small rodent teeth archive include: (i) there is usually a high abundance of microfauna in caves due to roosting raptors, which potentially allows for a statistically robust sample size; (ii) tooth enamel contains a high percentage of minerals, which survive in the sediment record for hundreds of thousands of years with minimal degradation; and (iii) rodents can survive in very arid environments, including the Sahara Desert which has ~100 mm/year annual rainfall. A recent study which measured the modern isotopic composition of small rodent enamel remains collected in owl pellets across all Moroccan climate zones showed a convincing relationship between enamel oxygen isotopes and the location's mean annual precipitation (Jeffrey, Denys, Stoetzel & Lee-Thorp 2015). As the rodents receive most of their water from seeds and plant parts, the authors suggest this relationship is caused by the oxygen isotope enrichment of plant water due to evaporation effects, which increase in less humid conditions. At sites not influenced by modern C4 crops (e.g., maize), which differ isotopically from Mediterranean plants with C3 pathways, the authors also found a relationship between the small rodent enamel carbon isotopes and site rainfall (Jeffrey *et al.* 2015). Further studies of this kind, which will extend the temporal record of environmental change, are in progress for the Moroccan caves of El Harhoura 2, El Mnasra, and Taforalt (Carolin *et al.* 2024).

The understanding of climate change in Morocco during the late MSA and LSA periods continues to improve with the availability of higher resolution studies. Detailed analysis of the sediment sequence at Taforalt in north-eastern Morocco has revealed raised levels of aeolian silt (dust) slightly before 22 ka cal BP (Barton *et al.* 2019). These are believed to indicate drier, windier conditions that are likely to correlate with the Last Glacial Maximum (LGM) (and the overlapping 'Heinrich 2' Hudson Straight iceberg discharge event) and provide a context for interpreting the Intermediate occupations at the site. Above these levels, during the LSA, there is a marked change in sedimentation due to increased anthropogenic activity in the cave. This is accompanied by evidence of relatively dry, cool conditions (with temperature ranges overlapping with those of the present day) indicated by remains of Barbary ground squirrel (*Atlantoxerus getulus*) and Moorish gecko (*Tarentola mauritanica*), and supported by charcoal evidence for juniper-thuja scrub (Barton *et al.* 2019). Soon after this, wood charcoals reveal an increase in Mediterranean sclerophyllous oak forest, and evidence for wetter conditions and a more developed tree canopy is suggested by a shift to isotopically lower $\delta^{13}C$ values in Barbary sheep enamel (Worthey *et al.* 2025). The approximate dating of the sedimentary change coincides broadly with the beginning of Greenland Interstadial 1e (GI1e) at ~14.7 ka cal BP (Barton *et al.* 2019). The regional rise in temperatures and humidity at this time is also marked by palaeoclimate proxies in the western Mediterranean (Cacho *et al.* 1999; Martrat *et al.* 2004).

In summary, evidence exists for substantial environmental change at intermittent periods in NW Africa, both in the Sahara and in the adjacent more humid Mediterranean region. However, interpretation is limited as there are currently only a small number of terrestrial environmental records available and few offer a robust

Figure 3. Middle Stone Age crania of Jebel Irhoud 1 (left) and Dar es Soltan II-5 (right). Photograph credit: C. Stringer, courtesy of the Rabat Museum.

chronology that extends back beyond the Holocene. Recently, other palaeoclimatic archives have begun to emerge in Morocco, such as speleothems (e.g., Ait Brahim *et al.* 2023; Day *et al.* 2023) and environmental proxies found in cave sediments with associated archaeology, e.g. microfaunal remains, charcoal, phytoliths, pollen, plant wax isotopes – all of which can be used to infer past climate variability (Barton *et al.* 2019; Carolin *et al.* 2024; Stoetzel *et al.* 2014). Work on improving the chronology of such changes is being aided by cryptotephra studies in archaeological caves and in regional marine core records which will allow better synchronization of archaeological and palaeoenvironmental records (e.g., Barton *et al.* 2015; McLean *et al.* 2023; 2024). The ongoing development of these new environmental archives with improved geochronology will ultimately lead to a more robust understanding of past climate change in the region and their effects on human populations during the MSA and LSA.

MSA and LSA peopling of Morocco

Further discoveries of human fossils in Morocco over the last two decades together with new dates and interpretation of previous finds have demonstrated that NW Africa was one of several core areas for the origins and expansion of *H. sapiens*. The morphological diversity of the Moroccan human fossils and their chronological spread add another level of complexity to the geographical and temporal overlap of different combinations of archaic and more-modern-looking morphologies observed in the human fossil record during the emergence of modern humans (Hublin *et al.* 2017; Mounier & Mirazón Lahr 2019; Scerri 2017; Stringer & Galway-Witham 2017).

Human fossils discovered at Jebel Irhoud in the 1960s included an adult cranium (Irhoud 1, Figure 3, left) and juvenile mandible (Irhoud 3). Early descriptions of these fossils emphasized similarities with Neanderthals whereas more recent studies stressed an absence of Neanderthal-derived traits (Hublin 1992; Stringer & Galway-Witham 2017). Reconstruction of the timing and pattern of tooth formation and emergence in Irhoud 3 suggested an extended period of development with some aspects showing close similarities to modern human children (T.M. Smith *et al.* 2007). Initially thought to be dated at around 40 ka BP, the Jebel Irhoud fossils were subsequently redated between 130 and 190 ka (Grün & Stringer 1991; Hublin 1992; T.M. Smith *et al.* 2007). Archaeological investigations initiated in 2004 uncovered a more extensive series of human fossils within a secure stratigraphic context, including an adult cranium (Irhoud 10), mandible (Irhoud 11), and maxilla (Irhoud 21) as well as several loose teeth and postcranial elements (Hublin *et al.* 2017). A new age for the fossils of 315 ± 34 ka (Richter *et al.* 2017) was determined based on an association with TL-dated MSA lithic artefacts. The fossil assemblage from Jebel Irhoud displays a mosaic of archaic and modern human features. The facial, mandibular, and dental morphology are most closely aligned with modern humans, suggesting that the fossils represent an early stage of the *H. sapiens* lineage (Hublin *et al.* 2017). The cranial vault is low and elongated, unlike the more globular shape seen in present-day humans and more recent *H. sapiens* fossils, which could imply that changes in brain morphology occurred more recently within the *H. sapiens* lineage (Hublin *et al.* 2017). A subsequent shape-based analysis confirmed similarities in facial shape between Irhoud 1 and early *H. sapiens* but found that the morphology of the cranial vault showed affinities to Neandertals, pointing towards the possibility that Irhoud fossils were part of a population that contributed to the ancestry of both groups (Mounier & Mirazón Lahr 2019).

Most of the human fossils at other MSA sites in Morocco are directly associated with MSA Aterian industries and are now thought to date between ~145 and 30 ka (Bergmann *et al.* 2022). The more complete remains are from cave sites along the Atlantic coast, including Dar-es-Soltan 2 (Ferembach 1976*a*), Contrebandiers (Ferembach 1976*b*), and El Harhoura 1 (Debénath 1980). More recent discoveries include a juvenile skull and partial skeleton of a child at Contrebandiers Cave, from a layer dated at around 115 ka (Freidline *et al.* 2024; Oujaa & Hublin 2012), and isolated bones and teeth at the nearby sites of El Harhoura II and El Mnasra (Oujaa & Lacombe 2012). A few human fossils have been recovered from Aterian levels at sites in the north and east of Morocco, including Mugharet el Aliya (Şenyürek 1940), Taforalt (Roche 1953) and Ifri N'Ammar (Nami & Moser 2010). The MSA Aterian human fossils exhibit robust faces and mandibles (Fig. 3), and the dentitions are notable for their large size, particularly of the post-canine teeth, thick enamel and the presence of mass additive traits such as extra crests and cuspules (Hublin *et al.* 2012). The Kebibat (Rabat) fossil assemblage, which includes a partial mandible, a maxillary fragment and twenty-one cranial fragments, was found during construction work in 1933 and lacks any archaeological associations. However, the original location can be traced, and the associated sedimentary horizon has recently been dated at 137 ± 7 ka (Chahid *et al.* 2020).

There is currently no human fossil record associated with the Intermediate industry at Taforalt or within a comparable time interval at other sites in the region. In contrast to earlier periods, the human skeletal and dental records from the Iberomaurusian are abundant. They include large numbers of skeletons from Afalou Bou Rhummel in Algeria and Taforalt in Morocco, and smaller numbers of articulated, disarticulated, or fragmentary remains from numerous other sites. Many of these remains are from well-documented funerary contexts which present evidence of funerary caching, intentional burial, manipulation of the body after death involving dismemberment, soft tissue removal and application of pigments, curation of skeletal elements, secondary burial, and incorporation of a range of funerary items into the burial deposits (Humphrey, Freyne & Bouzouggar 2021). The earliest direct dates on human bone are from Taforalt where bones from six burials have been radiocarbon-dated to between 13,993 cal

BP and 14,945 cal BP (Humphrey *et al.* 2014, updated with Intcal 20). The burials excavated in separate campaigns from layer X (Hachi 2006) and the double burial from level III (Arambourg, Boule, Vallois & Verneau 1934) at Afalou Bou Rhummel may be slightly earlier than those at Taforalt based on their stratigraphic position but are not directly dated. Despite this rich human osteological record, there is at present an interval of ~8,000 years between the earliest known appearance of LSA technologies at Tamar Hat at ~25 ka cal BP (Hogue & Barton 2016) and the earliest known human burials from this period, which may reflect a change in occupation patterns and treatment of the dead in a later part of the LSA (Barton *et al.* 2019; Humphrey *et al.* 2021).

Two of the key questions for this region have been whether there was continuity of *H. sapiens* throughout the MSA, and the extent to which the MSA-LSA transition involved direct descent from the preceding MSA population or the spread of people from Southwest Asia, Southern Europe, or elsewhere (Barton *et al.* 2013; Ferembach 1985). Redating of the MSA human fossils, including those from Jebel Irhoud, Kebibat, and those associated with Aterian industries, has increased the chronological distances among these groups and between these groups and LSA Iberomaurusians. This has led to a reframing of the debates surrounding evolutionary continuity between successive populations in the region. Several studies have addressed whether the later MSA fossils are morphologically intermediate between Jebel Irhoud and the Iberomaurusian (Bergmann *et al.* 2022; Harvati & Hublin 2012). The mosaic morphology of the more recent Aterian and Kebibat mandibles has been interpreted as intermediate between Jebel Irhoud and later *H. sapiens* and as evidence for accretion of modern traits through time within Morocco (Bergmann *et al.* 2022). Nevertheless, the age determination for Kebibat is younger than anticipated, based on morphology suggesting that change in human morphology during the MSA did not involve a simple unidirectional progression (Bergmann *et al.* 2022; Chahid *et al.* 2020; Oujaa, Arnaud, Bardley-Vaillant & Grimaud-Hervé 2017).

Another key question concerns whether the Iberomaurusian population persisted beyond the end of the Pleistocene. The most recent human burial attributed to the Iberomaurusian is from Hattab II Cave in north-western Morocco and was dated indirectly at 8,900 ± 1,100 years BP based on a TL age determination (Barton *et al.* 2008). The skeleton was articulated and a small bladelet core of Iberomaurusian type was found in direct contact with the upper leg bone. The skull is similarly robust to those from Taforalt, and the central incisors were removed from the upper jaw during life, a pattern of tooth evulsion which is characteristic of, but not limited to, the Iberomaurusian (De Groote & Humphrey 2016; Humphrey & Bocaege 2008).

Genomic data from Late Pleistocene and Holocene populations in Morocco provide an additional perspective on these issues. Mitochondrial genomes were reconstructed for seven 14.5 ka BP individuals from Taforalt, and nuclear data were analysed for five of these individuals. Mitochondrial DNA sequences of six of the Taforalt individuals belong to sub-lineages of haplogroup U6a, with one individual belonging to haplogroup M1b (van de Loosdrecht *et al.* 2018). Haplogroups U6 and M1 are autochthonous North African lineages that have been linked to a back-to-Africa migration from West Asia (Oliveri *et al.* 2006). The presence of basal U6 lineages in ~35 ka BP specimens found at Muierii cave in Romania (Hervella *et al.* 2016) and 26 ka BP specimens from Dzudzuana Cave in Georgia (Lazaridis *et al.* 2018) are consistent with a back-to-Africa migration. The divergence time of haplogroup U6a and the haplogroup M1 at Taforalt are both calculated to 24 ka BP, which closely approximates the earliest known LSA in the region (van de Loosdrecht *et al.* 2018).

A more recent model, incorporating additional data from Libya, suggests that 60 per cent of Taforalt ancestry is derived from a Natufian-like Levantine population and the remaining 40 percent is derived from an ancestral North African population (Salem *et al.* 2025). This may imply a degree of population continuity between the MSA and LSA in North Africa, and the possibility of genetic admixture between MSA and incoming groups.

The presence of U6a and M1b lineages in Taforalt and present-day populations in Morocco implies a degree of population continuity from the LSA (Fregel *et al.* 2018). Genomic data from Holocene populations in the Maghreb also support archaeological evidence for the continuity of Iberomaurusian populations into the Holocene (Fregel *et al.* 2018; Humphrey & Bouzouggar 2023; Lipson *et al.* 2025; Simões *et al.* 2023). DNA extracted from an isolated ~7.6 ka BP human phalanx from Ifri Ouberrid Cave yielded a genomic profile similar to the Taforalt population, suggesting an extended period of population continuity and isolation in hunter-gatherer groups in Morocco (Simões *et al.* 2023). Intriguingly, one ~8.0 ka BP individual from Djebba in Tunisia harboured ancestry from European hunter-gatherers (Lipson *et al.* 2025), consistent with archaeological evidence for some movement across the Strait of Sicily during the Early Holocene (Mulazzani *et al.* 2010). In Morocco, the earliest currently known evidence for external admixture occurs in ~7.2 ka BP Early Neolithic farmers from Kaf Taht el-Ghar, who showed mostly European Neolithic ancestry and some admixture with local groups (Simões *et al.* 2023). In contrast, slightly more recent Early Neolithic individuals from Ifri n'Amr o'Moussa in Morocco and Early Neolithic sites in Tunisa are genetically similar to the Taforalt population, implying the adoption of agricultural innovations by local hunter-gatherers (Fregel *et al.* 2018; Lipson *et al.* 2025).

Cognitively complex behaviours and coastal adaptation in the MSA

The publication of McBrearty and Brooks' landmark paper in 2000 signalled a significant paradigm shift in our understanding of the early evolution of complex human behaviour in the MSA of Africa. In the following decade, papers on the Moroccan MSA reported major innovative developments that appeared to mirror similar behavioural responses with those in sub-Saharan Africa (Barton & d'Errico 2012; Bouzouggar & Barton 2012; Bouzouggar *et al.* 2007*b*), some of which resembled the 'transformative technologies' described by Lyn Wadley (2013). One of the earliest examples of this kind with parallels in South Africa may have been the use of compound adhesives as binding agents for hafting stone tools like Aterian tanged points (Bouzouggar & Barton 2012). So far, the earliest appearance of such artefacts can be dated to around 145 ka at sites like Ifri n'Ammar in eastern Morocco (Richter *et al.* 2010) and perhaps of similar age at Bizmoune in the south (Sehasseh *et al.* 2021). The widespread distribution of these tanged forms across the Sahara suggested they were part of a more widely shared cultural tradition that may have originated in the Maghreb (an idea initially proposed by Caton-Thompson in 1946). A popular earlier view was that Aterian toolkits were produced by highly mobile human groups adapted to desert environments (Cremaschi *et al.* 1998; Garcea 2012). But this idea has recently been challenged by the dating of MSA Aterian sites in association with faunas indicative of more humid, savannah-like conditions (Sehasseh *et al.* 2021; Drake, pers. comm.). Current research suggests that the small symmetrical tanged points made highly effective hunting weapons as indicated by hafting traces and by impact fractures at the tips of the stone artefacts showing that they were used as projectiles (Tomasso, Cnuts, Mikdad & Rots 2020). This has also been suggested by the potential association of Aterian points with larger prey such as rhinoceros (Hutterer 2010). However, other studies have inferred a multiplicity of uses of these tools including as butchery knives (Bouzouggar, Barton & de Araujo 2007*a*). It should also be cautioned that tanged pieces vary a great deal in terms of size, symmetry, and overall shape and not all would have functioned as points. Similarly, whether the shape and functions of these artefacts varied geographically and/or over time remains to be fully established.

Another innovation at about this time entailed shell ornaments that have been widely interpreted as proxies for symbolically mediated behaviour (McBrearty & Brooks 2000). Such items have now been independently recorded from at least six stratified MSA sites in Morocco (Taforalt, Rhafas, Ifri n'Ammar, Contrebandiers, El Mnasra, Bizmoune) and Oued Djebbana in Algeria (Bouzouggar *et al.* 2007*b*; d'Errico *et al.* 2009; Dibble *et al.* 2012; Eiwanger, Mikdad, Moser & Nami 2012; El Hajraoui, Debénath & Nespoulet 2012; Nami & Moser 2010; Steele & Álvarez-Fernández 2011; Stoetzel *et al.* 2014; Vanhaeren *et al.* 2006). The marine gastropods selected for beads belong predominantly to the family Nassariidae (*Tritia gibbosula, Nassarius circumcinctus*) but include other marine shell such as *Columbella rustica* (Sehasseh *et al.* 2021). The shells sometimes have additional evidence of red ochre staining (e.g., Bouzouggar *et al.* 2007*b*) and blackening through heating suggesting deliberate efforts to alter their surface appearance and colour (d'Errico *et al.* 2009). In addition, where examined in detail, wear traces inside the perforations indicate that they were sometimes strung as beads (Bouzouggar *et al.* 2007*b*). Most of the sites in which these shells occur cover an age range of ~82-115 ka, broadly within MIS 5 (for a recent review, see Boisard & Ben Arous 2024). The one exception so far is Bizmoune where shell ornaments can be dated to ~145 ka (Sehasseh *et al.* 2021). In sum, the shell ornaments in NW Africa include those demonstrably older than examples in the South African MSA (d'Errico, Henshilwood, Vanhaeren & Van Niekerk 2005; Henshilwood, d'Errico & Watts 2009; Henshilwood *et al.* 2018) and are probably as early if not earlier than specimens from the Levantine Middle Palaeolithic (Vanhaeren *et al.* 2006).

Some of the earliest examples of a sophisticated bone technology can also be attributed to the NW African MSA. Bone tools have been recorded at Contrebandiers Cave in layers believed to date to ~120 ka (Hallett *et al.* 2021), and possibly of similar age at Grotte Zouhra (now known as El Harhoura 1) by Debénath (1994). Modified examples of organic materials were already recognized by Ruhlmann (1951) who noted two worked ivory objects in Aterian contexts from Dar es Soltan 1, while spatula-like bone objects, points and retouchers were identified in El Mnasra (Campmas 2012; El Hajraoui 1994; El Hajraoui & Debénath 2012). However, many of these studies lacked sufficient descriptive or contextual detail and it is only relatively recently that scientific analysis has shown that a flat bone knife from Dar es Soltan 1 has morphological similarities with the spatula-like objects from El Mnasra (Bouzouggar *et al.* 2018). The Dar es Soltan 1 find can be securely dated to ~90 ka, confirming that this technology was present in the last Interglacial.

The cumulative appearance in MIS 5 of bone tools, marine shell beads and the regular use of pigments is known archaeologically from a dense cluster of MSA sites in the Témara-Rabat region (Dibble *et al.* 2012; El Hajraoui *et al.* 2012; Morala, El Amrani, Hassani & Debénath 2012; Nespoulet *et al.* 2008). The caves all lie close to the present

Atlantic shoreline and within proximity of the MIS 5e raised beach (Rhodes, Singarayer, Raynal, Westaway & Sbihi-Alaoui 2006). This landscape setting has been used to argue that MSA humans in this part of NW Africa had developed a broad spectrum economy, with marine resources adding a significant component to a varied diet of large terrestrial ungulates, tortoises, and edible plants (Campmas 2017; Campmas *et al.* 2015; 2016; 2017; Campmas, Michel, Costamagno, Nespoulet & El Hajraoui 2017). Though perhaps not on the same scale as the shell middens of South African MSA sites (Marean 2014), there is nevertheless plentiful evidence for the collection and consumption of marine molluscs such as Patellidae, Mytilidae, Trochidae, and Muricidae, as well as sea fish potentially trapped in tidal pools (Steele & Álvarez-Fernández 2011; 2012). Sporadic consumption of marine mammals may have occurred too if a modified cetacean tooth from Contrebandiers dating to ~113 ka (Hallett *et al.* 2021) is indicative of such activity. The same may also be said for the single element of a monk seal (*Monachus monachus*) skeleton from a lower layer of Mugharet el Aliya, further along the coast near Tangiers (Steele 2012). The recent discovery of eighty-five footprints of young children, adolescents, and adults discovered on a former hardened beach surface near Larache in Morocco dating to ~90 ka (Sedrati *et al.* 2024) is a further indication that the foreshore was visited regularly.

Despite an undoubted association with coastal locations, it should be pointed out that there are also many MSA sites of contemporary age that lay many kilometres inland. These included sites in north-eastern Morocco with marine shell ornaments such as at Taforalt, Ifri n'Ammar, and Rhafas. It should also be highlighted that although coastal resources were intensively exploited in MIS 5, they were not exclusively restricted to this period. Examples of deliberately gathered marine molluscs have been described from the lowest MSA layers at Benzu Rockshelter dated to ~ 254 ka, whilst shells and numerous fish remains were recovered in a level of the same site dated to ~ 168 ka (Ramos *et al.* 2011; Ramos-Munoz *et al.* 2016). Indeed, Campmas herself also made the point that the Interglacial occupation of coastal sites was characterized by a low density of archaeological and palaeontological remains, suggesting events of only limited duration. She believed that this accorded well with a model of high mobility practised by groups living in the coastal zone (Campmas *et al.* 2016). The higher level (earlier) inland fossil beaches along the west coast of Morocco may repay survey for further evidence of coastal adaptations in the MSA.

Evidence of behavioural changes in the LSA

The onset of the LSA in the Maghreb soon after 25 ka cal BP is typified by the appearance of a distinctive bladelet lithic technology. This change in toolkit may have been due to the arrival of new peoples and/or to the spread of innovative ideas on weaponry, for example, the introduction of bow hunting perhaps using composite arrowheads, but otherwise there seems to have been little immediate change in the overall patterns of food procurement and related economic and subsistence behaviour. Indications from Taforalt and a number of other early Iberomaurusian sites suggest that the predated faunas continued to be dominated by medium-size herbivores such as antelope and Barbary sheep (Poti *et al.* 2019; Saxon, Close, Cluzel, Morse & Shackelton 1974), and there seems to have been a persistent use of caves for occupations of short duration (Barton *et al.* 2019). Lacking from this picture, however, are sites in other locations, such as open-air coastal or riparian settings, which might yield additional clues about developments in the early LSA.

In contrast to the beginning of the LSA, major changes in subsistence and other distinctive behavioural patterns can be identified later in this period. Amongst the most striking seems to have been a gradual broadening of the human diet coupled with evidence of greater sedentism and a marked intensification in the use of caves and rockshelters. This is a pattern repeated at many LSA cave sites across the Maghreb (Campmas *et al.* 2016; Klasen, Kehl, Mikdad, Brückner & Weniger 2018; Nami & Moser 2010, Poti *et al.* 2019) where signs of denser occupation are marked by thick midden deposits known as '*escargotières*' (Camps 1974; Lubell 2004) that contain vast quantities of burnt snail shells. A case in point is the site of Taforalt where there is a sudden switch in the depositional sequence, at about 15 ka cal BP, from gradually accumulating silts and sands in the early LSA to rapidly forming anthropogenic deposits rich in wood ash, charcoal, and other charred plant remains, as well as calcined lithic artefacts and burnt limestone, burnt land snail shells, and bone debris (Barton *et al.* 2007). According to conservative estimates, up to 60 million shells of mainly edible molluscan species were present in the rapidly accumulated ashy Grey Series (GS) deposits as opposed to the underlying sandy-silty Yellow Series (YS) at Taforalt. This was accompanied by a more than fifty-fold increase in charcoals passing from the YS into the GS sediments (Barton *et al.* 2019). Apart from indicating intense and persistent site use, such deposits also provide information on the rise in contribution in the diet of seasonally available plant foods. At least twenty-two edible taxa have so far been identified at Taforalt, dominated by foods rich in carbohydrates and proteins such as nuts, fruit, and seeds including sweet acorns (Mediterranean *Quercus ilex*) and pine nuts (*Pinus pinaster*) (Humphrey *et al.* 2014). Confirmation of the importance of these foods is indicated by an increase in the presence of grindstones suitable for preparing acorns and nuts, as well as 'cooking stones', possibly used in charring and cracking open pinecones (Barton *et al.* 2019). In addition, the high prevalence of dental caries in LSA human burials from the back of the cave has been linked with the increased consumption of starchy foods like acorns (Humphrey *et al.* 2014) while further evidence is provided by new isotopic studies on human teeth (Moubtahij *et al.* 2024).

Another contributory factor in these changes may have been the capacity to store foods for later consumption. It is interesting in this respect that the GS deposits at Taforalt contained high volumes of alfa/esparto grass (*Stipa tenacissima*) in the form of phytoliths and charred plant remains. The latter were preserved mainly in the form of burnt rhizomes (roots) which indicate that they were likely harvested by pulling up by the roots (instead of cutting). The minute size of alfa seeds suggests that, rather than food, the stems may have been preferentially collected as materials for matting and basketry containers (Humphrey *et al.* 2014; Morales 2018; Ziani *et al.* 2018). The presence of bone tools in GS deposits identified from their morphology and trace wear patterns as basketry-weaving implements may be significant in this respect (Desmond 2022).

If sedentism can be defined as 'the occupation of central places or base camps through a significant portion of the seasonal cycle' (Zeder 2012: 253), then there is strong evidence for this practice in the LSA at sites like Taforalt. Apart from the advantages offered by basketry for efficient food collecting and storage, various other lines of evidence support a sustained presence that would also be consistent with this model. In terms of seasonality data, information from growth and age patterns indicates that Barbary sheep were hunted from April until October and possibly into the winter months (Barton *et al.* 2019), while other foodstuffs including fruits, nuts, legumes, and wild cereals could be harvested from the spring until as late as November. At these and other times of the year the diet may have been supplemented by roots and tubers and possibly also freshwater fish like barbel from the nearby Zegzel river (for a fuller discussion, see Barton *et al.* 2019: 531-2). A further indicator of sustained, possibly year-round, occupation comes from the exceptionally thick accumulations of the GS deposits with thousands of artefacts including low transportable 'site furniture' such as grindstones, indicating repeated and intensive occupation. Another relevant criterion may have been in the appearance of communal burial areas in caves, first recorded at Taforalt from about 15 ka cal BP (Humphrey, Bello, Turner, Bouzouggar & Barton 2012; Humphrey *et al.* 2019). These and other similar examples described in an earlier section imply that caves became important ancestral burial places in the LSA, where people would have established important ties and not only lived there but may have aggregated for special occasions, including funerary celebration. Despite an absence in excavations of other tangible markers of reduced mobility such as permanent hut structures, certain parallels may be drawn with other broadly contemporary hunter-gatherer societies that relied on storable plant foods such as the Natufian in the Levant (Asouti & Fuller 2012; Boyd 2006; Maher, Richter & Stock 2012).

Although explanations for the behavioural changes at ~15 ka cal BP remain open to speculation, it is virtually certain that they did not take place against a background of deteriorating environmental conditions or resulting resource scarcity. For example, there is no evidence yet at Taforalt or elsewhere in the Maghreb (Merzoug 2017) for a noticeable reduction in Barbary sheep numbers or a shift towards the hunting of alternative prey. There were also, so far as one can see, no obvious changes in butchery practices that could be interpreted as evidence for extra pressure on such resources, for example intensive processing of adult Barbary sheep bones for marrow and grease production. Thus, no direct comparisons can be made with developments in the Natufian where diminishing resources of medium and large ungulates have been linked to dietary broadening (for recent discussion, see Yeshurun, Bar-Oz & Weinstein-Evron 2014). Equally, other theories concerning resource intensification due to environmental constraints (Binford 1999) would also appear to be less justified. Instead, a strong counter-argument may be advanced in NW Africa for a major improvement in climatic and environmental conditions from around 15 ka cal BP, with evidence for a rise in humidity possibly linked to the very early stages of the African Humid Period (DeMenocal *et al.* 2000; Shanahan *et al.* 2015). Such conditions make it very unlikely that broad spectrum dietary diversification in NW Africa occurred in the context of resource shortages, as has been proposed in other contexts (E.A. Smith 1983). An alternative scenario then would be that climatic amelioration led to increases in the variety and abundance of certain foods, and this in turn gave rise to greater opportunities to diversify the diet. It may also be that such changes were accelerated by technological innovations, for example in basketry-making, which facilitated the gathering of smaller packages of food (snails, nuts, acorns) and allowed longer-term storage, especially of calorifically rich pine nuts and acorns (Barton *et al.* 2019: chap. 18).

Conclusion

Research advances over the last twenty-five years have significantly improved our understanding of NW African prehistory. In particular, this has led to a reframing of debates on the evolutionary development and continuity of successive human populations in this region in the MSA. While evidence suggests that *H. sapiens* emerged at least as early here as in other parts of Africa, making it potentially a core area for early human origins, the pattern of human occupation was likely more complex than a simple continuous presence throughout the region. For instance, it remains uncertain whether humans persisted everywhere in NW Africa throughout full glacial/interglacial cycles. And although a model can be put forward favouring habitation of refugia characterized by raised coastal moisture and local temperature conditions, it is still unclear if population continuity was geographically widespread or not. One strong argument for long-term regional population continuity is the remarkable persistence in cultural practices such as pedunculate hafting methods and selection of *Tritia* and *Columella* for use as ornaments. The use of such ornaments may have occurred at Bizmoune Cave as early as 140 ka in MIS 6, and continued at other sites in Morocco until the later sub-stages of MIS 5. At Taforalt, despite fluctuations in the Late Pleistocene climate, there is also copious evidence for MSA humans throughout much of the last interglacial and succeeding cooler-drier phases. Based on the early appearance of indicators of cognitive complexity, as well as the distinctive and long-lived traditions of the Aterian MSA, we would conclude that the Maghreb was on its own cultural evolutionary trajectory and, in terms of external influences, that it was as likely to have influenced other regions of Africa as not.

Finally, a subject of lingering debate concerns the question of continuity between the MSA and LSA Iberomaurusian. Here genetic evidence, based on human bone samples from Taforalt, has suggested that new populations moved into NW Africa around 24 ka BP but opinion is divided on whether these reflected a complete replacement or genetic admixture between MSA and incoming groups. Certainly, archaeological features in the techno-typology of artefacts suggest a sharp break from flake-based to bladelet-based flint industries in the LSA beginning around 23-25 ka cal BP. However, the situation is complicated by the identification of an Intermediate industry at Taforalt which lies beneath the LSA levels and appears to fill a time gap with the indigenous MSA. Unfortunately, this industry has not yet produced any associated human remains. A subject of related interest encompasses the changes in land-use behaviours in the LSA. According to research conducted over the last twenty-five years, the greatest transformation seems to have occurred from around 15 ka cal BP indicated by a marked diversification in the diet accompanied by signs of long duration visits and repeated occupation of sites. Although the underlying drivers of these behavioural adaptations are yet to be fully clarified we would recognize significant links between climatic/environmental change and the overall reduction in group mobility coupled with the development of greater nutritional flexibility in allowing a fuller diversity of local food resources to be exploited and stored across different seasons. In becoming less mobile, at the same time groups developed greater nutritional flexibility, which in turn enabled them, through technological advances, to make more effective use of locally available food resources.

Acknowledgements

The authors would like to thank the Institut National des Sciences de l'Archéologie and Protars P32/09-CNRST (Morocco) for sponsoring the Morocco Caves Project. Other funding support has come from NERC (EFCHED NER/T/S/2002/00700 and RESET NE/E015670/1), the Leverhulme Trust (F/08 735/F and RPG-2022-049), the British Academy as well as grants from University of Oxford, the Natural History Museum and the Calleva Foundation. We would also like to thank the editors, three anonymous reviewers as well as Jacob Morales, Steve Kuhn, and Simon Collcutt for their helpful comments.

NOTE

[1] Subsequent application of OSL dating has revised the age of the early Aterian MSA at Rhafas to ~109 ka with older sedimentary units containing MSA material dating to ~135 ka (Doerschner *et al.* 2016).

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Réévaluer la préhistoire du Maroc, du *Middle Stone Age* au *Later Stone Age*

Résumé

La perception de la préhistoire lointaine de l'Afrique du Nord-Ouest a radicalement changé ces 25 dernières années, grâce à de nouveaux projets de terrain et à l'intérêt scientifique accru porté à la région. Une grande partie de ces travaux ont été menés au Maroc, pays déjà connu pour l'extrême richesse des archives fossiles et archéologiques présentes dans ses grottes et ses abris sous roche. Les auteurs résument ici quelques-unes des découvertes cruciales concernant les périodes du *Middle Stone Age* (MSA) et du *Later Stone Age* (LSA). Ils décrivent la façon dont la compréhension de la nature et de la chronologie de l'occupation humaine de cette région s'est transformée, de même que les idées concernant l'évolution des comportements humains. Les grands changements comportementaux attribués à *Homo sapiens* au MSA (entre 300 000 et 29 000 ans avant notre ère) semblent s'être produits surtout pendant des périodes humides, mais pas exclusivement. L'article examine également l'articulation entre MSA et LSA. On pensait jusqu'alors que ces deux unités culturelles étaient séparées par un large hiatus (de 29 000 à 23 000 ans avant notre ère), mais les traces retrouvées dans la Grotte des Pigeons (Taforalt) montrent que la charnière sans occupation est plus étroite. Enfin, l'article examine les changements de comportements d'utilisation des terres au cours du LSA, il y a 15 000 ans environ, qui ont conduit à une sédentarisation accrue et à une intensification des cultures vivrières.

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