Early Maritime Cultures in East Africa and the Western Indian Ocean

Papers from a conference held at the University of Wisconsin-Madison (African Studies Program) 23-24 October 2015, with additional contributions

Edited by

Akshay Sarathi

Access Archaeology

Archaeopress Access Archaeology

Archaeopress Publishing Ltd
Summertown Pavilion
18-24 Middle Way
Summertown
Oxford OX2 7LG

www.archaeopress.com

ISBN 978 1 78491 712 8
ISBN 978 1 78491 713 5 (e-Pdf)

This book is available direct from Archaeopress or from our website www.archaeopress.com

Contents

List of Illustrations

Prehistoric Settlements on the Red Sea Coast of Eritrea

Amanuel Beyin and Daniella E. Bar-Yosef Mayer

Interdisciplinary Approaches to Stratifying the Peopling of Madagascar

Roger Blench

From the Red Sea to the Indian Ocean and Beyond

Sing C. Chew

A tradition of large logboats on the Save River, south-eastern Zimbabwe?

Rosanne Hawarden

Ancient Connections between China and East Africa

Chapurukha Kusimba

Shellfish Exploitation at Kuumbi Cave, Zanzibar (c. 11kya – 20th cen. CE): A Preliminary Study

Akshay Sarathi

Artistic Dynamics Across the Seas

Vera-Simone Schulz

Prehistoric Settlements on the Red Sea Coast of Eritrea
Implications for assessing early human dispersals across the Red Sea basin

Amanuel Beyin

Department of Anthropology
University of Louisville, Kentucky, USA
E-mail: amanuel.beyin@louisville.edu

Daniella E. Bar-Yosef Mayer

The Steinhardt Museum of Natural History
Tel Aviv University, Tel Aviv, Israel
E-mail: baryosef@tauex.tau.ac.il

Abstract

This chapter focuses on a region that encompasses the Gulf of Zula and Buri Peninsula along the Red Sea coast of Eritrea. Middle and Later Stone Age (LSA) sites uncovered from the area shed light on the exploitation of marine and coastal resources that sustained human populations during these periods. Two sites with Middle Stone Age (MSA) remains, namely Abdur - located on an elevated reef and dated to 125kya, and Asfet containing diagnostic stone artifacts that existed roughly 200 – 50kya demonstrate that the coast was visited, and may have served as stepping-stones of Ancient Modern humans during their spread from Africa into Asia, whether northward into the Levant or across the Red Sea into Arabia. In addition, three early to mid-Holocene (LSA) shell middens documented from the region reflect the exploitation of different coastal environments. Misse East and Gelalo Northwest were both dated to the eighth millennium BP. The presence of *Atactodea striata* (a bivalve that dwells in tidal flats near sandy beaches) and *Terebralia palustris* (a gastropod living in mangrove swamps) at the sites signifies that these molluskan organisms likely served as a supplementary food source. Gelalo Northwest also included a relatively large number of shell beads. Asfet Unit F, dated to the sixth millennium BP, was also dominated by *Terebralia palustris*. This coastal settlement is probably the result of adverse climatic conditions that prevailed in the hinterland during that period.

Introduction

In recent decades, there has been a growing debate about the timing and geographic routes along which early humans (archaic and modern) dispersed out of Africa (Beyin, 2011; Kopp et al., 2014; Groucutt et al., 2015; Reyes-Centeno et al., 2015). The time and locations of early human dispersals remain unresolved due to sparse archaeological and fossil evidence from the geographic regions essential for early human expansions out of Africa (for example, Horn of Africa, the Nile Valley and Arabia). Most of the evidence that has so far been recovered from these regions suffers from either poor chronology or dearth of fossil traces in association with the archaeological assemblages. Due to its pivotal location at the nexus of northeast Africa, the Arabian Peninsula and the Levantine landmass, the Red Sea basin is emerging as a vital region for assessing the temporal and geographic contexts of early human dispersals out of

Africa (Stringer, 2000; Walter et al., 2000; Bailey, 2009; Beyin, 2013). While our knowledge of early human settlement history along the Red Sea basin remains largely sparse due to insufficient fieldwork in the past, the few coastal sites known from the western peripheries of the basin (Walter et al., 2000; Beyin and Shea, 2007; Beyin, 2013) suggest that the region hosted multiple hominin occupation episodes from which at least some populations may have dispersed into Arabia and Southwest Asia.

In this paper, we discuss the role that the Red Sea basin may have played as a potential refugia and dispersal corridor for early humans spreading from the hinterlands of East Africa into the adjacent regions, such as Southwest Asia and the Arabian Peninsula. The discussion is supported by archaeological evidence accumulated from the Red Sea coast of Eritrea in the past 20 years (Walter et al., 2000; Beyin and Shea, 2007; Beyin, 2010). The considered sites, namely Abdur, Asfet, Gelalo and Misse, range in age from Middle to Later Stone Age (dating roughly 130–5kya), and are located along the central part of the Eritrea coast that encompasses the Buri Peninsula and Gulf of Zula (Fig. 1). This region is located at the nexus of three broad ecological zones: highland escarpments to the west, the Danakil depression to the south and the ecotonal plains adjoining the coastline. The working hypothesis is that, the riverine tributaries of the Ethiopian rift and the Danakil depression, which was once invaded by oceanic water from the Red Sea (Bonatti et al. 1971), may have once served as potential conduits for early human niche expansion out of the interior landscapes of eastern Africa. Prehistoric foragers successfully adapted to the Eritrean coastal plains may have subsequently served as source populations for dispersals into the Arabian Peninsula and Southwest Asia.

Theoretical Consideration

In a world that is more than 75% covered by water, coastal environments represent an important human landscape at the present times, and must have been vital settings for prehistoric human survival and interaction. Carl O. Sauer (1962) once referred to the seashore as ‘primitive home of man’ and described the role of aquatic settings in the following words: ‘Our kind had its origins and earliest home in an interior land. However, the discovery of the sea, whenever it happened afforded a living beyond that.’ Currently, there is growing archaeological evidence showing that coastal habitats played an important role in the course of human evolution as stable refugia and corridors of biogeographic expansion (Sauer, 1962; Erlandson and Fitzpatrick, 2006; Bailey et al., 2007; Marean et al., 2007; Cohen et al., 2012). Studies have shown that aquatic foods are rich in substances that may have had a strong impact on hominin physiology, gene expression and brain development (Erlandson, 2001; Joordens et al., 2009; Parkington, 2010). Moreover, the colonization of Southeast Asia, Australia and the Americas are some of the major events in human prehistory believed to have been accomplished by coastal routes and maritime crossings (e.g., Balme 2013, Erlandson et al. 2015). Dispersal along coastal and esturine margins may have been successfully executed many times by prehistoric humans because such landscapes provide rich and diverse food sources for humans, and once dispersing foragers develop effective adaptive behaviors to a coastal habitat, the invention of new strategies is no longer necessary as they move along the coast.

Whether or not early humans exploited coastal settings habitually, and whether certain climatic episodes enabled human exploitation of coastal resources, is unclear. The earliest well-dated evidence for coastal adaptation by early modern humans comes from the site of Pinnacle Point (South Africa), dated to ~160kya, a glacial episode (Marean et al., 2007). More than a decade ago, Faure and colleagues (2002) proposed what is dubbed as *Coastal Oasis Model* (COM), according to which the decline in sea levels during glacial events is thought to have created fresh-water springs along the newly exposed coastal gradients (Figure 1B). Subsequently, such areas of fresh-springs (oases) would serve as viable refugia for humans and animals at a time when large parts of the terrestrial habitats experienced arid conditions. This hypothesis is based on the fact that fresh water is continuously discharged from the continental aquifers into ocean and sea basins. These fresh-water springs often remain submerged during interglacial times, but during glacial times, the falling sea level would expose several of them and may in fact intensify their flow as a result of the removal of hydrostatic pressure from the shelf. While the model needs to be further corroborated by archaeological evidence (which unfortunately is often hard to uncover due to post-glacial submergence of Pleistocene coastal settlements; (e.g., Bailey et al. 2007), it provides a feasible baseline for developing coastal Paleolithic research in areas where human coastal occupations were likely to have persisted.

Historically, South Africa has produced compelling Pleistocene coastal archaeological evidence (Volman, 1978; Singer and Wymer, 1982; Marean et al., 2007), on the basis of which Parkington (2010) and Marean (2011) have put forth two alternative models regarding how the consumption of aquatic resources may have contributed to the development of complex human cognition. While Parkington argues in favor of the view that regular consumption of nutrient rich aquatic prey fueled the development of advanced cognition, Marean proposes that the development of advanced cognition preceded (and may have been a prerequisite to) systematic exploitation of aquatic food. Outside of South Africa, the Red Sea basin represents another promising region for investigating long-term patterns of early human coastal adaptation, and how coastal settings may have contributed to successful dispersal of our lineage out of Africa. Its location adjacent to famous hominin fossil localities in the Afar and Ethiopian rift basins lend well to its potential importance as a viable destination for Pleistocene hominins that underwent dispersal from the interior landscapes of Eastern Africa as part of niche expansion or ecologically induced displacement. Either way, early humans who reached the coast would have exploited the marine resources.

Current dispersal models for early humans out of Africa and the Red Sea basin

Most current models about early human dispersals out of Africa point to two possible geographic routes, namely the Northern Route (NR) and Southern Route (SR). According to the NR, the Nile basin is regarded as the principal corridor through which hominins dispersed from northeastern Africa up to the eastern Mediterranean Levant by crossing the Sinai land bridge (Tchernov, 1992; Van Peer, 1998; Bar-Yosef and Belfer-Cohen, 2001; Derricourt, 2005). In addition to the Nile corridor, some researchers have proposed another northward dispersal route along the central Sahara up to the Maghreb and Mediterranean coast (Osborne et al., 2008). The SR model proposes a direct route of hominin migration from NE Africa into Southern Arabia via the Strait of Bab al Mandab (Kingdon, 1993; Lahr and Foley, 1994; Mithen and Reed, 2002; Macaulay et al., 2005; Field and Lahr, 2006; Mellars, 2006; Chauhan, 2009; Oppenheimer, 2009; Armitage et al., 2011). The main support for this route comes from genetic studies (Ingman and Gyllensten, 2003; Macaulay et al., 2005; Thangaraj K et al., 2006), showing close mitochondrial DNA similarity between East African and some native populations of Southeast Asia. Moreover, recent archaeological reports from the Arabian Peninsula have shown close techno-typological similarities with MSA assemblages from NE Africa, indicating periodic cultural contacts between the two regions (Marks, 2009; Armitage et al., 2011; Rose et al., 2011; Crassard and Hilbert, 2013).

The SR across the Red Sea is further supported by indirect evidence that comes from a recent study concerning hamadryas baboon phylogeographic history (Winney et al., 2004; Fernandes, 2009; Kopp et al., 2014). The hamadryas baboon (*Papio hamadryas hamadryas*) is found exclusively in East Africa and western Arabia, and is the only free-ranging nonhuman primate in the entire Arabia (Kummer, 1995; Winney et al., 2004). Previously, it has been hypothesized that hamadryas baboons colonized Arabia in the Holocene (Kummer, 1995). However, a recent study of mtDNA variation among some Arabian and East African (Eritrean) hamadryas populations shows that these baboons did not colonize Arabia in the recent past nor did they use a northerly route via the Sinai land bridge to enter Arabian Peninsula. The emerging genetic data supports the hypothesis that hamadryas baboons reached Arabia via temporary land bridges formed during glacial maxima along the Strait of Bab al Mandab. The likely time for hamadryas entrance to Arabian Peninsula has been estimated ~130 –12 kya (Kopp et al., 2014). In all likelihood, whatever route used by the hamadryas baboon to cross the Red Sea basin must have been readily accessible to early humans. In other words, if primates could migrate across the Red Sea, there is no conceivable reason for early humans not to use the same route.

Whether the two migration routes were always accessible and preferable for early humans remains unclear. Due to environmental barriers associated with the aridity of the Saharan Desert, the central Saharan and the Nile routes may have been traversable only during wet climatic conditions (Beyin, 2006; Field and Lahr, 2006; Osborne et al., 2008). At times when the Sahara and the Nile corridor posed a risk to human expansion, either the SR across the strait of Bab al Mandab or the western margin of the Red Sea along the Eritrean-Sudanese-Egyptian littoral may have served as alternative routes of biogeographic movements between Africa and Eurasia. Extensive coastal plains could be exposed on the African side of the Red Sea during low sea-level events, particularly around the southern part, close to the Bab al Mandab area (Head, 1987), Figure 1. During such times, the width of the Bab al Mandab could be narrowed to less than 10 km in width, thus becoming shorter to navigate (Flemming et al., 2003). The COM described above provides a plausible scenario for early human adaptation along these vast coastal plains during glacial events. From the coast, some hominin groups could have launched successful dispersals northward into the Levant or eastwards across the Bab al Mandab. Although finding sites directly associated with the COM is not easy as most of the sites may have been submerged, thus making it difficult to evaluate the COM archaeologically, it should be possible to find later Paleolithic sites along the inland terrains near the active oases zones formed by hominin populations that retreated to the near coastal strand plains during the subsequent interglacials (Beyin, 2013).

Prehistoric Settlements on the Eritrean Red Sea Coast

Background

The geographic position of Eritrea adjacent to the major proposed dispersal routes for early humans, and possessing a long stretch of coastal landscape (more than 1000km) along the western margin of the Red Sea makes it an ideal place to search for evidence of prehistoric coastal habitations. The Stone Age record of Eritrea remained poorly known for much of its history due to protracted political instability in the region. Research opportunities were opened soon after the country declared its independence in 1991 (Abbate et al., 1998; Curtis and Libsekal, 1999; Pedersen, 2000; Schmidt et al., 2008). The first evidence for early human presence along the Red Sea coast of Eritrea has come from the site of Abdur (on the eastern margin of the Gulf of Zula), where lithic artifacts with MSA affinity and handaxes were found within an emerged coral reef terrace dating to ~125kya (Walter et al. 2000), Figures 2-3. Subsequent to the Abdur discovery, the first archaeological reconnaissance on the Eritrean coast took place in 2005 (Beyin and Shea, 2007), followed by two seasons of systematic survey and excavation in 2006. The survey covered approximately 400 sq km area in the Buri Peninsula and along the coastal plains of the Gulf of Zula (Figure 2). The Buri Peninsula is a thumb shaped landmass that protrudes northward into the Red Sea, and the Gulf of Zula, a narrow bay (~40km north-south and 6-14 km wide east-west) is situated between the Buri Peninsula and the Foro Plains to the west.

Survey and excavation of prehistoric sites on the Eritrean coast hoped to address the following specific questions: i) under what climatic conditions have the Buri and Zula coastal plains become attractive for Late Pleistocene and Holocene humans? ii) what economic and technological developments were associated with human adaptation of the Buri Peninsula and Gulf of Zula? iii) how were prehistoric

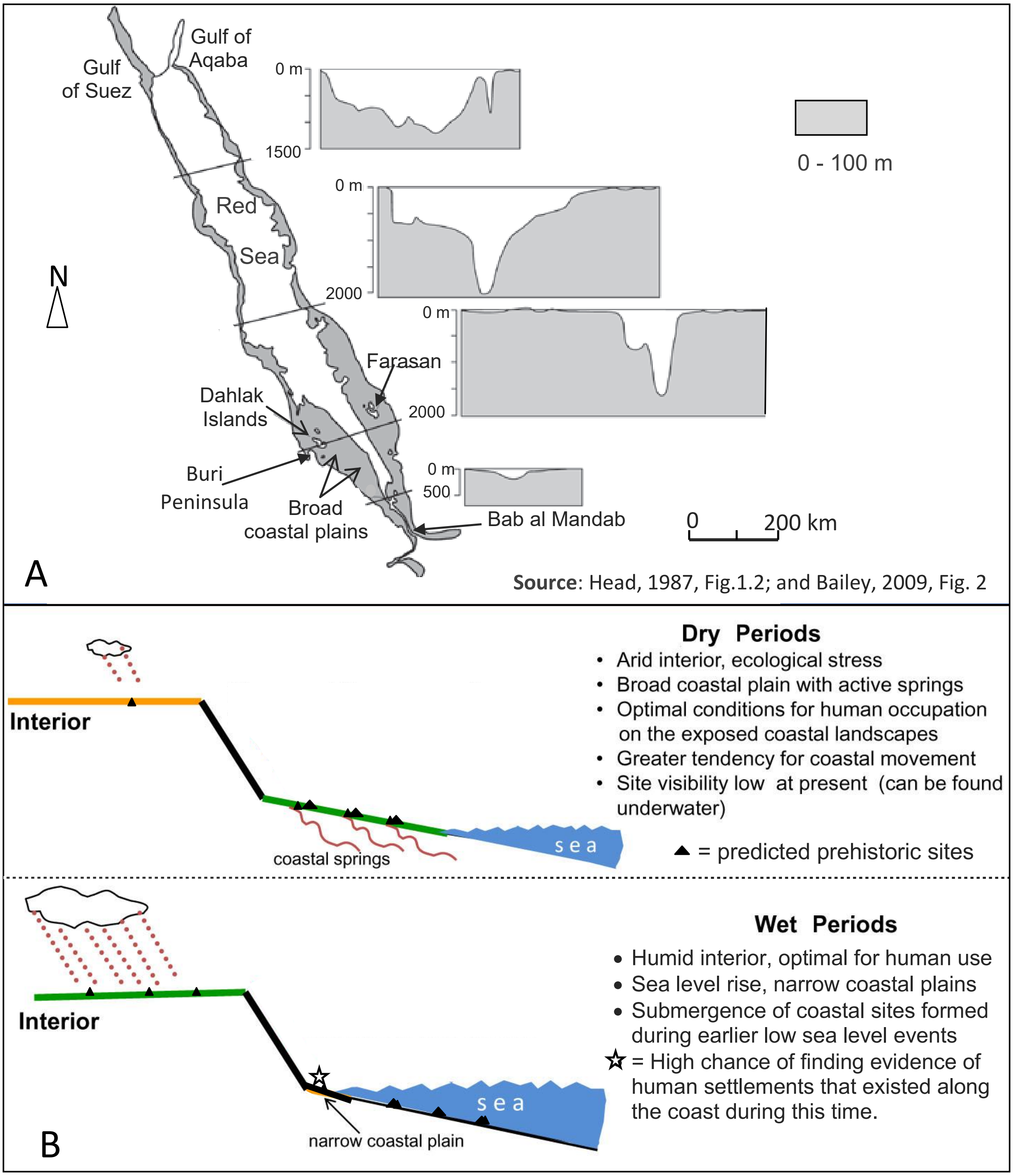


Figure 1. A: bathymetric map of the Red Sea showing coastal plains formed during an Ice-Age, B: a hypothetical model of human settlement dynamics along the Eritrean Red Sea Coast.

human settlements located with respect to the shorelines? , and iv) how does human adaptation along the Eritrean coast compare with other regions? The survey documented more than a dozen sites representing MSA, LSA and isolated Acheulian artifacts suggesting at least intermittent prehistoric human presence in the region. Sites were recorded from near coastal and inland landscapes. Three sites, namely Asfet, Gelalo NW and Misse East (Figure 2) were selected for excavation.

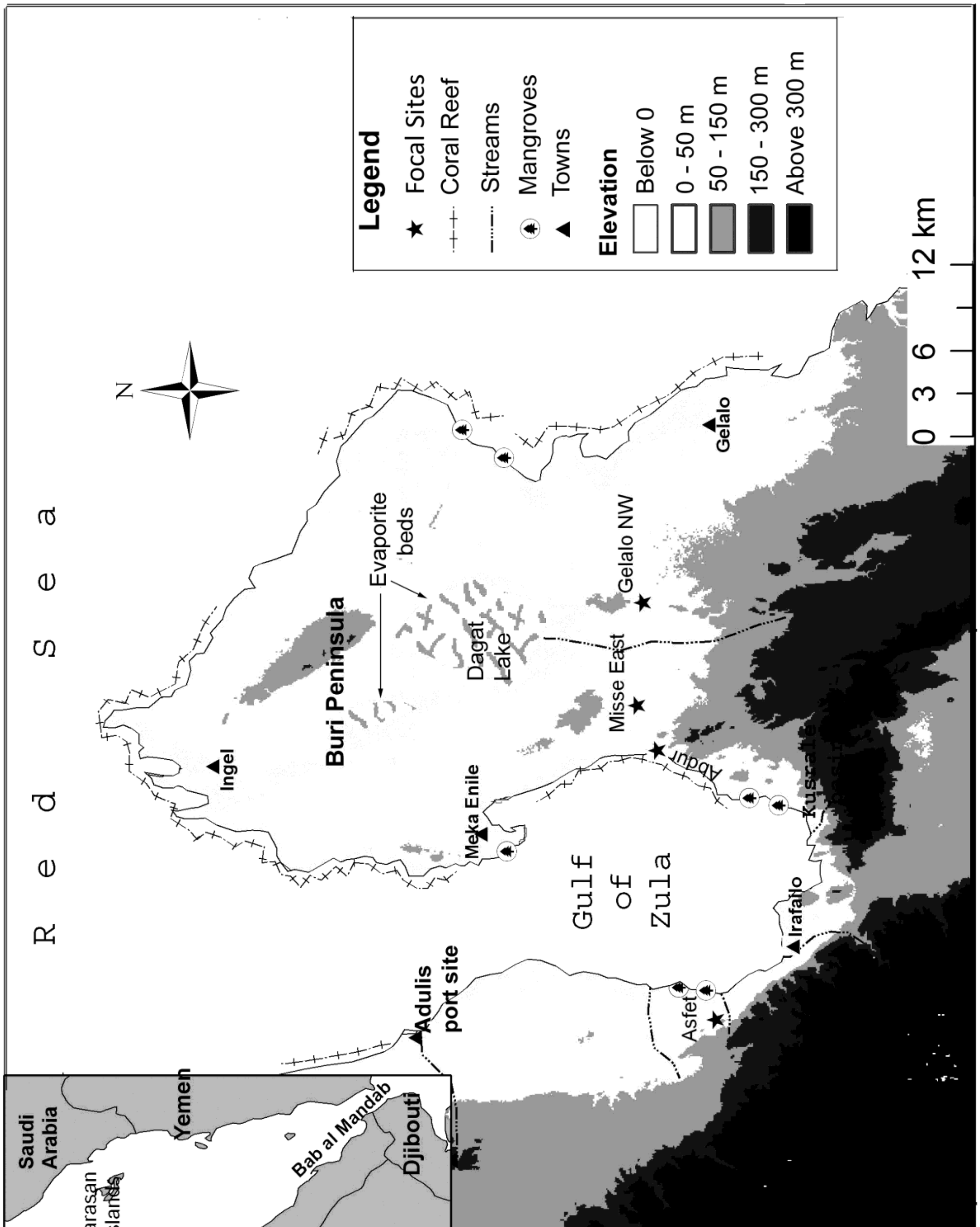


Figure 2. Map showing the location of the study area and sites discussed in this paper.

The focal area (the Buri Peninsula and Gulf of Zula plains) occupies an important position at the confluence of three broad ecological zones: the highland escarpments to the west, the Danakil depression to the south and coastal plains adjacent to the seashore. At present, it is the driest part of Eritrea with growing period ranging below 75 days and precipitation less than 200 mm (Government of Eritrea, 1999). Plant cover consists of sparsely distributed halophytic A*cacia* communities, and low shrubs and grass (Yohannes, 2003). The geological history of the region had been greatly affected by the Tertiary and Quaternary tectonics associated with the formation of the East African Rift System (Barberi and Varet, 1977; Ghebretensae, 2002). As such, hot springs and volcanic inselbergs are common in the surrounding landscape. The northern, eastern and western peripheries of the Buri Peninsula feature meandering limestone cliffs, shallow beaches, promontories and sheltered bays. The shallow beaches and inlets may have presented prehistoric humans ideal fishing and shellfish harvesting grounds. The water salinity and tidal pattern of the Gulf of Zula is under the influence of monsoonal winds that blow from the Indian Ocean, and a few seasonal rivers that flow from the adjacent escarpments.

The archaeological data discussed in the paper comes from two Middle Stone Age (MSA) sites, namely Abdur and Asfet, and three LSA sites (Asfet Unit F, Gelalo, and Misse). What follows below is a brief description of the focal sites with an emphasis on their cultural and chronological contexts. Dates pertaining to the sites are shown in Figure 4.

Abdur

Located on the eastern coast of the Gulf of Zula, Abdur is the find-spot of stone tools and marine invertebrates in close association, embedded in a reef limestone terrace (Figure 3), dated to ~125kya BP (Walter et al., 2000; Buffler et al., 2010), Figure 4. The Abdur finding came to light in late 1990's during a geological survey by an international team of researchers (Walter et al., 2000). The reef terrace is ~ +11m thick, and belongs to a marine transgression event that covered a large part of the Buri-Zula plains at the onset of the Last Interglacial (MIS-[1]5e). It overlies a volcanic layer referred to as the Abdur Volcanic complex dated to 2.12–0.17Ma (Buffler et al., 2010). Two kinds of occupation scenarios have been hypothesized by the Abdur team; one consisting of bifaces and cores of the Acheulian Industry associated with oyster beds and lag deposits, and the other featuring MSA blades and flakes on obsidian raw material associated with near-shore beach context. Large land mammals and marine invertebrates were found in association with the MSA occupation (Bruggemann et al., 2004). The discovery of bifaces and MSA tools in close geological association at Abdur suggests that the Acheulian and MSA tool making traditions continued to co-exist possibly because they both acquired a new, profitable use for the exploitation of diverse habitats, including the aquatic niche (ibid.). Since the raised Abdur beach terrace represents a relic of high sea level event during the Last Interglacial, the archaeological discovery signifies that hominin (modern humans and their ancestral lineages) habitation there occurred during or at the onset of a wet episode (in this case MIS-5e Interglacial phase).

Abdur represents the only well dated and widely publicized coastal Paleolithic site in the entire Red Sea basin. As such, despite some unsettled issues regarding the context of the archaeological finds, the site provides the oldest evidence of coastal adaptation by African hominins along the Red Sea coast prior to the generally accepted date for Late Pleistocene human dispersals out of Africa (Stringer, 2000; Mellars, 2006). However, it is unclear whether the evidence represents an isolated occurrence or part of a widespread coastal adaptation that existed along the Red Sea basin. Clarifying such a question requires investigating other near-coastal terrains along the Red Sea littoral. Moreover, the lithic technology at the site has not been properly examined hindering cultural comparison with other MSA assemblages.

[1] MIS = Marine Isotope Stage

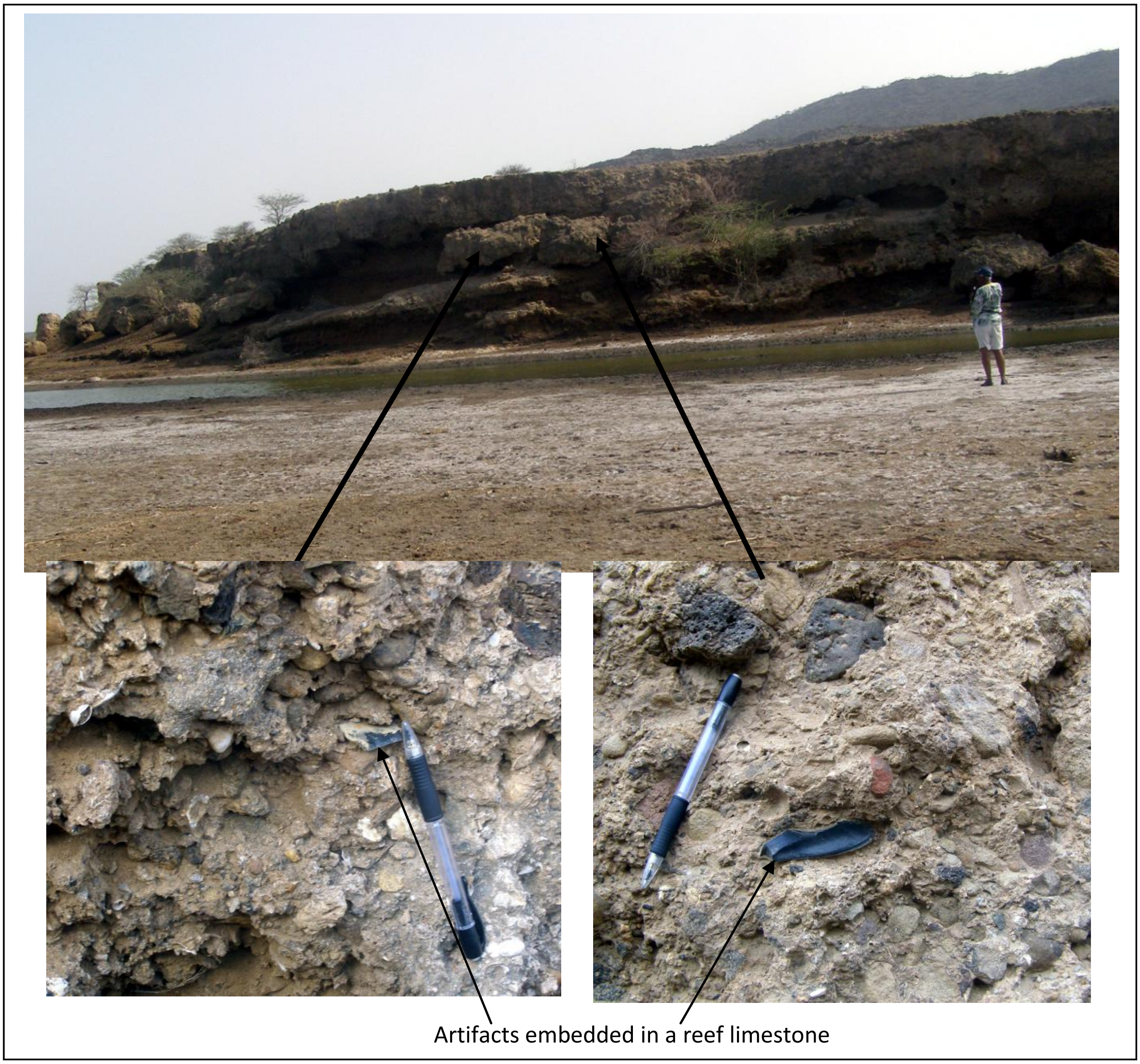


FIGURE 3. NORTHERN SECTION OF THE ABDUR REEF LIMESTONE WHERE OBSIDIAN FLAKES ARE EXPOSED.

The identity of the hominin group that left their trace at Abdur also remains unclear. Given that the modern human lineage was already established prior to the Abdur date as attested by discoveries from the Omo Kibish and Herto in Ethiopia (White et al., 2003; McDougall et al., 2005), it is possible that the inhabitants of Abdur were modern humans. The site fell short of any further archaeological exploration after the initial field expeditions between 1999 and 2001.

Asfet Surface Middle Stone Age

The Asfet study area is located on the southwestern edge of the Gulf of Zula, ~1000m from the present coastline (Figure 5). The landscape encompasses a low-lying sandy basin between two north-south running basalt ridges that taper into a shallow drainage to the north. The western ridge rises higher, offering a good view of the nearby plain. Research at the site involved transect survey, mapping (topographic and surface artifact distribution), artifact collection, and on-site and museum artifact analyses. The site produced two kinds of assemblages, a surface MSA Industry, and an LSA one excavated

Site	Lab ID	Level	Dating Method	Original dates	Calibrated Age€ (BP)
Abdur	-	-	U-Th mass # spectrometry	125 ± 7 kyr (1σ)	-
Asfet Surface	-	-	Diagnostic artifacts	150,000 – 50,000 (estimate)	-
Asfet Unit F	A0794*	1 (-6cm)	AMS	5385 ±15	5571-5662 (2σ)
	GX -32978**	2 (-21cm)	AMS	5350± 40	5475-5672 (2σ)
Gelalo NW	A0797*	C (-14)	AMS	7345 ± 20	7611-7749 (2σ)
	GX-32910**	A (-10)	Conventional	7890 ± 130	7953-8478 (2σ)
	GX-32911**	B (-8)	Conventional	6970 ± 170	6982-7658 (2σ)
	GX-32913**	C (-9)	Conventional	7900 ± 190	7826-8651 (2σ)
Misse East	A0796*	(-6cm)	AMS	7145± 20	7452-7564 (2σ)
	GX-32911**	(-5cm)	Conventional	7330 ± 190	7323-8039 (2σ)

Figure 4. Dates for the focal sites. Note to Lab ID symbols: *= Illinois State Geological Survey (reported as University of California-Irvine in previous publications), **=Geochron Laboratories of Kruger Enterprise, €= Stuiver, *et al*. 2005 (http://calib.qub.ac.uk/calib/); # = Walter et al. 2000; AMS = Accelerator Mass Spectrometry. The radiocarbon dates from Asfet Unit F, Gelalo NW and Misse East are on mollusc shells.

from Unit F. This section deals with the surface assemblage, while the Unit F material will be discussed in the next section.

The surface assemblage is best characterized by stone tools featuring prepared core and blade technologies, the production of points (triangular, perforators, and small bifaces) and various retouched tools, signifying MSA technocomplex (Figure 6). The majority of the tools are made on locally available raw material sources with a primary emphasis on basalt (Figure 7). Good quality rocks, such as obsidian, chert and quartz were utilized, but comprise a small percentage. Two kinds of points are recognized: triangular flakes produced from Levallois cores (without much retouch), and those shaped through peripheral retouches into triangular or sub-triangular points and foliates. The diversity in tool size, shape and core morphology suggests that the Asfet toolmakers employed a broad range of core reduction and tool maintaining strategies. Terrestrial faunal remains were not discovered at Asfet, a situation attributed to a taphonomic bias. The discovery of numerous points, perforators and bifaces, however suggests that hunting and butchering may have constituted a vital part of hominin subsistence at the site.

Although the Asfet site lacks an absolute date, it shares similar diagnostic artifacts with dated MSA assemblages from the Afar and Ethiopian rift basins in the interior in which prepared core products, blades and a variety of points are the dominant components, Figure 8 (Wendorf and Schild, 1974; Clark, 1988; McBrearty and Brooks, 2000; Yellen et al., 2005; Shea, 2008). Assuming such similarities demonstrate cultural and demographic relationships between Asfet and the interior MSA settlements, hominin

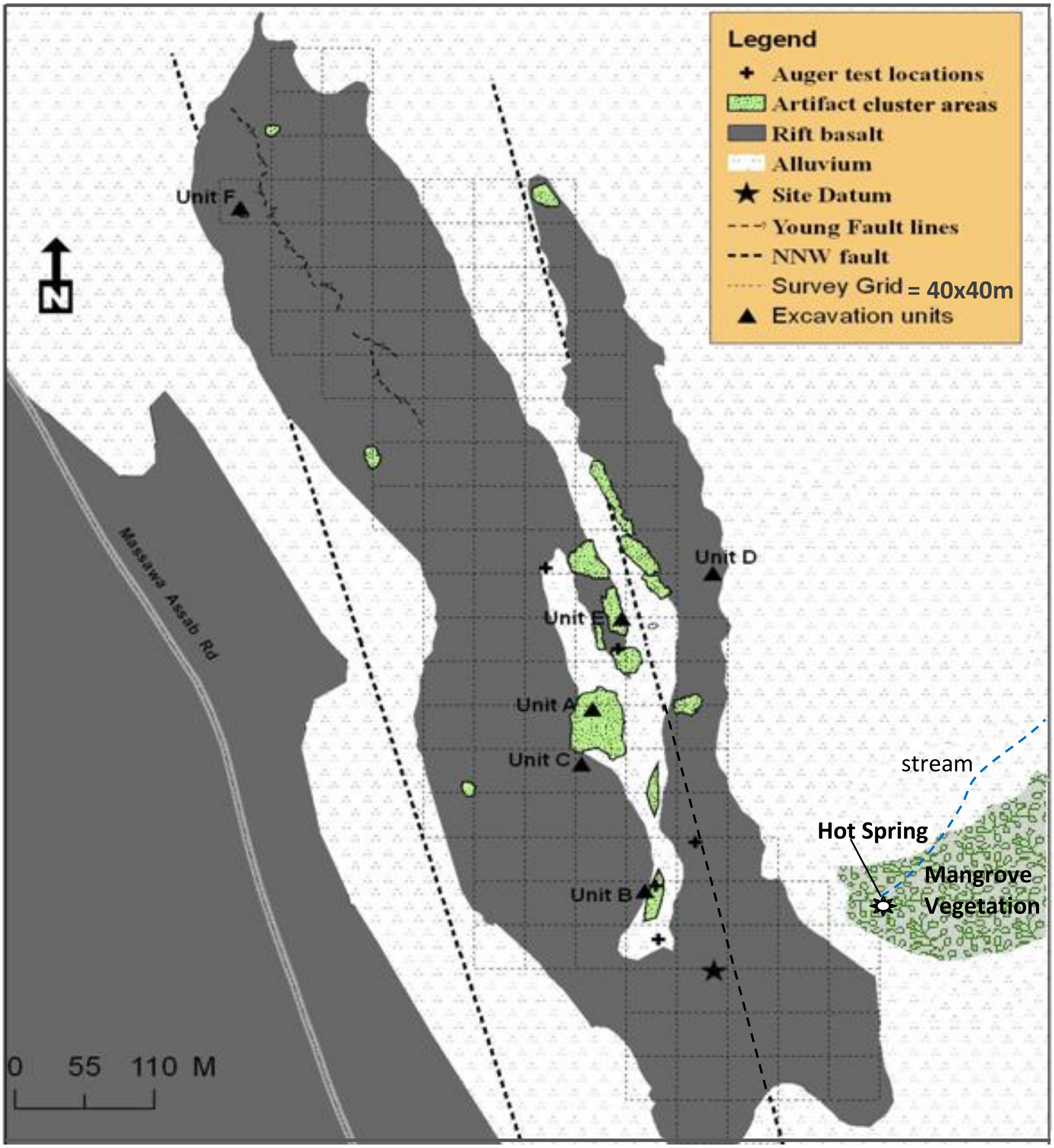


Figure 5. Setting of the Asfet site, locations of test excavations and survey grids used for controlled recording of surface artifact distribution.

occupation of the Asfet site may have occurred in the time range (a conservative estimate) anywhere between 150 and 50kya. The settlement at Asfet might have represented a northern extension of broad riverine adaptations by Late Pleistocene hominins along the Afar and Ethiopian Rift basins. Outside of the Ethiopian and Afar rift basins, there are two other regions, namely the Nile Valley and Arabian Peninsula, with which the Asfet assemblage shares broad technotypological affinity (Van Peer, 1998; Olszewski et al., 2005; Olszewski et al., 2010; Rose et al., 2011; Crassard and Hilbert, 2013). Of particular significance to this discussion are MSA entities commonly known as foliate points and Nubian Levallois cores, both of which were found at Asfet (Figures 6&8). Both of these entities are diagnostic elements of

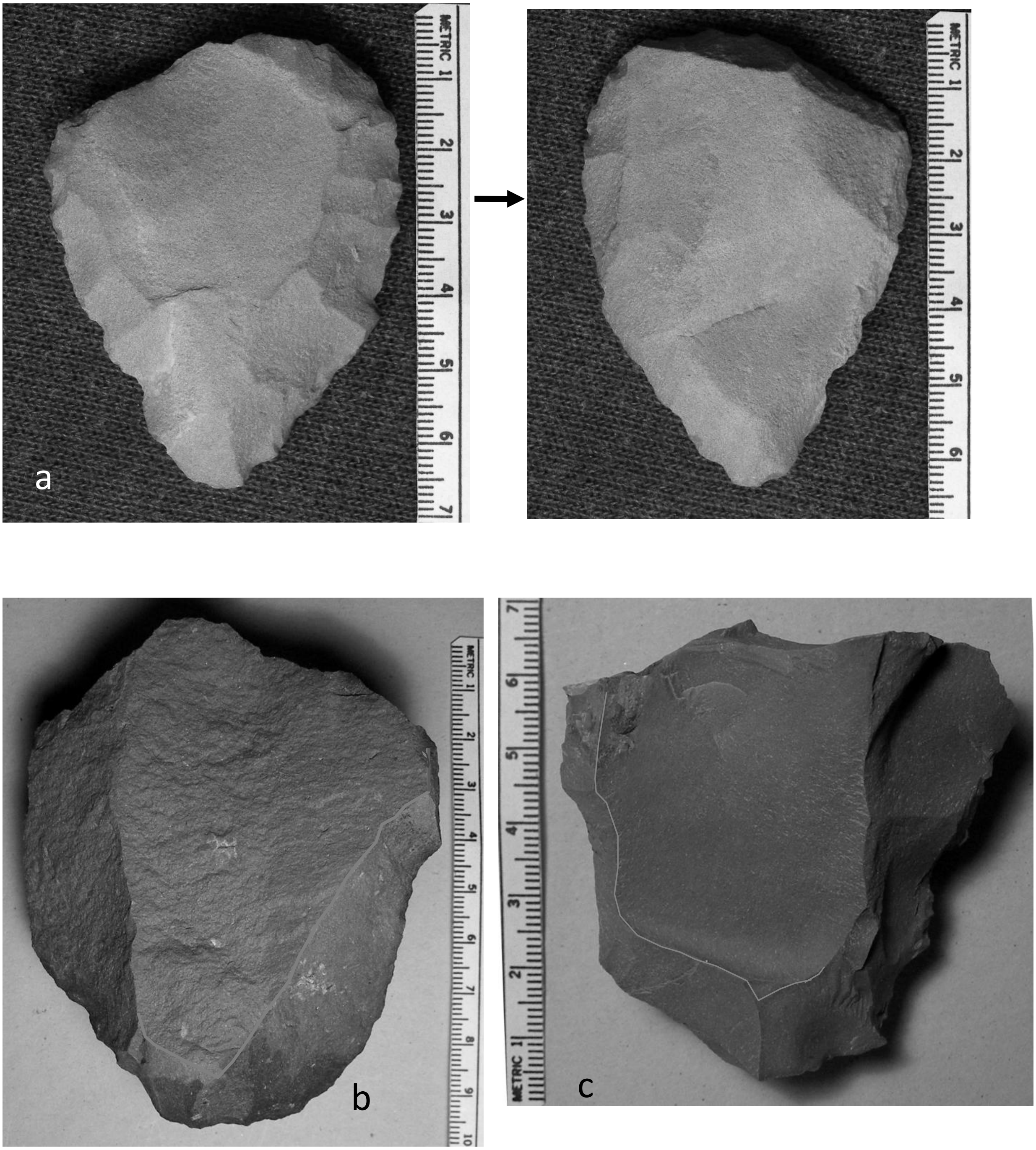


Figure 6. Cores from Asfet: Nubian Type II Levallois (a), preferential Nubian Type I Levallois (b), preferential-centripetal (c).

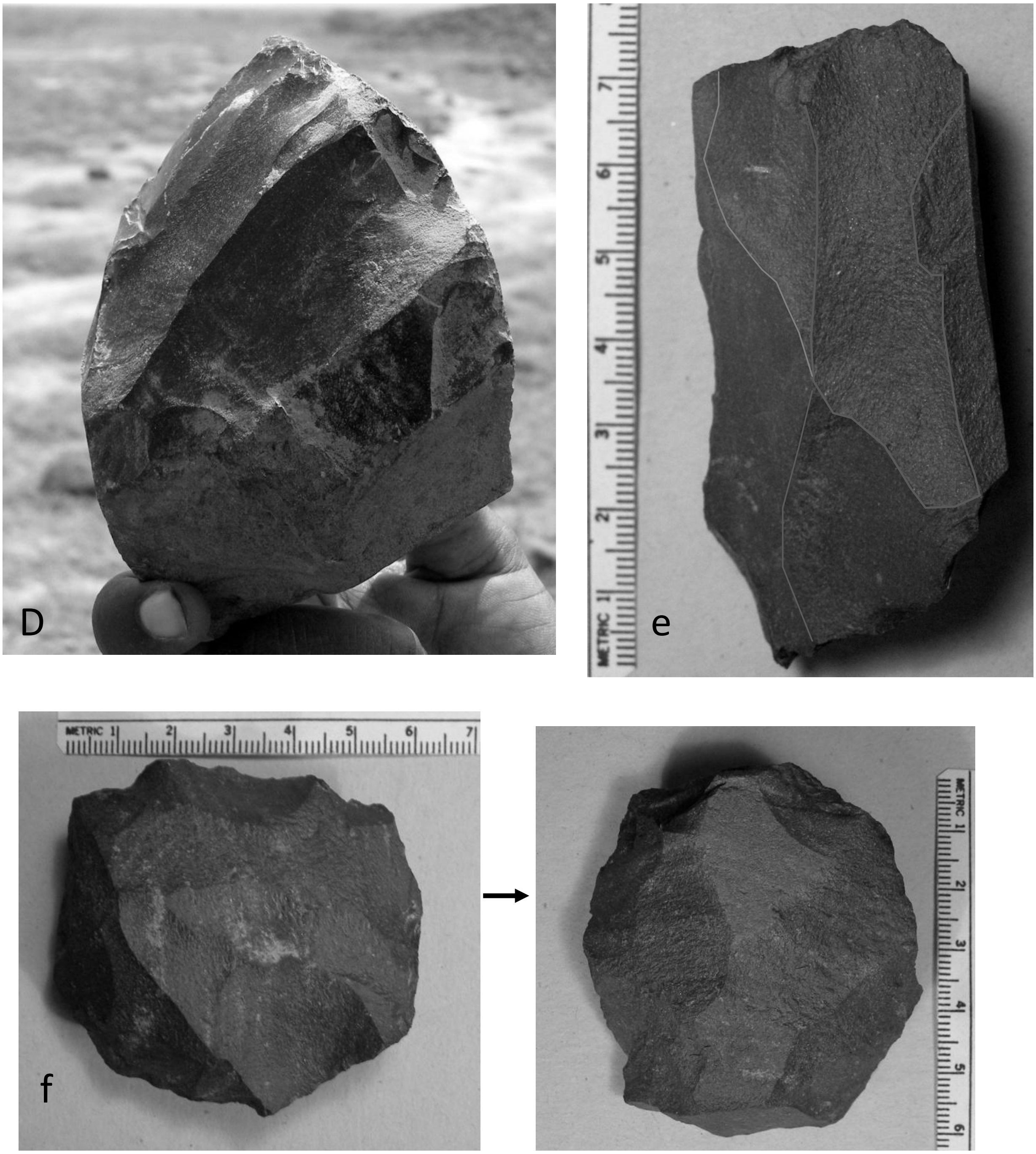


Figure 6 continued. Cores from Asfet: prismatic blade (d,e), discoid (f).

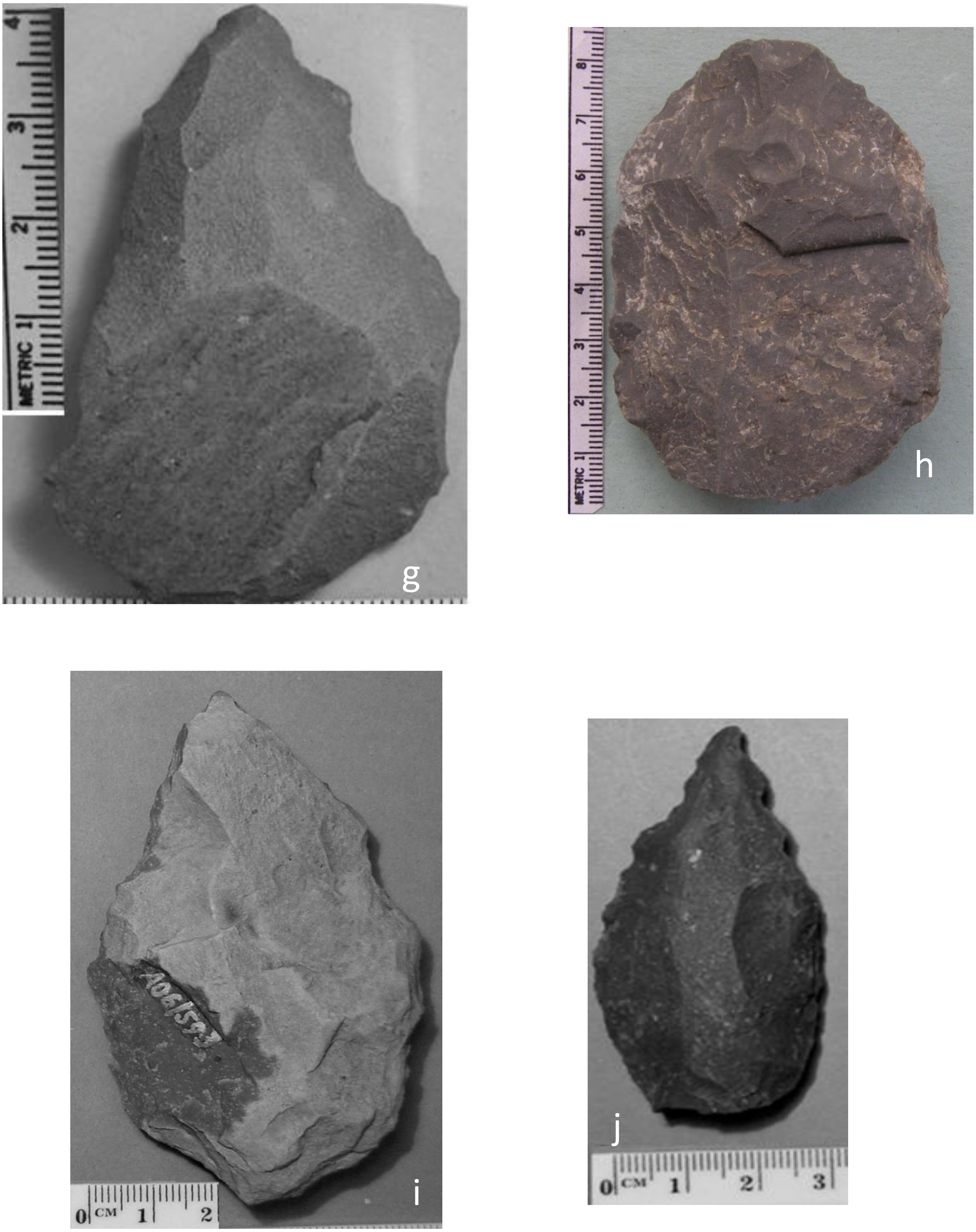


Figure 6 continued. Shaped tools: handaxe (g), ovate or small handaxe (h), foliate points (i,j).

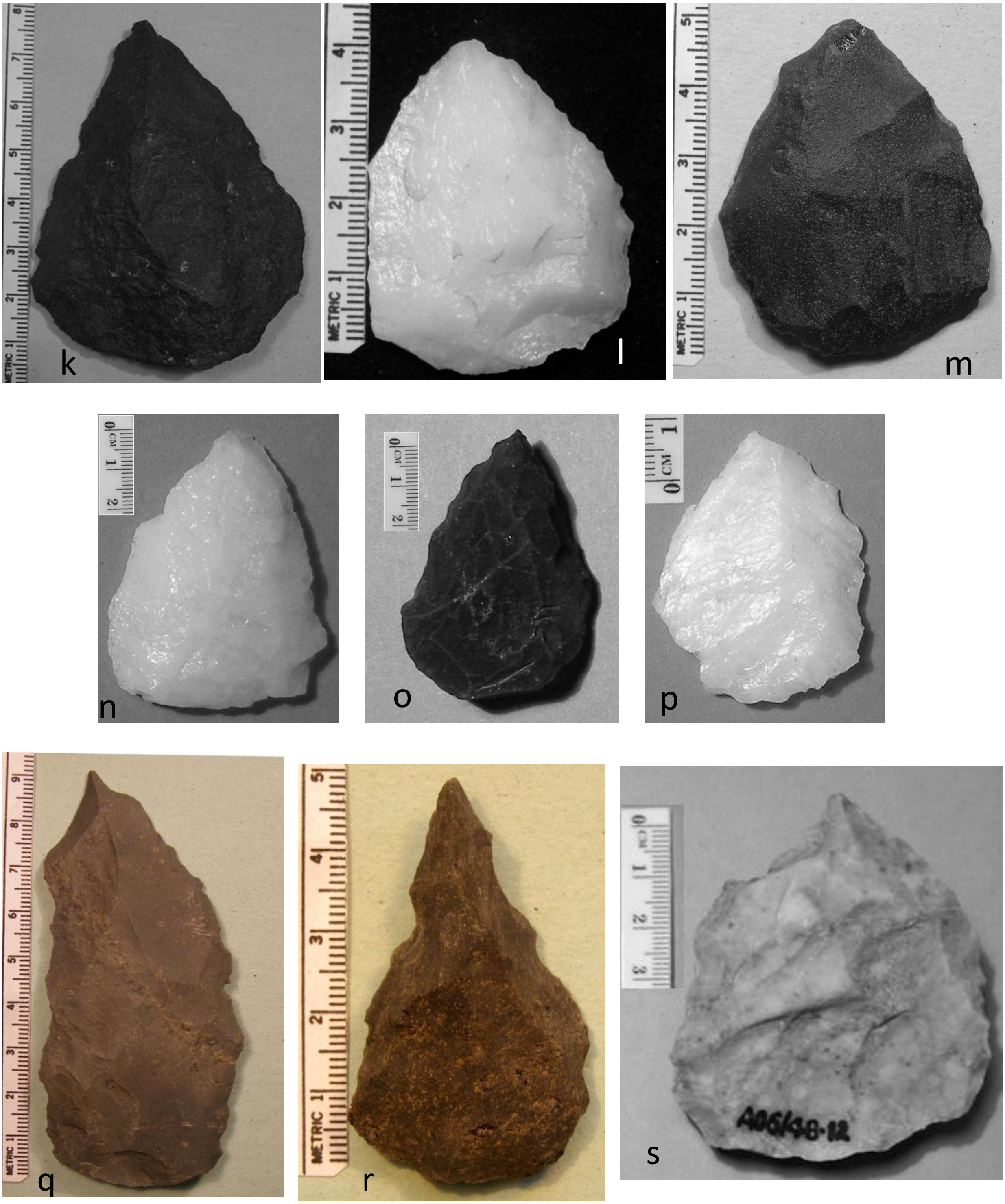


Figure 6 continued. Classic MSA points (k-p). Additional shaped tools: Perforators (q-s).

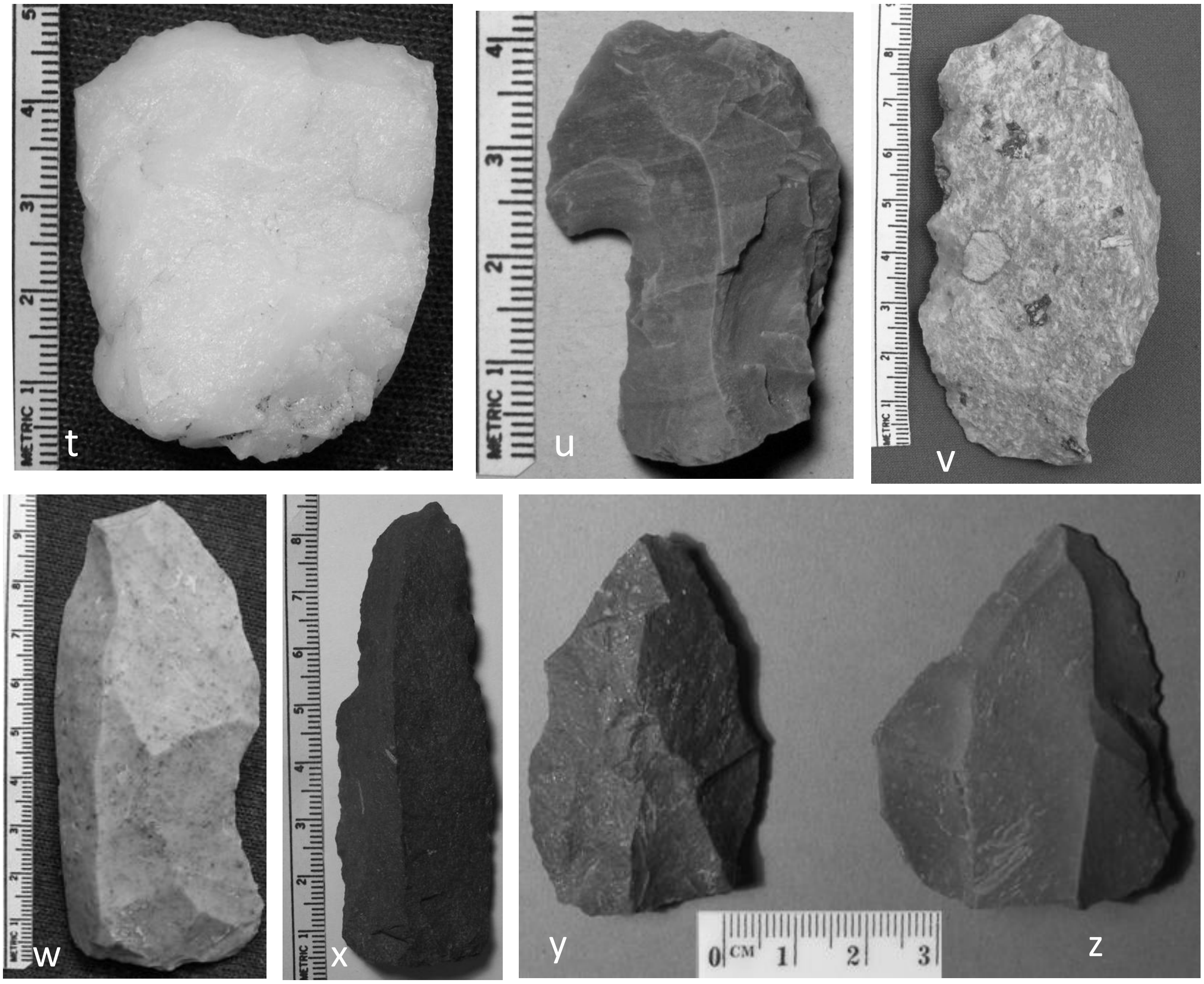


Figure 6 continued. Scraper (t), notch (u), denticulate (v). Blanks: Blades (w-x), Levallois (y-z).

MSA technological innovations and their geographic distribution has been used by current researchers to track Late Pleistocene hominin movement within and outside of Africa (Armitage et al., 2011; Rose et al., 2011; Beyin, 2013; Crassard and Hilbert, 2013), Figure 8. Their discovery at Asfet may then suggest that the Red Sea basin hosted MSA hominins related to those groups that ended up inhabiting Arabia.

In sum, the Asfet evidence corroborates the plausibility of the African side of the Red Sea as a potential refugium and departure point for hominid dispersals into Eurasia. Assuming that the ancestral source populations for the Arabian MSA makers originated from northeast Africa and dispersed via the Red Sea, as claimed by the investigators of the Arabian sites, it follows that the makers of the Asfet assemblage may have been related to those hominins that brought the NE African technocomplexes into Arabia. Since typical MSA artifacts (i.e., points and prepared core products) are often regarded as characteristic behavioral innovations of *Homo sapiens* in Africa (McBrearty and Brooks, 2000), the makers of the Asfet assemblage may belong to the *Homo sapiens* lineage whose remains have been recovered from securely dated MSA contexts in eastern Africa.

Raw Material	Debitage, Complete Blanks and Fragments										Totals
	Fully Cortical Flakes	Partially Cortical Flakes	Non-cortical Flakes	Levallois Flakes	Levallois Points	Levallois Blades	Prismatic Blades	Proximal Fragments	Other Fragments	Other Flake Types	
Basalt	22	96	124	43	14	24	42	9	74	55	503
Chert		8	6	5	1	4	3	2	2	5	36
Green Schist	2	5	8	3	2	1		2	3		26
Obsidian	2	7	91	41	19	11	18	19	166	35	409
Quartz	2	13	24	10	10	3	3	5	40	4	114
Rhyolite		2	6		1	1	4	3	9	2	28
Shale	3	5	2	5		1	2	1	3	2	24
Other	3	4	3			1			2	1	14
Totals	34	140	264	107	47	46	72	299	41	104	1154
%	3	12	23	9	4	4	6	26	4	9	100

Figure 7. Asfet Surface Middle Stone Age raw material variability in the débitage/ flake blank class.

Asfet Unit F

In addition to the surface MSA discovery discussed above, six test units were excavated at Asfet (A–F) of which only Unit F produced archaeological remains below surface. The Unit was placed on a flat area on the northern summit of the western ridge (FigureS 5&9). It was initially excavated on a 1x1m area down to 30 cm. Subsequently, a 50 x 100cm sounding pit was added on the southern section and excavation resumed for another 20cm. The unit produced a dense shell assemblage and a modest quantity of lithic artifacts (n = 411). Non-diagnostic complete flakes and fragmentary débitage dominate the lithic sample (Figure 10). A few fully cortical flakes were recovered from the upper layer of the unit indicating some level of initial stage core reduction activity. Obsidian, quartz and basalt account for 59.6, 18.7, and 14.8 percent respectively in the assemblage (Figure 11). While the Unit F lithic assemblage is dominated by non-diagnostic débitage, the presence of a few backed elements hints at LSA tradition. The unit has yielded two radiocarbon dates on mollusk shells, calibrated age range of 5475-5672 Cal BP (Figure 4). So far, the Asfet Unif F represents the first definitive evidence for middle Holocene (sixth millennium BP) human habitation along the Red Sea coast of Eritrea.

A sample of the excavated shell assemblage from Asfet Unit F was subject to lab analysis (Bar-Yosef Mayer and Beyin, 2009). Despite the fragmentary nature of the assemblage, it was possible to discern certain patterns in species composition and ecological conditions associated with human foraging activities along the coast. At the outset, *Terebralia palustris* (Figure 12) is the dominant species in the assemblage accounting for 97% of the total NISP[2] (n=3018), and 96% of the total MNI[3] (n = 616), Figure

[2] NISP = Number of Identifiable Specimens
[3] MNI = Minimum Number of Individuals

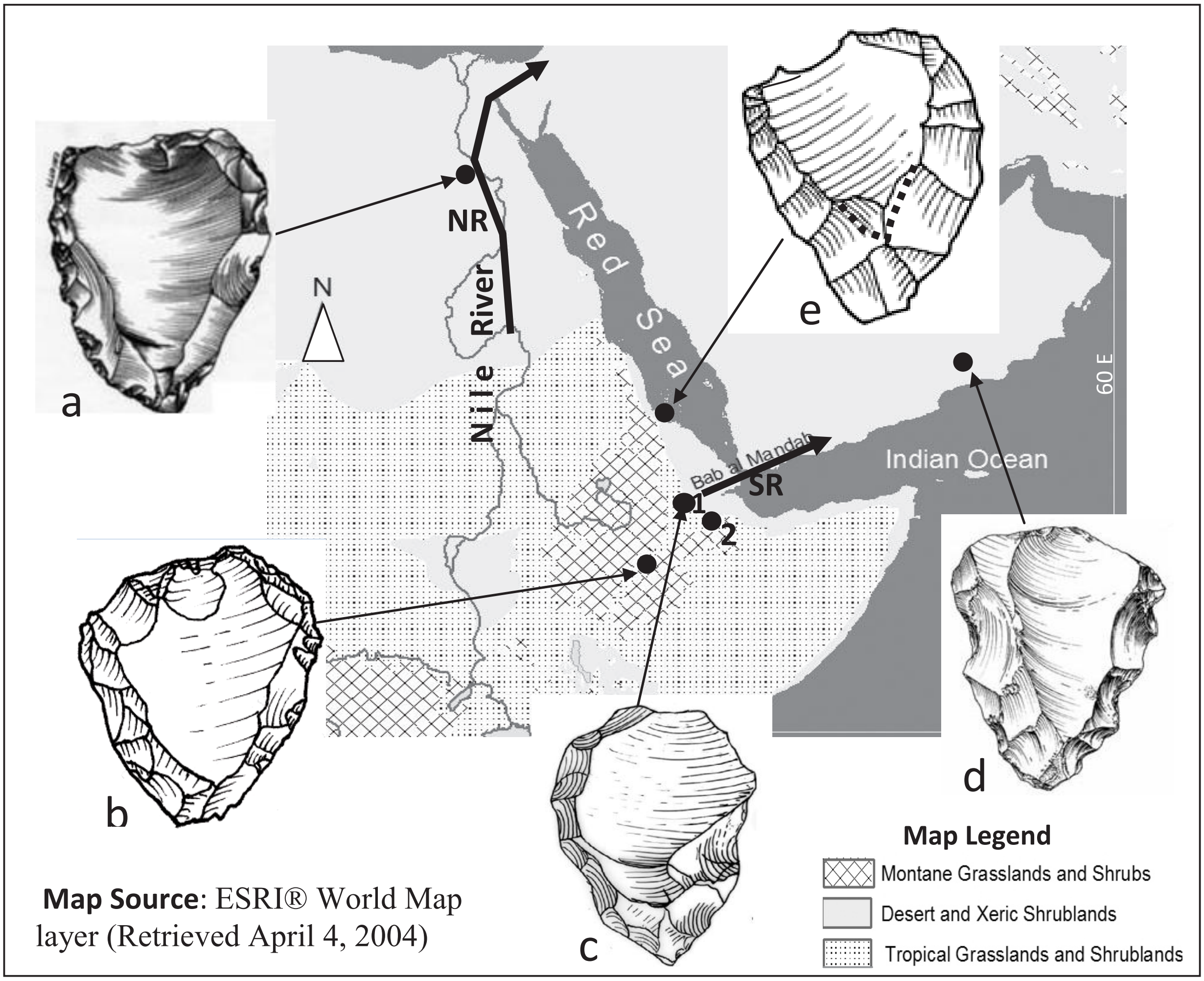


FIGURE 8. MAP SHOWING REPRESENTATIVE NUBIAN TYPE II SITES, AND HORN OF AFRICAN SITES COMPARED WITH ASFET: A = ABYDOS, EGYPT (OLSZEWSKI ET AL., 2005: 290), B = GADEMOTTA, ETHIOPIA (WENDORF AND SCHILD, 1974: 189), C = ADUMA, ETHIOPIA (YELLEN ET AL., 2005: 92), D = AYBUT AL AUWAL, OMAN (ROSE ET AL., 2011: 10), E = ASFET, ERITREA. KEY TO ABBREVIATIONS AND NUMBERS; **NR** = NORTHERN ROUTE, **SR** = SOUTHERN ROUTE, 1 = HERTO, 2 = PORC EPIC.

13. This is also the most abundant fauna in the mangrove forests in the nearby shoreline, and could have been easily harvested due to its fairly large size ~90 mm (Bosch et al., 1995). As is the case with most edible mollusks, this species can provide rich dietary supplements including proteins, minerals and a fair amount of calories (Claassen, 1998; Bar-Yosef Mayer and Beyin, 2009). All the mollusk shells discovered at Asfet are common in the Red Sea, and most of them were likely collected for food. One artificially perforated shell on *Chicoreus ramosus* and two *Nerita polita* with naturally abraded apertures were discovered at Asfet signifying that some of the shells were used as beads.

Gelalo NW

Located about 15km from the coastline in the Buri Peninsula, the Gelalo NW study area sits on top of a steep basalt inselberg surrounded by low relief plains now dominated by Acacia woodland (Figure 14A). During dry periods, frequent sandstorms could deter human habitation around the low fields. Thus, the ridge top could have offered hunter-gatherers a livable space and a good vantage point to monitor game movement in the surrounding fields. Three radiocarbon dates obtained from mollusk samples placed the settlement of Gelalo site in the range of 7000–8500 years Cal BP (Figure 4). Three

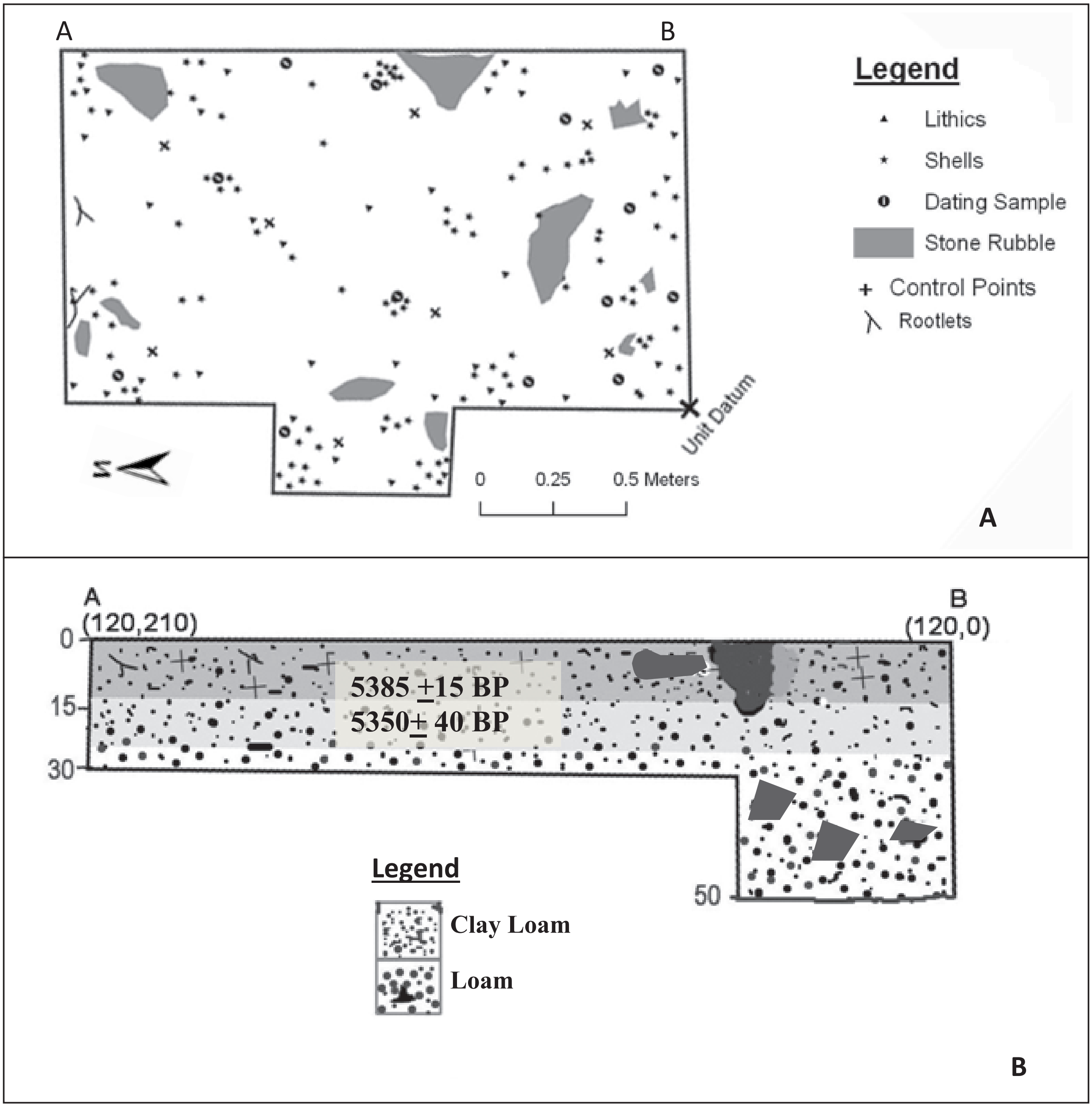


Figure 9. Asfet Unit F plan view (a) and unit profile along A-B axis (b).

1m² units were excavated to a depth of 50, 40, and 50cm respectively at the site (Figure 14B). The three excavated units produced a total of 4883 lithic artifacts, comprising cores, shaped tools and débitage, all on obsidian (Figure 11). Based on our survey of volcanic raw material sources, obsidian could have been procured from a distance of 10 to 15km. Moreover, over 1000 stone tools were collected from a 2x2m surface collection grid. In all the excavated units, the cultural traces were limited to the upper 25cm of the deposit with artifact densities decreasing sharply with depth. Prismatic core reduction and backed tools (crescentic in shape, also modified from prismatic blades) are the main diagnostic entities (Figure 15), and signify LSA Industry. Circular ostrich eggshell beads were other important cultural artifacts discovered at the site, and may have been used as markers of social or cultural identity (gender, status or ethnicity), Figure 16.

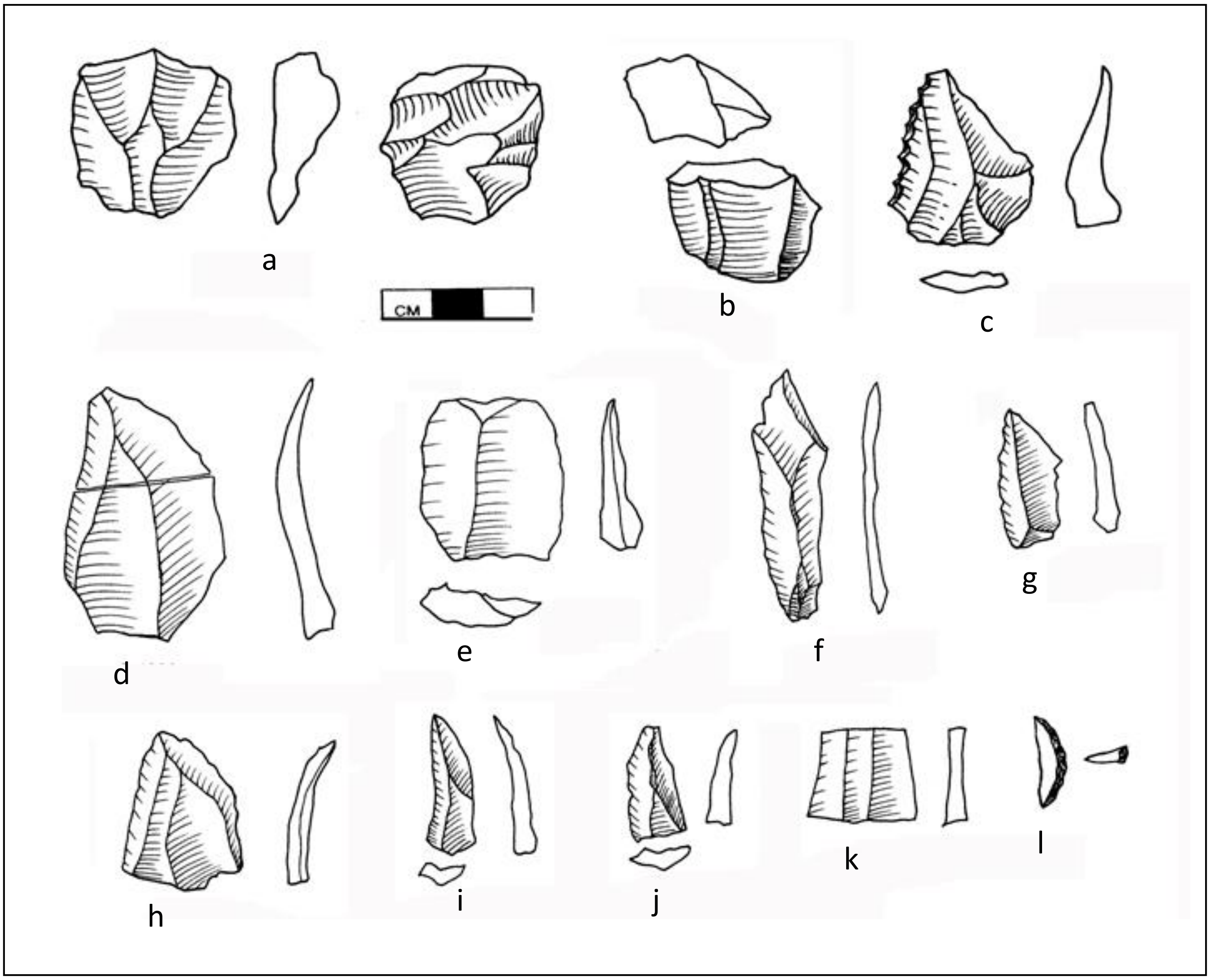


Figure 10. Asfet Unit F representative lithic artifacts: bipolar core (a), prismatic core (b), flake with left edge modified by use (c), various kinds of blank flakes (d-k), backed microlith (l). All on obsidian except g.

		Raw Material Count (%)				
Site	**Tool Type**	**Obsidian**	**Quartz**	**Basalt**	**Other**	**Totals**
Asfet	Cores	4 (.97)	3 (.73)	0	1(.24)	8
	Shaped tools	12 (2.9)	0	1(.25)	0	13
	Débitage	245(59.6)	77 (18.7)	61 (14.8)	7(1.7)	390
Gelalo NW	Cores	58 (1.2)	0	0	0	58
	Shaped tools	242(4.9)	0	0	0	242
	Débitage	4583 (93.8)	0	0	0	4583
Misse East	Cores	8 (1.08)	0	0	0	8
	Shaped tools	54 (7.3)	0	0	0	54
	Débitage	677 (91.6)	0	0	0	677

Figure 11. Raw material variability in the Afet Unit F, Gelalo and Misse lithic assemblages.

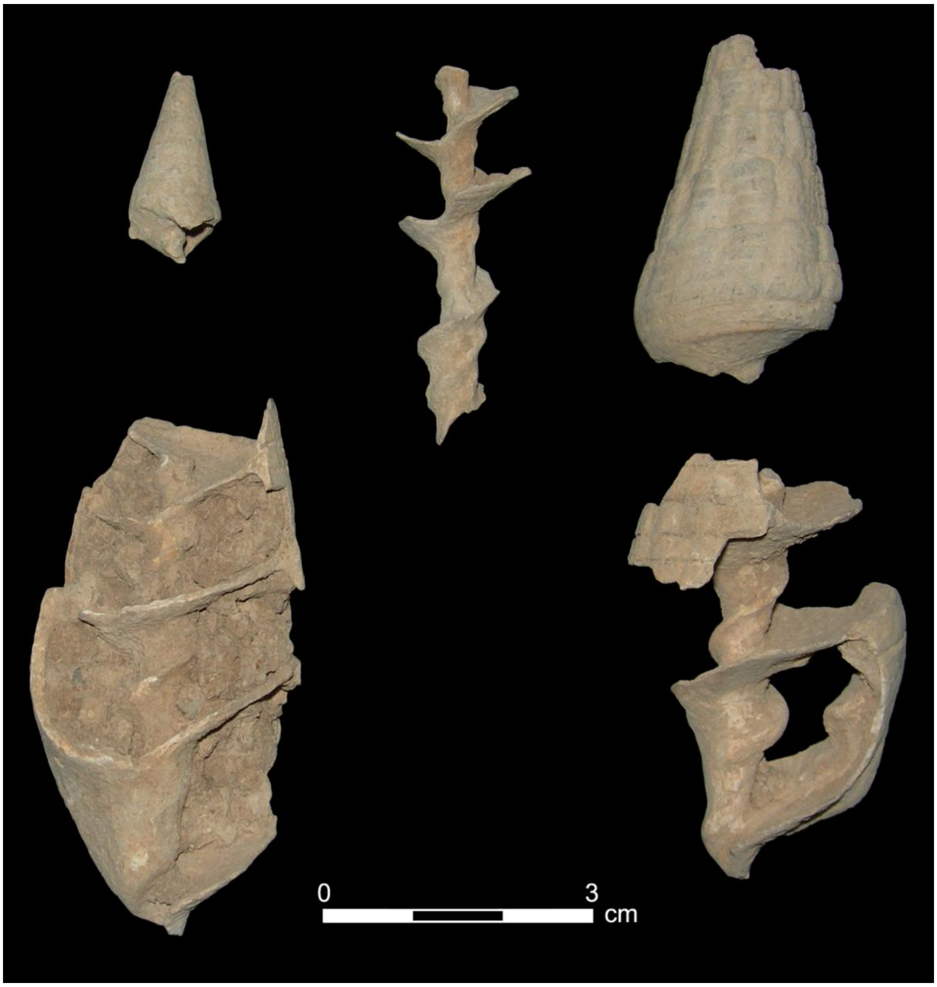


Figure 12. Typical *Terebralia palustris* body parts recovered from Asfet Unit F.

Class	Genus/species	Habitat	NISP	MNI
Polyplacophora	*Chiton*	On or under rocks	1	1
Gastropoda	*Nerita* spp.	Intertidal on rocks	12	5
	Chicoreus ramosus	Intertidal rocks and coral	9	1
	Tibia insulaechorab	Intertidal on sand	17	3
	Terebralia palustris	Mud among mangroves	3018	616
	Unidentifiable gastropods		3	0
Bivalvia	Ostreidae	Usually attached to rocks	1	1
	Anadara antiquata	Muddy sand, intertidal and off-shore	22	4
	Barbatia decussata	Under rocks, upper shore	34	9
	Cardiidae	variable	3	1
	Unidentifiable bivalves		3	0
unknown	Shell disc bead		1	1
	Total		3124	642

Figure 13. Composition of the analyzed shell assemblage from Asfet Unit F (after Bar-Yosef Mayer and Beyin, 2009: 116).

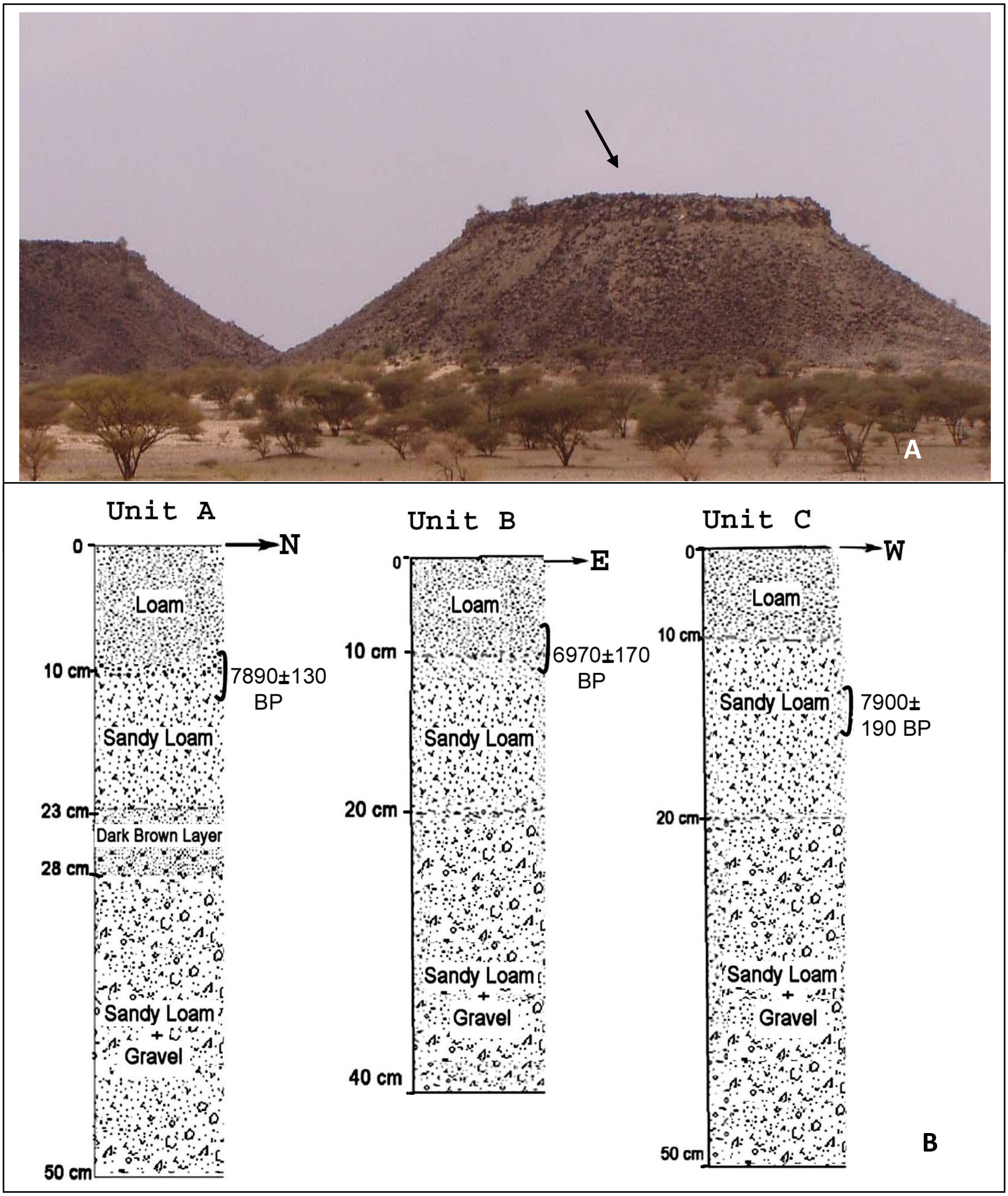


Figure 14. Location of the Gelalo NW site, south view (a) and profiles of the excavated units (b).

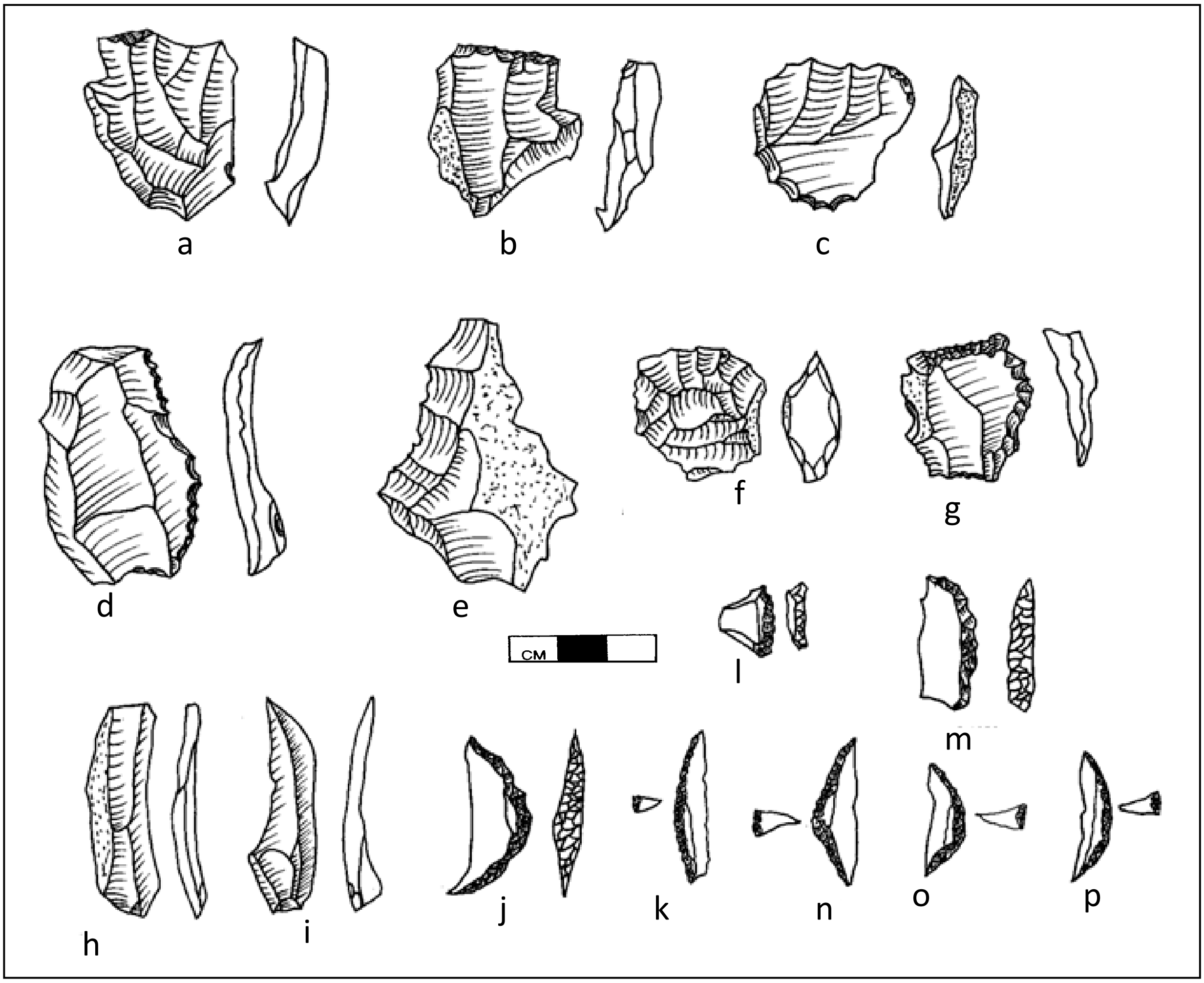
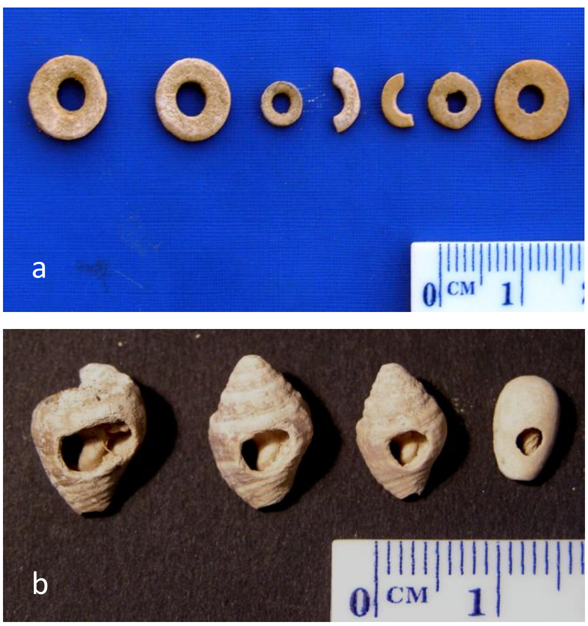


Figure 15. Representative lithic artifacts from Gelalo NW: cores (a-c), blades (h-i), scrapers (f,g, l), backed microliths (j,k,m,n,o,p).



A small shell assemblage was recovered from the site, represented by a high frequency of *Terebralia palustris*, and constituting 297 NISP and 17 MNIs (Bar-Yosef Mayer and Beyin, 2009), Figure 17. While it was not possible to make definitive assessment regarding the importance of shellfish to human subsistence due to the limited size and fragmentary nature of the assemblage, the occurrence of shells on a hill-top, at such a distant location from the seashore signifies that coastal resources were brought to the interior landscapes by specialized groups who intermittently visited the coast on special trips. Terrestrial faunal remains were not

Figure 16. Beads from Gelalo Site: a) ostrich eggshell, b) *Engina mendicaria* shells (the three specimens on left) and *Volvarina monilis* (the specimen on right).

Class	Genus/species	Habitat	NISP	MNI
Polyplacophora	*Chiton*	On or under rocks	1	1
Gastropoda	*Nerita sanguinolenta*	Intertidal on rocks	1	1
	Terebralia palustris	Mud among mangroves	188	8
	Engina mendicaria		3	3
	Volvarina monilis		1	1
Bivalvia	*Barbatia decussata*	Under rocks, upper shore	1	1
	Atactodea striata	Intertidal in sand	1	1
	Unidentifiable bivalve		1	1
Unknown	Shell disc bead		3	3
	Total		200	20

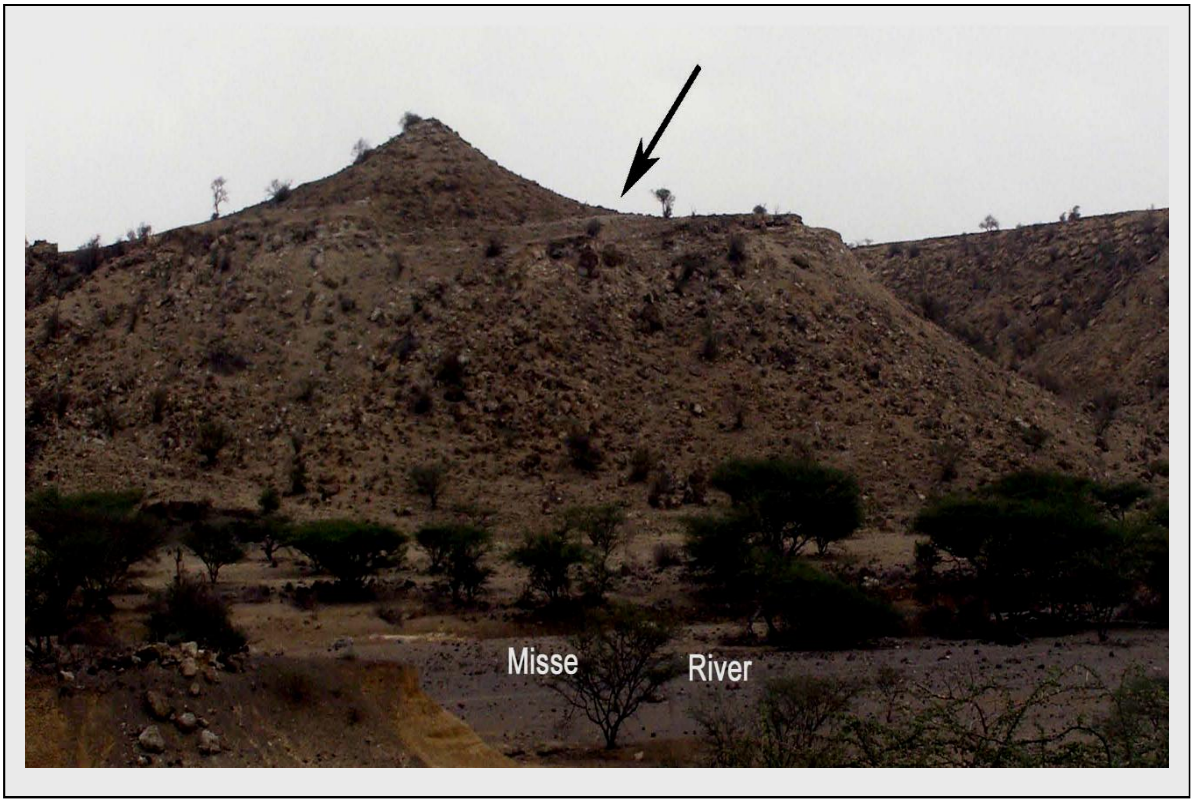
Figure 17. Composition of the analyzed shell assemblage from Gelalo NW (after Bar-Yosef Mayer and Beyin, 2009:120).

recovered at the site, presumably due to preservation and/or excavation biases, but the location of the site farther inland suggests that it was primarily selected for terrestrial resource exploitation. The discovery of abundant lithic artifacts (with microlithic component) suggests human hunting and other activities as very few stone tools are necessary for mollusk exploitation. Ethnographic studies show that coastal foragers rarely travel more than 5-10km daily (Bigalke, 1973). Thus, the fact that Gelalo lies about 15km inland suggests that, the coastline may not have been much farther than its present location. The exploitation of shells at Gelalo may reflect periods of terrestrial resource deterioration that forced people to harvest low rank resources from the coast.

Misse East

The Misse study area lies about 4km inland from the present coastline on the Gulf of Zula side of the Buri Peninsula. It is situated on top of a level section limestone ridge overlooking the Misse River that flows into the Gulf of Zula (Figure 18A). Like the other sites discussed above, the site was subjected to surface and subsurface investigations, but only one 1x1m unit was excavated here (Figure 18b). The site preserves a shallow deposit, but artifact density was much greater per the same excavated space at the other sites, especially mollusk shells. The excavated unit produced a modest quantity of lithic artifacts (n =739) and the majority of the artifacts and shells were collected from the upper 10cm deposit. Obsidian was the sole raw material for making the Asfet lithic artifacts (Figure 11). Cores, shaped tools and débitage make up 1, 7.3, and 91.6 percent respectively (Figure 11). The Misse débitage blanks are relatively longer in size than the Gelalo and Misse samples. As is the case with the Gelalo assemblage, blades and backed tools constitute the most diagnostic entities in the Misse assemblage (Figure 19). A *chaîne opératoire* assessment of the assemblage reveals that longer blades (more 30mm) were preferred for making backed tools.

The Misse shell assemblage is characterized by the predominance of one particular species, *Atactodea striata*, which accounts for 94% of the MNI (n=133), and 83% of the total NISP (n=267), FigureS 20-21. With the exception of *Atactodea striata*, most of the other species represented in the Misse assemblage were also encountered at Asfet. However, the dominance of this species changes the character of the midden. *Atactodea* is a small bivalve that buries itself in sandy intertidal beaches. It could have been



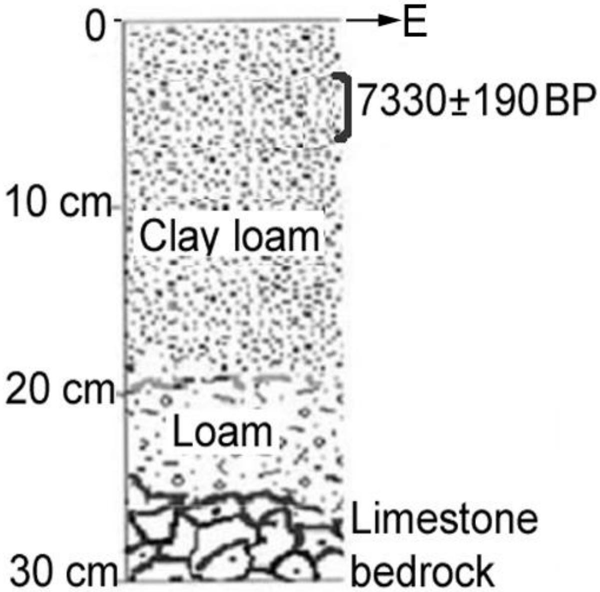


Figure 18. Location of the Misse East site, south view (a), and profile of the excavated unit (b).

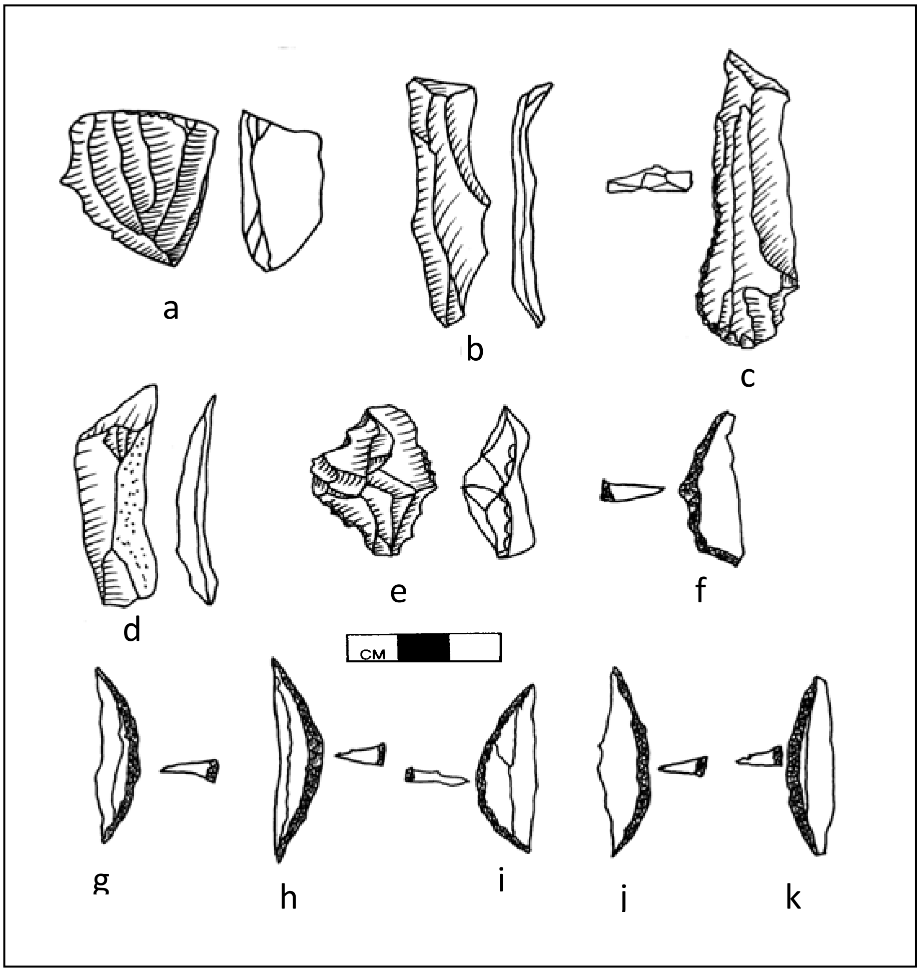


Figure 19. Excavated lithic artifacts from Misse East: cores (a,e), a = prismatic core; blades (b-d), backed microliths (f-k).

easily collected from the nearby coast during low tide. The predominance of a single species of *A. striata* at Misse hints at selective harvesting of shellfish from the coast. Two shell samples gave the site a calibrated age range of 7323-8039 BP (Figure 4), confirming the presence of an early Holocene (eighth millennium BP) human settlement on the eastern coast of the Gulf of Zula, contemporaneous to Gelalo NW. The presence of contemporaneous sites at different locations with respect to the coastline implies that humans exploited diverse landscapes on episodic or seasonal bases.

Implications of the Archaeological evidence from the Eritrean Red Sea Coast

From the evidence so far available from the Eritrean coastal area, it appears that the western littoral zone of the Red Sea basin (to which the Buri-Zula plains are a part) had hosted at least intermittent early human occupations. The sites fall into two broad occupation episodes: a) Abdur and the Asfet surface assemblage representing MSA occupations, b) Gelalo, Misse and Asfet Unit F representing LSA occupations. Besides the four sites considered here, several other sites representing LSA and MSA lithic evidence were recorded around the Buri Lake and along the southern peripheries of the Zula Gulf (Beyin and Shea, 2007). The Eritrean coast lies in a strategic location adjacent to the presumed dispersal routes of early humans from eastern Africa into Arabia and the Levant. The position of the Buri-Zula region at the confluence of the Red Sea shorelines and the Danakil depression (a northern extension of the East African Rift Valley) makes it particularly important in the context of ongoing debates about

Figure 20. *Atactodea striata* shells (a), and ostrich eggshell beads (b) from the Misse East site.

the geographic routes and ecological backgrounds of early human dispersal out of Africa. In this regard, the Abdur and Asfet MSA sites, by virtue of their older age, can be regarded as representatives of early human adaptation along the Red Sea coastal margins prior to their dispersal out of Africa. Assuming that hominins were following major water courses during their expansion out of eastern Africa, the Zula and Buri plains would have been regularly inhabited by hunter-gatherer groups dispersing from the hinterlands of eastern Africa following riverine tributaries along the Ethiopian rift and Danakil depression.

There are various incentives for hunter-gatherers to disperse to the Buri-Zula plains. The low plains of the Buri-Zula landscapes dotted by volcanic inselbergs are ideal for terrestrial grazers. At present, the area hosts a wide-range of such animals (e.g., Soemmerring's and Dorcas gazelles, dik-dik and one of the last free-ranging species of African wild ass, *Equus africanus*). If hunting terrestrial game were to become precarious for any reason, aquatic resources and shellfish would always have been accessible on the intertidal zones. Furthermore, shellfish as a supplementary food source could have also been a matter of choice (e.g., Erlandson, 2010). The recovery of diverse mollusks at the younger Holocene settlements (Bar-Yosef Mayer and Beyin, 2009) indicates that the shorelines of the Zula gulf would have offered prehistoric foragers a range of shellfish options that could have been harvested at different seasons.

Although we are not certain where the sea level might have been during human occupation episodes of the Asfet and Abdur sites, in all likelihood, the climatic condition may not have been much different than today. At least when it comes to Abdur, the general consensus is that human settlement there occurred during an interglacial period or high sea level stand (Walter et al., 2000). It is also likely the case that Asfet was inhabited during an interglacial episode. If, in fact, the sites were occupied

Class	**Genus/species**	**Habitat**	**NISP**	**MNI**
Polyplacophora	*Chiton*	On or under rocks	2	1
Gastropoda	*Nerita* sp.	Intertidal on rocks	8	3
	Unidentifiable gastropods		10	0
Bivalvia	Ostreidae	Usually attached to rocks	21	1
	Anadara antiquata	Muddy sand, intertidal and off-shore	3	1
	Barbatia decussata	Under rocks, upper shore	10	1
	Cardiidae	variable	1	1
	Atactodea striata	Intertidal in sand	267	133
Unknown	Shell disc bead		1	1
	Total		323	142

Figure 21. Composition of the analyzed shell assemblage from Misse East (Bar-Yosef Mayer and Beyin, 2009:119).

during low sea level (glacial) event, most human settlements during this time would have been located several kilometers eastward from the present shoreline, where according to the COM discussed above, the presumed green oases belts were situated. Based on a rough estimate derived from the Red Sea bathymetric map (Bailey, 2009; Lambeck et al., 2011), at its lowest point (corresponding to major glacial maxima of the Pleistocene), the shorelines around the Buri-Zula plains would have retreated ~140km eastward. During this time, the Buri-Zula area would have turned to desolate landscape, devoid of human settlement because there is no major drainage around the area that could have served as a source of freshwater for hominins and terrestrial fauna.

Granted any dispersal via the Bab al Mandab was preceded by prolonged adaptation to the African side of the Red Sea, especially on the southern end of the basin, the Asfet and Abdur sites might represent part of a widespread coastal adaptation by African hominins along the western margins of the Red Sea prior to their dispersal to neighboring Eurasian landmasses.

Later Pleistocene foragers successfully adapted to the Buri-Zula plains may have continued moving southward along the Danakil-Djiboutian coast, afterwards entering Southern Arabia via the Strait of Bab al Mandab (Figure 22). Likewise, there does not appear to be any conceivable obstacle for the Asfet hominins to disperse northward up to the Levant along the Sudanese-Egyptian Red Sea coastal littorals. The evidence in and of itself can serve as a plausible baseline to launching Paleolithic survey along the Sudanese and Egyptian coastlines.

Outside of the Eritrea coastline, Holocene sites with microlithic component are scarce on other parts of the western Red Sea coastal peripheries. From the Arabian side, sites of comparable age (dating between the eighth and sixth millennia BP) have been recorded from the Tihamah region of southwestern Yemen and from the Farasan Islands, off the western coast of Saudi Arabia (Tosi, 1986; Bailey et al., 2007). *Terebralia palustris*, the dominant species in the Asfet and Gelalo assemblages characterizes the Tihamah sites. Moreover, several of the middle Holocene sites in the Tihamah region of Yemen produced stone tools made on obsidian raw material, the sources of which were identified on the Eritrean coastal areas (Khalidi, 2009). Some of the Eritrean sources with which the Yemeni sites showed close affinity include Irafailo, Dahlak Islands and Alid Vocano. While the nature of cultural interaction between the two sides of the Red Sea remains unclear, the obsidian data hints that the prehistoric inhabitants of the Tihamah and the Buri-Zula sites may have been sharing the same obsidian sources located on the Eritrean side. Other commodities besides obsidian may also have been exchanged between the two regions. All evidence considered, the Holocene settlements along the Eritrean coast seem to represent a broader regional phenomenon of human exploitation of coastal landscapes with the possibility of direct human interaction across the Red Sea basin.

Conclusions

The Eritrean coastal region holds a crucial position as a plausible destination for Late Pleistocene and Holocene foraging groups dispersing from the hinterlands of Africa, some of which may have served as source populations for later dispersals into Eurasia (Figure 21). Given the paucity of Paleolithic record from the western side of the Red Sea basin, the discovery of MSA and LSA assemblages along the Eritrean coast provides a much needed reference data to assess the role of the Red Sea coast as a potential refugium and dispersal corridor for early humans. Even though there are only a few known coastal sites from the African side of the Red Sea, it is likely the case that the coastal territories of Eritrea, Djibouti, Somalia, Sudan and Egypt were continuously visited by prehistoric foragers. The discovery of several sites in the Buri-Zula region suggests that other sites (with important implications for early human dispersals history) may yet be discovered along the African side of the Red Sea basin. Future systematic research should target limestone reef deposits and near-coastal ecotonal plains along the western side of the basin.

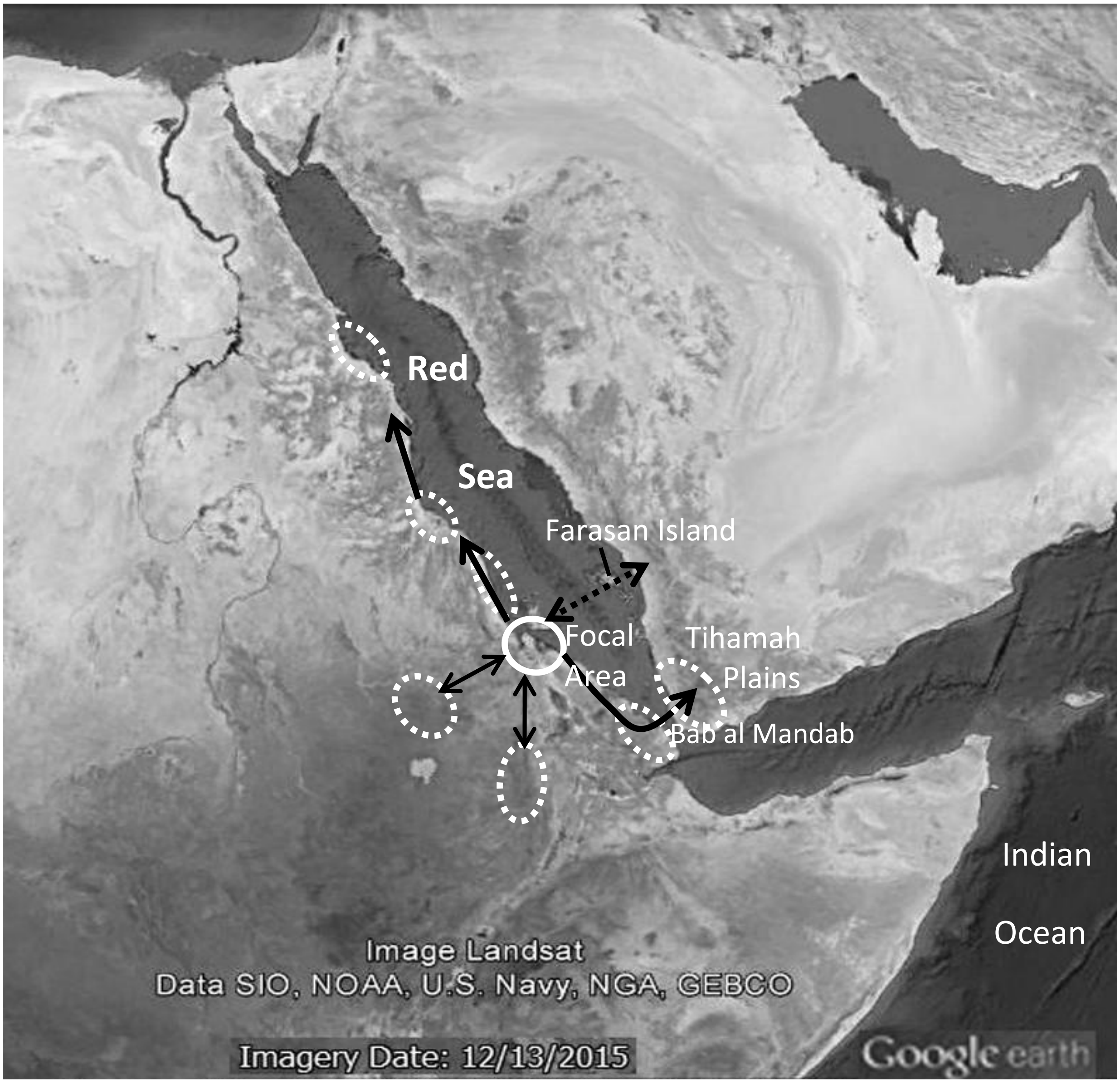


Figure 22. Hypothetical cultural and demographic connections between the settlements discussed in this paper and settlements that could have potentially occurred in the neighboring regions. Solid arrows = possible paths of interactions, dashed arrow = path of interaction that may have existed during low sea level, dashed circles = regions where prehistoric settlements are predicted/recorded.

Acknowledgements

Fieldwork that led to the discovery of Asfet, Gelalo and Misse was supported by the Dan David Prize, the LSB Leakey Foundation, and Wenner-Gren Foundation. We are grateful to Dr. Yosief Libsekal, director of the NationalMuseum of Eritrea, and Dr. Zemenfes Tsighe of the University of Asmara for making this research possible. Mr. H. K.Mienis, Collections Manager of the Mollusk Collection at the Hebrew University of Jerusalem, helped with species identification. Dr. Ruth Shahak-Gross (University of Haifa) and Prof. Paul Goldberg (Boston University) provided consultation on shell and bone preservation. Bar-Yosef Mayer thanks the staff of the Israel Embassy in Asmara for their kind assistance. Beyin thanks his research collaborators from the National Museum of Eritrea and University of Asmara. Special thanks from both of us to John J. Shea for following this project. Finally, thanks to Akshay Sarathi and the African Studies Program at the University of Wisconsin-Madison for the invitation to attend the 'Early Maritime Cultures on the East African Coast' conference, which led to the inception of this paper.

Bibliography

Abbate, E., Albianelli, A., Azzaroli, A., Benvenuti, M., Tesfamariam, B., Bruni, P., Cipriani, N., Clarke, R.J., Ficcarelli, G., Macchiarelli, R., Napoleone, G., Papini, M., Rook, L., Sagri, M., Tecle, T.M., Torre, D., Villa, I. 1998. A one-million-year-old *Homo* cranium from the Danakil (Afar) Depression of Eritrea. Nature 393, 458-460.

Armitage, S.J., Jasim, S.A., Marks, A.E., Parker, A.G., Usik, V.I., Uerpmann, H.-P. 2011. The Southern Route 'Out of Africa': Evidence for an Early Expansion of Modern Humans into Arabia. Science 331, 453-456.

Bailey, G. 2009. The Red Sea, Coastal Landscapes, and Hominin Dispersals In: Petraglia, M.D., Rose, J.I. (Eds.), The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics. Dordrecht, New York, pp. 15-38.

Bailey, G.N., Flemming, N.C., King, G.C.P., Lambeck, K., Momber, G., Moran, L.J., Al-Sharekh, A., Vita-Finzi, C. 2007. Coastlines, Submerged Landscapes, and Human Evolution: The Red Sea Basin and the Farasan Islands. *Journal of Island & Coastal Archaeology* 2, 127-160.

Bar-Yosef Mayer, D.E., Beyin, A. 2009. Late Stone Age Shell Middens on the Red Sea Coast of Eritrea. Journal of Island and Coastal Archaeology 4, 108 - 124

Bar-Yosef, O., Belfer-Cohen, A. 2001. From Africa to Eurasia – early dispersals. Quaternary International 75, 19-28.

Barberi, F., Varet, J. 1977. Volcanism of Afar: Small-scale plate tectonics implications. Geological Society of American Bulletin 88, 1251-1266.

Beyin, A. 2006. The Bab-al-Mandab vs the Nile-Sinai-Levant: an appraisal of the two dispersal routes for early modern humans out of Africa. African Archaeological Review 23(1), 5-30.

Beyin, A. 2010. *Prehistoric Settlements on the Red Sea Coast of Eritrea: Archaeological Investigation of the Buri Peninsula and Gulf of Zula*. Lambert Academic Publishing, Saarbrücken, Germany.

Beyin, A. 2011. Upper Pleistocene Human Dispersals Out of Africa: A Review of the Current State of the Debate. International Journal of Evolutionary Biology Ariticle ID 615094, 1-17.

Beyin, A. 2013. A surface Middle Stone Age assemblage from the Red Sea coast of Eritrea: Implications for Upper Pleistocene human dispersals out of Africa. Quaternary International 300, 195-212.

Beyin, A., Shea, J. 2007. Reconnaissance of prehistoric sites on the red sea coast of Eritrea, NE Africa. *Journal of Field Archaeology* 32, 1-16.

Bigalke, E.H. 1973. The exploitation of shellfish by the coastal tribesmen of the Transskie. Annals of the Cape Province Museum 9, 159-175.

Bonatti, E., C. Emiliani, G. Ostlund & H. Rydell. 1971. Final desiccation of the Afar Rift, Ethiopia. *Science* 172: 468-69. https://doi.org/10.1126/science.172.3982.468

Bosch, D.T., Dance, S.P., Moolenbeek, R.G., Oliver, P.G. 1995. *Seashells of Eastern Arabia*. Motivate Publishing, London.

Bruggemann, H.J., Buffler, R.T., Guillaume, M.M.M., Walter, R.C., Cosel, R.v., Ghebretensae, B.N., Berhe, S.M. 2004. Stratigraphy, palaeoenvironments and model for the deposition of the Abdur Reef Limestone: context for an important archaeological site from the last interglacial on the Red Sea Coast of Eritrea. Palaeogeography, Palaeoclimatology, Palaeoecology 203, 179-206.

Buffler, R.T., Bruggemann, J.H., Ghebretensae, B.N., Walter, R.C., Guillaume, M.M.M., Berhe, S.M., McIntosh, W., Park, L.E. 2010. Geologic setting of the Abdur Archaeological Site on the Red Sea coast of Eritrea, Africa. Global and Planetary Change 72, 429-450.

Chauhan, P.R. 2009. Early Homo Occupation Near the Gate of Tears: Examining the Paleoanthropological Records of Djibouti and Yemen, In: E. Hovers and D.R. Braun (eds.) (Ed.), Interdisciplinary Approaches to the Oldowan. Springer, New York, pp. 49-59.

Claassen, C. 1998. *Shells*. Cambridge University Press, Cambridge.

Clark, J.D. 1988. The Middle Stone Age of East Africa and the Beginnings of Regional Identity. Journal of World Prehistory 2, 235-305.

Cohen, K.M., MacDonald, K., Joordens, J.C.A., Roebroeks, W., Gibbard, P.L. 2012. The earliest occupation of north-west Europe: a coastal perspective. Quaternary International 271, 70-83.

Crassard, R., Hilbert, Y.H. 2013. A Nubian Complex Site from Central Arabia: Implications for Levallois Taxonomy and Human Dispersals during the Upper Pleistocene. Plos One 8, e69221.doi:69210.61371/journal.pone.0069221.

Curtis, M., Libsekal, Y. 1999. Archaeological Survey in the Adi Qeyeh area, Eritrea. Nyame Akuma 51, 25-35.

Derricourt, R. 2005. Getting 'Out of Africa': Sea Crossings, Land Crossings and Culture in the Hominin Migrations. Journal of World Prehistory 19, 119-132.

Erlandson, J.M. 2001. The Archaeology of Aquatic Adaptations: Paradigms for a New Millennium. Journal of Archaeological Research 9 (4), 287-350.

Erlandson, J.M., Fitzpatrick, S.M. 2006. Oceans, Islands, and Coasts: Current Perspectives on the Role of the Sea in Human Prehistory. Journal of Island & Coastal Archaeology 1, 5-32.

Faure, H., Walter, R.C., Grant, D.R. 2002. The coastal oasis: ice age springs on emerged continental shelves. Global and Planetary Change 33, 47-56.

Fernandes, C.A. 2009. Bayesian Coalescent Inference from Mitochondrial DNA Variation of the Colonization Time of Arabia by the Hamadryas Baboon (*Papio hamadryas hamadryas*), In: Petraglia, M.D., Rose, J.I. (Eds.), The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics. Springer, Dordrecht, pp. 89-100.

Field, J.S., Lahr, M.M. 2006. Assessment of the Southern Dispersal: GIS-Based Analyses of Potential Routes at Oxygen Isotopic Stage 4. Journal of World Prehistory 19, 1-45.

Flemming, N.C., Bailey, G.N., Courtillot, V., King, G., M., Lambeck, K., Ryerson, F., Vita-Finzi, C. 2003. Coastal and marine palaeo-environment and human dispersal points across the Africa-Eurasia boundary, In: Brebbia, C.A., Gambin, T. (Eds.), Maritime and underwater heritage. Wessex Institute of Technology Press, Southampton, UK, pp. 61-74.

Ghebretensae, B. 2002. Late Cenonzoic Sedimentation and Tectonics of the Bada, Dandero -Mahable and Abdur Areas, Northern Danakil Depression, Eritrea, Africa. Unpublished MA Thesis Thesis, University of Texas, Austin.

Government of Eritrea. 1999. Environmental Report: . Ministry of Land Water and Environment, Asmara -Eritrea.

Groucutt, H.S., Petraglia, M.D., Bailey, G., Scerri, E.M.L., Parton, A., Clark-Balzan, L., Jennings, R.P., Lewis, L., Blinkhorn, J., Drake, N.A., Breeze, P.S., Inglis, R.H., Deves, M.H., Meredith-Williams, M., Boivin, N., Thomas, M.G., Scally, A. 2015. Rethinking the Dispersal of Homo sapiens out of Africa. Evolutionary Anthropology 24, 149-164.

Head, S.M. 1987. Introduction, In: Edwards, A.J., Head, S.M. (Eds.), Key Environments: The Red Sea. Pergamon, Oxford, pp. 1-21.

Ingman, M., Gyllensten, U. 2003. Mitochondrial Genome Variation and Evolutionary History of Australian and New Guinean Aborigines. Genome Res. 13, 1600-1606.

Joordens, J.C.A., Wesselingh, F.P., Vos, J.d., Vonhof, H.B., Kroon, D. 2009. Relevance of aquatic environments for hominins: a case study from Trinil (Java, Indonesia). Journal of Human Evolution 57 656-671.

Khalidi, L. 2009. Holocene Obsidian Exchange in the Red Sea Region, In: Petraglia, M.D., Rose, J.I. (Eds.), The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics. Dordrecht, New York, pp. 279-294.

Kingdon, J. 1993. *Self-Made Man: Human Evolution from Eden to Extinction*. John Wiley, New York.

Kopp, G.H., Roos, C., Butynski, T.M., Wildman, D.E., Alagaili, A.N., Groeneveld, L.F., Zinner, D. 2014. Out of Africa, but how and when? The case of hamadryas baboons (Papio hamadryas). Journal of Human Evolution 76, 154-164.

Kummer, H. 1995. *In Quest of the Sacred Baboon: A Scientist's Journey*. Princeton University Press, Princeton.

Lahr, M.M., Foley, R. 1994. Multiple Dispersals and Modern Human Origins. Evolutionary Anthropology 3, 48-60.

Lambeck, K., Purcell, A., Flemming, N.C., Vita-Finzi, C., Alsharekh, A.M., Bailey, G.N. 2011. Sea level and shoreline reconstructions for the Red Sea: isostatic and tectonic considerations and implications for hominin migration out of Africa. Quatern. Sci. Rev 30, 3542–3574.

Macaulay, V., Hill, C., Achilli, A., Rengo, C., Clarke, D., Meehan, W., Blackburn, J., Semino, O., Scozzari, R., Cruciani, F., Taha, A., Shaari, N.K., Raja, J.M., Ismail, P., Zainuddin, Z., Goodwin, W., Bulbeck, D., Bandelt, H.-J., Oppenheimer, S., Torroni, A., Richards, M. 2005. Single, Rapid Coastal Settlement of Asia Revealed by Analysis of Complete Mitochondrial Genomes. Science 308, 1034 - 1036.

Marean, C.W. 2011. Coastal South Africa and the coevolution of the modern human lineage and the coastal adaptation, In: Bicho, N.F., Haws, J.A., Davis, L.G. (Eds.), Trekking the Shore. Springer, New York, pp. 421-440.

Marean, C.W., Bar-Matthews, M., Bernatchez, J., Fisher, E., Goldberg, P., Herries, A.I.R., Jacobs, Z., Jerardino, A., Karkanas, P., Minichillo, T., Nilssen, P.J., Thompson, E., Watts, I., Williams, H.M. 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. Nature 449, 905-908.

Marks, A.E. 2009. The Paleolithic of Arabia in an Inter-regional Context, In: Petraglia, M., Rose, J. (Eds.), Evolution of human populations in Arabia: paleoenvironments, prehistory and genetics. Springer, Dordrecht, pp. 293–309.

McBrearty, S., Brooks, A. 2000. The revolution that wasn't: a new interpretation of the origin of modern human behavior. Journal of Human Evolution 39, 453-563.

McDougall, I., Brown, F.H., Fleagle, J.G. 2005. Stratigraphic placement and age of modern humans from Kibish, Ethiopia. Nature 433, 733-736.

Mellars, P. 2006. Going East: New Genetic and Archaeological Perspectives on the Modern Human Colonization of Eurasia. Science 313, 796-800.

Mithen, S., Reed, M. 2002. Stepping out: a computer simulation of hominid dispersal from Africa. Journal of Human Evolution 43, 433-462.

Olszewski, D.I., Dibble, H.L., McPherron, S.P., Schurmans, U., Chiotti, L., Smith, J. 2010. Nubian Complex Strategies in the Egyptian High Desert. Journal of Human Evolution 59, 188-201.

Olszewski, D.I., Dibble, H.L., Schurmans, U.A., Mcpherron, S.P., Smith, J.R. 2005. High Desert Paleolithic Survey at Abydos, Egypt. Journal of Field Archaeology 30, 283–304.

Oppenheimer, S. 2009. The great arc of dispersal of modern humans: Africa to Australia Quaternary International 202, 2-13.

Osborne, A.H., Vance, D., Rohling, E.J., Barton, N., Rogerson, M., Fello, N. 2008. A humid corridor across the Sahara for the migration of early modern humans out of Africa 120,000 years ago. PNAS 105, 16444-16447.

Parkington, J. 2010. Coastal Diet, Encephalization, and Innovative Behaviors in the Late Middle Stone Age of Southern Africa, In: Cunnane, S.C., Stewart, K.M. (Eds.), Human brain evolution: the influence of freshwater and marine food resources. John Wiley & Sons, Inc., Hoboken, NJ.

Pedersen, R.K. 2000. Under the Erythraean Sea: An ancient shipwreck in Eritrea. Institute of Nautical Archaeology Quarterly 27, 3-13.

Reyes-Centeno, H., Hubbe, M., Hanihara, T., Stringer, C., Harvati, K. 2015. Testing modern human out-of-Africa dispersal models and implications for modern human origins. Journal of Human Evolution 87, 95-106.

Rose, J.I., Usik, V.I., Marks, A.E., Hilbert, Y.H., Galletti, C.S., Parton, A., Geiling, J.M., erny´, V.C., Morley, M.W., Roberts, R.G. 2011. The Nubian Complex of Dhofar, Oman: An African Middle Stone Age Industry in Southern Arabia. Plos One 6 1-22.

Sauer, C.O. 1962. Seashore - Primitive home of man? Proceedings of the American Philosophical Society 106, 41 - 47.

Schmidt, P.R., Crutis, M.C., Teka, Z. 2008. The Archaeology of Ancient Eritrea, In: Schmidt, P.R., Crutis, M.C., Teka, Z. (Eds.). Red Sea Press Inc., Trenton.

Shea, J.J. 2008. The Middle Stone Age Archaeology of the Lower Omo Valley Kibish Formation: Excavations, Lithic Assemblages, and Inferred Patterns of early *Homo sapiens* Behavior. Journal of Human Evolution 55, 448-485.

Singer, R., Wymer, J. 1982. *The Middle Stone Age at Klasies River Mouth in South Africa*. University of Chicago Press, Chicago, IL.

Stringer, C. 2000. Coasting out of Africa. Nature 405, 24-26.

Stuiver, M., Reimer, P.J., Reimer, R. 2005. CALIB 5.0 [WWW program and documentation]. .

Tchernov, E. 1992. Biochronology, paleoecology, and dispersal events of hominids in the southern Levant, In: Akazawa, T., Aoki, K., Kimura, T. (Eds.), The Evolution and Dispersal of Modern Humans in Asia. Hokusen-sha, Tokyo, pp. 149-188.

Thangaraj K, Chaubey G, Singh VK, Vanniarajan A, Thanseem I, R.A., Singh L. 2006. In situ origin of deep rooting lineages of mitochondrial Macrohaplogroup 'M' in India. BMC Genomics 7, 151.

Tosi, M. 1986. Survey and excavation on the coastal plain (Tihamah). East and West 36 (1-3), 400-414.

Van Peer, P. 1998. The Nile corridor and the Out-of-Africa model: an examination of the archaeological record. Current Anthropology 39, S115-S140.

Volman, T.P. 1978. Early archaeological evidence for shellfish collecting. Science 201, 911-913.

Walter, R.C., Buffler, R.T., Bruggemann, J.H., Guilaume, M.M.M., Berhe, S.M., Negassi, B., Libsekal, Y., Cheng, H., Edwards, R.L., von Cosel, R., Néraudeau, D., Gagnon, M. 2000. Early human occupation of the Red Sea coast of Eritrea during the last interglacial. Nature 405, 65-69.

Wendorf, F., Schild, R. 1974. *A Middle Stone Age Sequence from the Central Rift Valley, Ethiopia*. Polska Akademia Nauk, Warsaw, Poland.

White, T.D., Asfaw, B., DeGusta, D., Gilbert, H., Richards, G., Suwa, G., Howell, F.C. 2003. Pleistocene *Homo sapiens* from Middle Awash, Ethiopia. Nature 423, 742-747.

Winney, B.J., Hammond, R.L., Macasero, W., Flores, B., Boug, A., Biquand, V., Biquand, S., Bruford, M.W. 2004. Crossing the Red Sea: phylogeography of the hamadryas baboon, *Papio hamadryas hamadryas*. Molecular Ecology 13, 2819-2827.

Yellen, J., Brooks, A., Helgren, D., Tappen, M., Ambrose, S., Bonnefille, R., Feathers, J., Goodfriend, G., Ludwig, K., Renne, P., Stewart, K. 2005. The archaeology of Aduma Middle Stone Age Sites in the Awash Valley, Ethiopia. Paleoanthropology 10, 25 -100.

Yohannes, H. 2003. Wildlife conservation in Eritrea, Eritrea Horizons. Ministry of Tourism, Eritrea, Vision Africa, Oman, pp. 37-41.