

“Out of Arabia” and the Middle-Upper Palaeolithic transition in the southern Levant

„Out of Arabia“ und der Übergang vom Mittel- zum Jungpaläolithikum in der Südlichen Levante

Jeffrey I. ROSE^{1*} & Anthony E. MARKS²

¹ Ronin Institute, Montclair, NJ, USA; e-mail: jeffrey.rose@ronininstitute.org

² Southern Methodist University, Dallas, TX, USA; e-mail: amarks@mail.smu.edu

ABSTRACT - Beginning some 50 thousand years ago, a technological transition spread across the Near East and into Eurasia, in the most general terms characterized by a shift from preferential, prepared core reduction systems to the serial production of elongated points via opposed platform cores. The earliest known occurrence of such a technological shift is the Emiran Industry, whose oldest manifestations are found in the southern Levant. The cultural and demographic source(s) of this industry, however, remain unresolved.

Looking to archaeogenetic research, the emerging picture indicates a major dispersal of our species out of Africa between 100 and 50 thousand years ago. Ancient DNA evidence points to low levels of admixture between Neanderthal and pioneering modern human populations in the Near East. These propositions underscore the significance of the Emiran and beg a reassessment of its origins. In this paper, we ask whether the Emiran was a local development, a cultural/demographic replacement, or the fusion of indigenous and exogenous lithic traditions. Our analysis considers the techno-typological features of the Emiran in relation to late Middle Palaeolithic and contemporaneous assemblages from adjacent territories in northeast Africa and the Arabian Peninsula, in order to identify overlapping cultural features and potential antecedents. Parsimonious with the archaeogenetic scenario of admixture, the Emiran seems to represent a fusion of local southern Levantine Mousterian tool types with the Afro-Arabian Nubian Levallois reduction strategy. We propose that Emiran technology is primarily rooted in the Early Nubian Complex of the Nile Valley, which spread onto the Arabian Peninsula during the Last Interglacial and developed at the interface of northern Arabia and the southern Levant between 100 and 50 thousand years ago.

ZUSAMMENFASSUNG - Vor etwa 50.000 Jahren begann ein technologischer Wandel, welcher zuerst im Nahen Osten und folgend auch in Eurasien greifbar wird. Diese Veränderung wird im Allgemeinen gekennzeichnet durch das Ersetzen von präparierten, formbestimmenden Abschlagskernen durch bidirektionale Kerne, die der seriellen Herstellung von langgestreckten Spitzen dienen. Das früheste bekannte Auftreten eines solchen technologischen Wandels ist das Emiran, dessen älteste Erscheinungsformen in der südlichen Levante zu finden sind. Der kulturelle und demographische Ursprung dieser Industrie bleibt jedoch ungeklärt.

Jüngsten archäogenetischen Forschungen zufolge fand die Ausbreitung anatomisch moderner Menschen zwischen 100 und 50 tausend Jahren vor Heute statt. Nachweise durch aDNA deuten auf eine geringfügige Vermischung von Neandertalern und Pionieren der anatomisch modernen Menschen im Nahen Osten hin. Diese Tatsachen unterstreichen die Bedeutung des Emiran und verlangen eine Neubewertung dessen Herkunft. In diesem Aufsatz gehen wir den Fragen nach, ob das Emiran eine lokale Entwicklung, einen kulturell-demografischen Wechsel oder die Verschmelzung von indigen und exogen lithischen Traditionen darstellt. Die techno-typologischen Merkmale des Emiran werden mit den spätmittelpaläolithischen Industrien der Levante und den benachbarten Gebieten im Nordosten Afrikas und der Arabischen Halbinsel verglichen um überlappende kulturelle Merkmale zu erfassen. Des Weiteren sollen, mittels der vorgelegten Analysen, mögliche technologische Vorgänger des Emiran festgelegt werden. Entsprechend geringer genetischer Vermischung, scheint das Emiran eine Verschmelzung von typologischen Elementen des südlevantinischen Mousterian und der afro-arabischen, nubischen Levallois Abbautechnik darzustellen. In diesem Sinne sind die technologischen Wurzeln des Emiran vor allem in dem frühen nubischen Komplexen des Niltals zu suchen, welches seit dem letzten Interglazial auch in der Arabischen Halbinsel verbreitet war. Zusammenfassend liegt der Ursprung des Emiran demnach an der Schnittstelle von Nord-Arabien und der südlichen Levante zwischen 100 und 50 tausend Jahren vor Heute.

KEYWORDS - Out of Africa; Out of Arabia; Emiran Industry; Nubian Complex; Middle-Upper Palaeolithic transition; modern human dispersal
 Out of Africa; Out of Arabia; Emiran; Nubischer Komplex; Übergang Mittel- zu Spätpaläolithikum; Ausbreitung moderner Mensch

*corresponding author

Introduction: through a prism of paradigms

The following paper builds upon the "Out of Arabia" modern human expansion scenario proposed by Marks and Rose (2014). Our initial publication reviewed archaeological and genetic data to posit an origin of the Upper Palaeolithic in the southern Levant. From this synthesis, we concluded that there was some degree of cultural, hence demographic, input from populations in the Arabian Peninsula during early Marine Isotope Stage 3 (MIS 3). The work presented here expands and refines our hypothesis by providing a quantitative and qualitative description of the proposed archaeological scenario using lithic technological patterning across northeast Africa, Arabia, and the southern Levant.

As the only extant land bridge out of Africa, the "Levantine Corridor" is often presumed to have been a primary conduit of demographic exchange between Africa and Eurasia throughout the Quaternary. The transition from the Middle (MP) to Upper Palaeolithic (UP) in the Levant, which occurred during early MIS 3 around 50 thousand years ago (ka), has been explained by some as an influx of African groups through the Levantine Corridor bearing early UP cultural features (e.g., Bar-Yosef 1987; Tostevin 2000; Meignen & Bar-Yosef 2005; Douka et al. 2013). While it is clear that both anatomically modern humans (AMHs) and Neanderthals were present in the Levant prior to the UP (e.g., Stringer & Andrews 1988; Stringer 1994; Hublin 2000), the taxonomy of toolmakers and chronology of occupations (e.g., Shea 2007; Hovers & Belfer-Cohen 2013) are far from resolved. Due to this ambiguity, the archaeological record of the Levant tends to be tied to the prevailing paradigm of modern human evolution. The region serves as a prism through which to view these paradigms, guiding and framing scholars' views of the biological and behavioral emergence of our species.

Most of the Initial UP assemblages found in the vast territory stretching from central Europe to southwestern Asia and to northern Asia are recognized by a similar stage of technological development involving the serial production of elongated points via opposed platform, bidirectional core reduction systems (Kuhn & Zwyns 2014). The earliest known manifestation of this technological transition outside of Africa - the Emiran Industry - appeared some 50 ka in the southern Levant and subsequently spread northward (Leder 2013). Given the co-association of anatomically modern human remains (AMHs) with an Emiran assemblage at Ksar Akil in Lebanon, researchers often link the appearance of this technology during the Initial UP to the migration of AMHs out of Africa (e.g., Douka et al. 2013). Yet, despite its significance, the ultimate origin(s) of the Emiran Industry still remain unknown.

Broadly speaking, there are three possibilities to explain the appearance of the Emiran: 1) it arose from an exclusively local technological base, manufactured

by indigenous toolmakers (e.g., Ewing 1947; Garrod 1951; Copeland 1975; Azoury 1986; Bar-Yosef & Belfer-Cohen 1988; Ohnuma 1988; Demidenko & Usik 1993; Marks 2003); 2) it developed outside of the Levant from a non-Levantine technological base and was brought by foreign populations moving into the region (e.g., Mellars 1996; Tostevin 2000; Meignen & Bar-Yosef 2005; Shea 2008); or 3) its development was the fusion of a local tradition influenced by external stimuli from one or more adjacent regions (e.g., Van Peer & Vermeersch 2007; Van Peer et al. 2010; Meignen 2012; Marks & Rose 2014). The three paradigms of modern human evolution that accompany these interpretations of the MP-UP transition in the Levant are, respectively, a local development from archaic forms to modern, the total replacement of archaic populations by incoming modern human groups, and replacement with some admixture between these two species. Although the possibility of admixture was considered in the past (e.g., Ahrensburg & Belfer-Cohen 1998; Hawks & Wolpoff 2001), only recently has enough empirical evidence emerged to support genetic exchange between subspecies. Ancient DNA extracted from Neanderthal and Denisovan remains in Europe and Asia indicate that modern humans interbred, to some extent, with these populations, as well as with archaic groups within sub-Saharan Africa as recently as ca. 20 ka (Durand et al. 2011; Hammer et al. 2011; Reich et al. 2011; Skoglund & Jakobsson 2011; Alves et al. 2012; Meyer et al. 2012; Neves & Serva 2012; Sankararaman et al. 2012, 2014; Fu et al. 2014; Vernot & Akey 2014). Some researchers have proposed that the initial locus of AMH-Neanderthal admixture was in the Near East, inferred from the distribution of shared Neanderthal markers among all modern Eurasian populations (Green et al. 2010; Yotova et al. 2011; Sanchez-Quinto et al. 2012). This has significant implications for understanding the Levantine archaeological record, making total replacement of local populations by African emigrants unlikely.

Only recently have we been able to reconsider early human occupation in the southern Levant in respect to the adjacent Arabian Peninsula. The posited significance of the southern dispersal route out of Africa (e.g., Lahr & Foley 1994; Quintana-Murci et al. 1999; Kivisild et al. 2004; Metspalu et al. 2004; Forster & Matsumura 2005; Macaulay et al. 2005; Ghirotto & Barbujani 2011) served to invigorate archaeological fieldwork programs throughout Arabia over the past decade. In stark contrast to the "coasting out of Africa" model (Stringer 2000; Mellars 2006; Oppenheimer 2009; Mellars et al. 2013), all of these new findings in Arabia unanimously suggest that demographic movements into and out of the Peninsula were not associated with occupation of the littoral zone, and were far more complex than previously considered (e.g., Rose 2006, 2007; Bailey 2009; Crassard 2009; Rose & Petraglia 2009; Rose & Usik

2009; Armitage et al. 2011; Rose et al. 2011; Delagnes et al. 2012; Petraglia et al. 2011, 2012; Usik et al. 2013).

Reviewing these new data, we revisit the origins of the southern Levantine Emiran Industry, *sensu stricto*. As we have previously suggested (Marks & Rose 2014), the technological trajectories of Arabia and the southern Levant appear to have been long intertwined. The two regions encompass a single but varied physiographic landmass belonging to the Saharo-Arabian phytogeographic zone (Al Nafie 2008); logically, discussions of potential population movements to and from the southern Levant should include Arabia, as well as Africa.

Background

Recognizing and defining the Emiran

The Emiran Industry was formally defined by Garrod (1951) and named for the type assemblage excavated at Mugharet el-Emireh (Garrod 1955). Such assemblages bore a mix of both MP and UP diagnostic features, including MP tools made on classic Levallois blanks, typical UP tools made on UP blade blanks, and Emireh points - Levallois points with distinct bifacial basal thinning (Garrod 1951: 128). Garrod (*ibid.*: 129) emphasized that at el-Wad there was "an absence of forms transitional from one to the other" and attributed the presence of a prismatic blade technology to the "invention of a new technique within an old tradition." This was the initial definition of the Emiran. Because of the Emiran's stratigraphic position within clearly defined MP-UP sequences, as well as the presence of both MP and UP tools and blanks, Garrod (*ibid.*) interpreted the industry as being both "truly intermediate" and "truly transitional" between the MP and UP.

By the 1970s, Garrod's definition had been changed: rather than a simple co-association of MP tools on Levallois blanks and UP tools on UP blade blanks, the assemblages were described as essentially consisting of UP tools (e.g., burins, end scrapers and chamfered pieces) made on elongated Levallois blanks (Azoury 1986), as well as elongated points from unipolar cores, which "differ little from those of the Levallois-Mousterian levels below" (Copeland 1975: 337). Aside from the north/south dichotomy in type fossils, with chamfered pieces in the north (Newcomer 1970) and Emireh points largely in the south (Copeland 2001; Volkman & Kaufman 1983), the Emiran was conceived as static, with no technological or typological development through time.

Our understanding of the Emiran developed considerably in the early 1980s, with the discovery of the stratified site of Boker Tachtit (Fig. 2: 1). The site's state of preservation allowed for large-scale core reconstructions and detailed descriptions of technological changes over four consecutive periods beginning around 50 ka (Marks 1983b). These changes manifested in a shift from Level 1 at the bottom of the

sequence, which exhibits a standardized, hard hammer bidirectional Levallois point and blade reduction strategy utilizing extensive cresting in initial core shaping (Fig. 1), to Level 2, which shows a co-association between the bidirectional Levallois point production system and hard hammer volumetric blade core reduction, primarily bidirectional with occasional unidirectional flaking, to Level 3, with a marked shift away from bidirectional Levallois point cores and to an increase in unidirectional reduction. Finally, in Level 4, the assemblage is dominated by a hard hammer volumetric blade strategy, mainly unidirectional, but with some bidirectional reduction, as well (Volkman 1983). The sequence begins with Levallois point and blade reduction and ends with an entirely non-Levallois blade strategy; yet, this change in technology had very little impact on the morphology of the blanks produced, and virtually no effect on the tool types, which throughout were dominated by points and various types of burins and end scrapers (Marks & Kaufman 1983).

The technological developments documented at Boker Tachtit (Volkman 1983, 1989) raised the question as to when the "transitional" Emiran had reached a stage it could be perceived as being fully UP. In this case, the disappearance of Levallois reduction in Level 4 was the criterion by which the Initial UP at Boker Tachtit was recognized (Marks & Ferring 1988). In combining the Üçağizli sequence with that at Boker Tachtit, Kuhn et al. (2009) lost the taxonomic distinction between Emiran (Boker Tachtit, Levels 1 - 3) and Initial UP (Boker Tachtit, Level 4). Most recently, scholars working on this topic (i.e., Leder 2013; Kuhn & Zwyns 2014; Marks & Rose 2014) have reasserted a strict definition of the industry by limiting the Emiran to those assemblages technologically and typologically comparable to Boker Tachtit, Levels 1 - 3. We consider only those levels from Boker Tachtit as Emiran.

Leder's (2013) study of MP-UP transitional assemblages in the Levant recognizes two distinct industries: the Emiran, occurring primarily in Lower Galilee, and a new industry called "Bokerian," which Leder (*ibid.*: 162) describes as "a specific industry within the Levant that emerged in the Negev desert and later spread into Lebanon and western Jordan." The author divides the Bokerian into seven chronological phases, with its initial stage linked to Boker Tachtit, Level 1, and final phase associated with the Üçağizli sequence. Although his terminology differs from that used in this paper, we fully agree with Leder's recognition of a transitional industry that emerged in the Negev and subsequently spread northward.

Methods

Evaluating the origins of the Emiran

Part of the problem lies in what actually constitutes an "origin" or "transition." Origins are either inherently

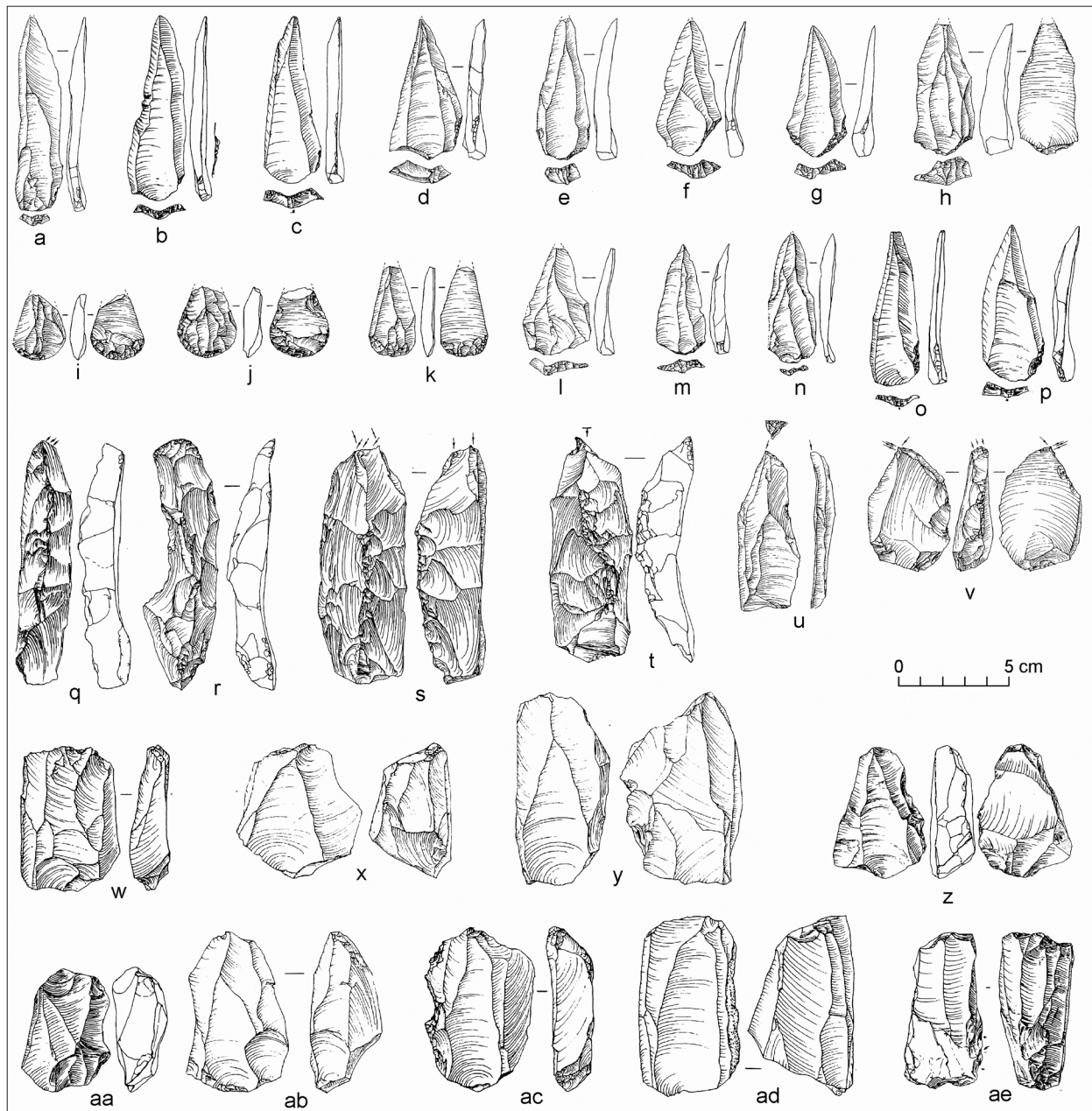


Fig. 1. Early Emiran artifacts from the southern Levant: Levallois points from Boker Tachtit, level 1 (a,d,e-h,l-n) and 'Ain Difla, levels 1-5 (b,c,o,p); Emireh points from Boker Tachtit, level 1 (i-k); crested blades from Boker Tachtit (s,t) and 'Ain Difla (q); burins from Boker Tachtit, level 1 (u,v); endscraper on crested blade from Boker Tachtit, level 1 (r); Levallois point cores from Boker Tachtit, level 1 (w-y,aa-ad) and 'Ain Difla (z,ae). Illustrations after Marks and Kaufman (1983: Figs. 5.2, 5.6-5.9, 5.11, 5.18); Demidenko and Usik (1993: Figs. 2-7).

Abb. 1. Steinartefakte des frühen Emiran aus der Südlichen Levante: Levalloisspitzen aus Boker Tachtit, Level 1 (a,d,e-h,l-n) und Ain Difla, Level 1-5 (b,c,o,p); Emireh-Spitzen aus Boker Tachtit, Level 1 (i-k); Kernkantenklingen aus Boker Tachtit (s,t) und Ain Difla (q); Stichel aus Boker Tachtit, Level 1 (u, v); Kratzer an Kernkantenklinge aus Boker Tachtit, Level 1 (r); Levalloisspitzenkerne aus Boker Tachtit, Level 1 (w-y, aa-ad) und Ain Difla (z, ae). Zeichnungen nach Marks und Kaufman (1983: Abbildungen 5.2, 5.6-5.9, 5.11, 5.18); Demidenko und Usik (1993: Abbildungen 2-7).

difficult or extremely easy to recognize and define. They are easily recognized when they represent an obvious in situ transformation from one state to another in a stratified context, (e.g., the passage from Emiran to Initial UP at Boker Tachtit), or the relatively sudden appearance of something so different from what came before that no serious case could be made for autochthonous developmental change (e.g., the appearance of the Aurignacian in the Levant). These situations are extremes, however, and most transitions

tend to be far less obvious and more difficult to define.

Finding the root of a lithic industry first involves differentiating between continuity and discontinuity. In this case: does the Emiran industry represent something new to the region, or is it merely a late manifestation of the Levantine MP? The detailed technology of core formation and blank production, as described in Copeland (1975), is essentially the same as that in the local MP. Yet, if this same pattern can be shown to also occur in Africa around that time,

then an African origin for the Emiran is also a reasonable option. The same may be said for Emiran typology: are the Emiran type fossils (i.e., the Emireh point and the chamfered piece) associated with typical UP tools found somewhere in Africa, either with or without Levallois technology? What of the predominance of UP tools made on Levallois blanks, does such a pattern exist in the Levant outside of the Emiran? Does it exist in Africa, at all?

In this paper, we systematically consider from whence came the Emiran, in light of techno-typological attributes found in contemporary and preceding industries from 1) the southern Levant, 2) northeast Africa, and 3) the Arabian Peninsula. On a very broad level, Emiran technology (i.e., hard hammer removals, presence of Levallois *per se*, etc.) is not very useful for tracking its origin because these attributes are very widespread and may represent technological convergence from disparate cultural bases (Kuhn et al. 2009). Within the Levallois method, however, there are different reduction strategies that have limited distributions in time and space. Since virtually all MP industries have some retouched tools, the composition of tool assemblages and the presence or absence of specific tool types are valid observations for comparison when shown to document regional, time-transgressive patterns.

Since Bordes (1950, 1953) introduced the “total tool assemblage” as the unit of comparison, it has become the norm. For this paper, however, we are concerned with typology mainly at the class level and across a huge geographic spread. Those factors that influence total tool assemblages: e.g., site function, intensity of occupation, availability of raw material, cave versus open-air sites, etc. simply cannot be controlled for and add noise to the broader trends of interest here. In order to remove as much noise as possible in our study, we exclude most central and northern Levantine sites from our analysis. This area is not part of the contact zone between posited populations expanding from Arabia and/or Africa. Moreover, most, but not all (Zaidner et al. 2014), of the published MP sites in the northern Levant are found in karstic cavities, while in the whole of the southern Levant, Arabia and the Nile Valley, there is only one thinly deposited cave site (Sodmein Cave in the Red Sea Hills) and three shallow rock shelters (Tor Sabiha and Tor Faraj in Jordan and Jebel Faya in eastern Arabia). By excluding most Levantine cave sites, we also avoid the fundamental differences between cave and open-air occupations. Only some of those central and northern sites with Tabun-C like assemblages are included, since they do not occur in the south and their association with AMH fossils is clearly relevant here.

Characterizing Emiran technology and typology

In the Emiran, there were a few variations in how blocks of raw material were shaped into cores,

particularly the initial formation of ridges on both the major core surfaces and at the core extremities prior to platform formation (Volkman 1989: Fig. 6-3). The ridges formed on the major flaking surface and the two extremities were then struck off, resulting in classic crested blades, while the ridge formed on the bottom of the core was left intact throughout subsequent core reduction (Volkman 1989: Fig. 6-6). After the ridge formation on the major flaking surface and the extremities, the latter were flaked to create striking platforms, during which a small crested blade was produced from each end. One platform was used to strike off the ridge along the major flaking surface, resulting in a long crested blade (Volkman 1989: Fig. 6-6). The major flaking surface was cleared of what cortex remained, and then blades were struck from both platforms to shape the flaking surface, platforms being rejuvenated as needed and, in the case of Levallois point production, to establish the appropriate Y-arête pattern. In the case of point cores, three removals were required to set up the point removal. First, a flake was struck from one end of the core, then two elongated blanks were struck from the other end, forming a central arête. Finally, a point was struck from the first platform.

A large number of reconstructions show variations on this theme: the number of blanks struck, the number of platform rejuvenations, other means of stripping cortex, etc. (ibid.). Yet, the basic two patterns remain the same for all Levallois cores, whether point, flake, or blade: bidirectional removals and the initial use of constructed crests to set up core surfaces, which comprised the majority of the Level 1 core assemblage (Fig. 3). Hence, while the predominant use of bidirectional flaking may be a signature characteristic in tracking the source of the Emiran, the co-association of these two distinct reduction strategies is also significant.

The lack of extensive core reconstructions at other southern Levantine MP sites means that technological similarities and differences with Boker Tachtit, Level 1, can only be addressed via the products of its signature bidirectional reduction strategy. Bidirectional core reduction, regardless of the specific reduction strategy, is monitored both through the scar patterns on the primary working surface of abandoned cores, and by dorsal scar patterns on byproducts and endproducts of core reduction. Two kinds of bidirectional scar patterns exist, only one of which indicates true bidirectional reduction. In the most common case, a few short scars originate from one end of the core or blank, while most of the scars were struck from the other end. In these cases, the platform with a few scars is considered secondary and the result of core maintenance when convexities need to be re-established (Monigal 2002: 162-165; Mustafa and Clark 2007: 65-68). On the other hand, when dorsal scar patterns show removals originating from both distal and proximal platforms that meet close to the

mid-point of the flaking surface of the core (or on the dorsal surface of the blank), then true bidirectional reduction may be inferred. For our analysis, we measure the frequency of bidirectional reduction within each assemblage using an index of bidirectionality (IBi), calculated by the number of cores exhibiting at least one working surface with some form of bidirectional flaking strategy (i.e., preferential or recurrent opposed platform Levallois, Type 1 Nubian Levallois, or bidirectional blade cores).

In terms of typology, Emiran assemblages are characterized by a high percentage of UP tools and Levallois points (Fig. 3). The predominance of UP retouched tools alongside Levallois points, however, does not clearly distinguish the Emiran from Levantine Mousterian sites. In the south, MP assemblages at Rosh Ein Mor (Fig. 2: 12), Nahal Aqev (Fig. 2: 7), and 'Ain Difla (Fig. 2: 6) all have significant numbers of both Levallois points and UP type tools. In particular, burins and end scrapers were found manufactured on elongated Levallois blanks, in conjunction with MP tools that were well in the minority (Marks & Crew 1972; Marks & Kaufman 1983; Munday 1976, 1977; Clark et al. 1997). Even at the late MP sites of Tor Faraj, top C (Fig. 2: 2), and WHS621 (Fig. 2: 3), UP tools are

more numerous than MP variants (Henry 1995, 1998). Thus, the dominance of UP tools over MP tools is consistent across the southern Levant, regardless of the type of Mousterian industry that is present.

Another important typological aspect of the Emiran is the percentage of Levallois points, including Emireh points (Levallois points with bifacial basal thinning), relative to the number of traditionally diagnostic MP (Bordes 1961) and UP tools (e.g., de Sonneville-Bordes & Perrot 1954). In Boker Tachtit Level 1, the high proportional occurrence is consistent with Mousterian sites in the southern Levant, regardless of age (Fig. 3). Thus, Levallois point production is time-transgressive, typical of both Emiran and MP assemblages in the region. This trait is also characteristic of Tabun type D and B assemblages in the northern Levant (Meignen & Bar-Yosef 2005) and, as such, typifies much of the Levantine Mousterian.

One additional typological characteristic of the Emiran, particularly in Boker Tachtit Levels 1 and 2, is right lateral or bilateral nibbling to steep retouch adjacent to the platforms of Levallois points. On some it is minor, but the number of points and blade/points with this modification is striking: 65% in Level 1 and 59.5% in Level 2 (Marks & Kaufman 1983). Although

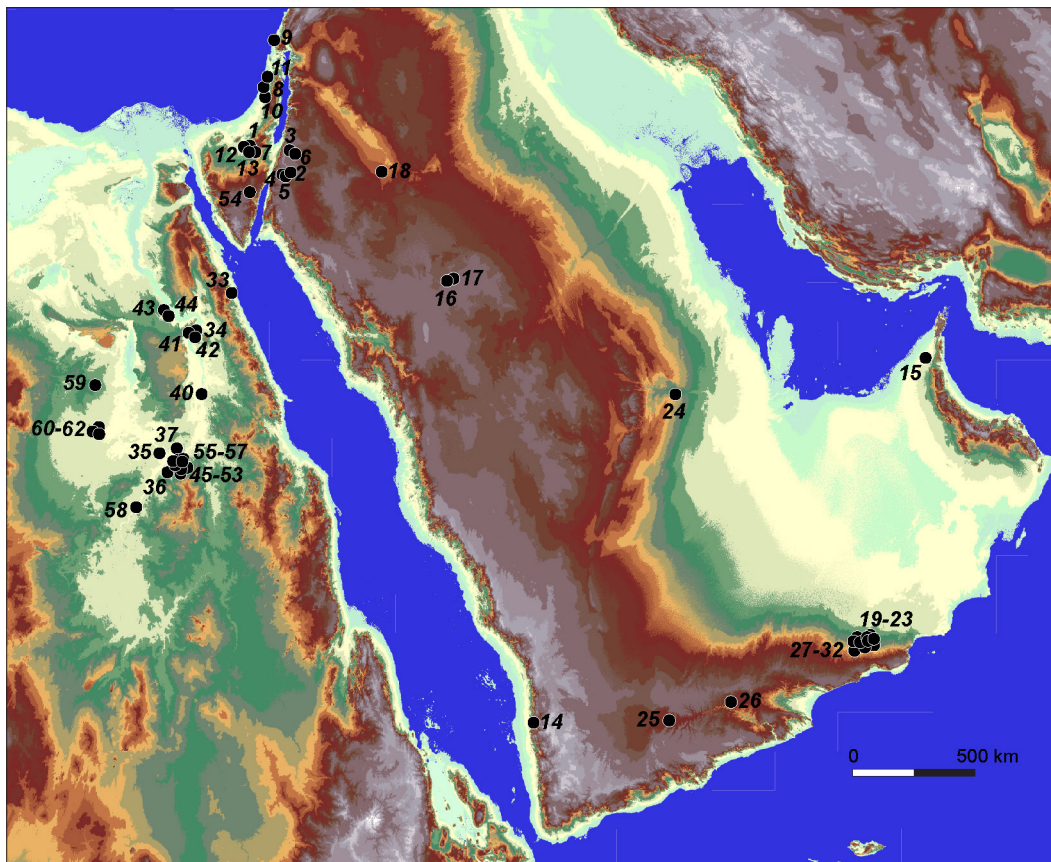


Fig. 2. Map of Middle Palaeolithic/Middle Stone Age approximate site locations included in this study. Sites correspond to the reference numbers listed in Figures 3, 8 & 11. DEM courtesy of Yamandú Hilbert.

Abb. 2. Karte zur Lage der in dieser Studie einbezogenen Fundstellen. Die Nummerierung der Fundstellen entsprechen denen in Abb. 3, 8 & 11. Das digitale Höhenmodell wurde von Y.H.Hilbert erstellt.

Assemblage	Reference #	Pts, MP, & UP tools (n)	% Levallois points	% MP tools	% UP tools	Blanks (n)	ILam	Cores (n)	IBi
Emiran									
Boker Tachtit, level 1	1a	63	70	2	33	4274	40	58	91
Boker Tachtit, level 2	1b	155	42	3	56	9432	29	198	84
Boker Tachtit, level 3	1c	15	87	0	13	2147	35	34	71
Late Levantine Mousterian									
Tor Faraj, top C	2	131	78	6	16	372	26	41	25
WHS 621	3	279	36	49	15	4005	19	71	N/A
J444	4	85	95	4	1	1468	38	30	N/A
Tor Sahbiha	5	59	90	7	3	1867	37	10	N/A
Ain Difla, all levels	6	336	83	5	16	7228	45	180	30
Nahal Aqev, level 3a-b	7a	55	56	18	26	1938	26	76	11
Nahal Aqev, level 3c-e	7b	200	64	16	20	3531	28	197	6
D40	12	23	70	9	22	504	29	140	36
Early/Middle Levantine Mousterian									
Skhul, B1	8	1304	7	87	6	2564	N/A	1127	N/A
Ksar Akil, level XXVI A	9a	85	0	82	18	171	24	56	13
Ksar Akil, level XXVI B	9b	73	10	81	10	306	20	90	19
Ksar Akil, level XXVII A	9c	54	0	69	32	227	25	116	17
Ksar Akil, level XXVII B	9d	125	14	61	26	546	26	110	14
Tabun, Bed 39	10	105	19	71	10	194	29	26	N/A
Qafzeh, levels XXII-XVII	11	107	8	40	53	1877	9	67	12
Rosh Ein Mor, all levels	13	2795	64	8	28	41574	29	1153	11

Fig. 3. Composite data for Levantine sites included in the study. Site reference number corresponds to the map number on Figure 2 as well as the plot numbers on Figures 13 & 14.

Abb. 3. Aufgeführt sind die technischen Daten der Levantinischen Fundstellen, die in der hiesigen Studie behandelt werden. Referenznummer der Fundstellen stimmen mit der Karte in Abbildung 2 und dem Diagramm in Abb. 13 & 14 überein.

this trait is difficult to compare with other assemblages in the region because it was not consistently recognized, there are data to suggest that it is not time-transgressive, but only common in Late Mousterian assemblages, regardless of the Tabun industry type.

Through these signature Emiran characteristics (i.e., elongated point production via a bidirectional Levallois reduction strategy, the use of lateral cresting in core preparation, the significant presence of UP tool types, right lateral/bilateral nibbling at the base of Levallois points from hafting, and the production of Emireh points), we examine lithic techno-typological patterning in the southern Levant and surrounding areas from the time period between approximately 130 - 50 ka. In theory, the Emiran should demonstrate significant overlap, in both core reduction strategies and tool types, with the industry from which it arose.

Archaeological Evidence

The southern Levant

The Tabun problem

Determining whether or not the Emiran is rooted in the southern Levantine MP, or comes from an exogenous source, depends largely upon how one interprets the geographic and temporal relationship of Levantine Mousterian industries. Logic suggests that any argument for or against continuity should

consider the youngest Mousterian and the oldest Emiran assemblages (Tostevin 2003). This logic, however, necessitates acceptance of the view that the MP sequence from Mount Carmel (e.g., et-Tabun and Kebara) is pan-Levantine, both chronologically and techno-typologically (e.g., Howell 1959; Bar-Yosef 1980, 1998; Tostevin 2003).

Until the early 1980s, such a view was reasonable, since little was known of MP assemblage types outside of Mount Carmel and Lebanon. Taking into account the sizable body of evidence amassed over the last three decades, however, numerous scholars have forcefully argued that the Tabun assemblage type definitions are not representative of the technological complexity found across the whole of the Levant (e.g., Hovers 1998; Goren-Inbar & Belfer-Cohen 1998; Hovers 2009; Hauck 2011; Meignen 2011; Leder 2013; Marks & Rose 2014). As such, our use of the Tabun terminology should be understood as a necessary evil, in order to engage with pre-existing literature, and not a reflection of the actual range of Levantine Mousterian variability. At this point, there is little doubt that the MP Tabun industries are neither chronologically linear nor pan-Levantine.

In particular, the southern Levantine sequence indicates that some form of Tabun D-like Mousterian lasted longer in the arid margins than it did in the Mediterranean zone, where there was a major

technological shift seen in the appearance of Tabun C-type assemblages. The chronology of the southern Levant raises the possibility that some form of Tabun D-like industry persisted in the Negev after 80 ka, thus, may be considered as a potential candidate for the cultural source of the Emiran.

The Early Levantine Mousterian

In the northern Levant, Tabun D assemblages are roughly bracketed between 270 and 150 ka. These ages vary widely, depending upon which dating technique is used. In the case of TL, the range is 270 - 170 ka, while ESR produces results between 200 and 150 ka (Bar-Yosef 1998). In the same caves, TL and ESR measurements from Tabun C assemblages range from 170 ka to 85 ka (*ibid.*). Given the average TL (92 ± 5 ka) and ESR (96 ± 13 ka) ages on the Tabun C materials from Qafzeh (Fig. 2: 11), Tabun C is likely to be closer to 100 ka than to 170ka.

Dates from the southern Levant are much less consistent. The Tabun D site of Rosh Ein Mor produced a Th/U date of 200 ka (Rink et al. 2003), corresponding with comparable assemblages in the north. The Tabun D-type assemblage at Nahal Aqev, however, is younger than ~80 ka, based on two Th/U dates (85.2 ± 10 ka and 74 ± 5 ka) from a travertine directly underlying an elongated Levallois point embedded in the adjacent fossil spring (Schwarcz et al. 1979). While additional dates are desirable, there is presently no good reason to reject them (*contra* Shea 2003).

Within the Early Mousterian assemblage from Rosh Ein Mor in the central Negev, there are trivial amounts of bidirectional reduction (Fig. 4). Among the Levallois cores, 3% show bidirectional removals on the major flaking surface (Munday 1976: Table 6-14), while 2% of blades have comparable scars (Monigal 2002: Appendix D). Levallois points exhibit a similar pattern, with less than 3% struck from opposed platform cores (Crew 1976: 83; Henry 1992: Table 11.2). Flat, opposed platform cores of all types account for 13%, most of which were small, heavily reduced, and close to exhaustion (Monigal 2002: 352). In terms of the Levallois points with limited retouch adjacent to the butt - one of the key features of the Emiran - only 8% of Levallois points at Rosh Ein Mor had any retouch and none was similar to those from Boker Tachtit, (Crew 1976: 100; Monigal 2002).

An undatable surface workshop, the assemblage from D40 was initially ascribed to the Early Levantine Mousterian, yet exhibits some degree of bidirectional reduction (Fig. 3). Although the two sites are in close proximity, D40 differs from Rosh Ein Mor in that regard, and might suggest a later date closer to 'Ain Difla. Unlike the triangular/sub-triangular point cores found at 'Ain Difla, however, the D40 specimens are mainly squat and ovate (Monigal 2002: 382).

In the Sinai Peninsula, surveys in the north located a single MP surface scatter with centripetal Levallois

reduction, which may be one of the few Tabun C-type sites outside the Mediterranean zone (Gilead 1985). Two assemblages in secondary but stratified position were excavated at the Split Rock site (Fig. 2: 54) in central Sinai (Kobusiewicz 1999); OSL ages indicate the lower horizon falls within MIS 5.3 (~100 ka) and the upper around MIS 5.1 (~75 ka) (Kobusiewicz et al. 2001). Technologically, the two assemblages are seemingly distinct; the lower is characterized by a combination of preferential Levallois and non-Levallois reduction strategies, mainly discoidal, single platform, and multiplatform. Bidirectional cores occur, but are rare (9%). Blade production is minor and comes from single platform cores. Although no Levallois point cores were found, four points were present. From the cores, the upper horizon is dominated by preferential Levallois flake reduction, accompanied by single and multiplatform reduction. Again, bidirectional cores are uncommon (8%) and only two blades come from such cores. Typologically, the lower horizon has few retouched tools aside from notches, denticulates and simple retouched pieces, insufficient tools to warrant discussion. It is clear, however, that Levallois point production was rare (one point and one point core), while Levallois flake production was considerably more frequent. MP tools far exceed UP types, with no fewer than ten sub-types of side scraper (Kobusiewicz 1999: 197).

The Late Levantine Mousterian

In the Negev, the chronologically late Levantine Mousterian site of Nahal Aqev, dated to ca. 80 ka, shows a similar technological pattern to the nearby Tabun D-like assemblage from Rosh Ein Mor (Figs. 3, 5). On the southern Jordanian plateau, over 50 Levantine Mousterian surface scatters and a handful of rockshelters were found, including the "Tabun B" assemblages from Tor Sabiha (Fig. 2: 5) and Tor Faraj (Potter 1995; Henry 1995, 1997, 1998, 2003). Three TL dates from Tor Faraj, top C range from 43.8 ± 2 ka to 52.8 ± 3 ka, averaging 48 ± 2.7 ka (Henry 1998), making it contemporary with the youngest of the Tabun B assemblages at Kebara Unit VI, dated to 48 ± 3.5 ka (*ibid.*). AAR measurements on Tor Faraj, top C and Tor Sabiha, top C provided matching ages of 69 ± 6 ka (Henry 1995). While correlating TL and AAR dates is difficult, the AAR dates indicate that the occupations at Tor Faraj, top C and Tor Sabiha, top C were essentially contemporary, and based on the TL dates, were coeval with Boker Tachtit, Level 1.

The ages of the 'Ain Difla assemblages are open to interpretation. Three ESR dates from Test A, levels 19 and 20, produced early uptake readings between 88.3 ka and 112.5 ka, averaging 98.8 ± 12.7 ka, while late uptake for the same samples gave a range of 142.8 ka to 185.8 ka, with an average date of 161.1 ± 28.2 ka (Clark et al. 1997). One ESR date from Level 12 gave an early uptake date of 114.5 ± 14.2 ka, while under the assumption of late uptake it was

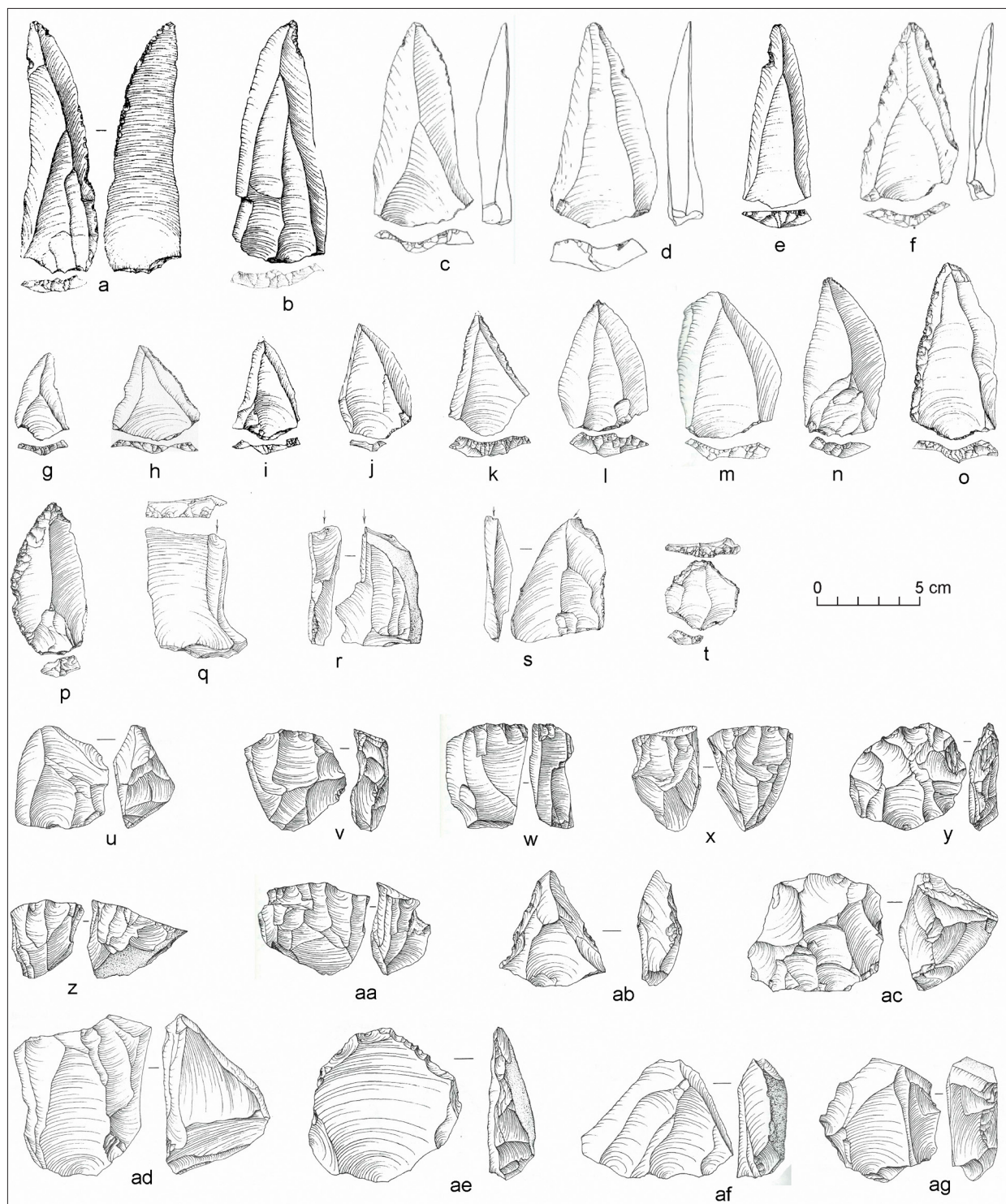


Fig. 4. Early Levantine Mousterian artifacts from Rosh Ein Mor: Levallois points (a-o); sidescraper (p); burins (q-s); endscraper (t); unidirectional-convergent Levallois cores (u,ab,af,ag); bidirectional Levallois core (ad); centripetal Levallois cores (v,v,ac,ae); single platform unidirectional cores (x,z,aa). Illustrations after Crew (1976: Figs. 5.3-5.10).

Abb. 4. Steinartefakte des frühlevantinischen Moustérien aus Rosh Ein Mor: Levalloisspitzen (ao); Schaber (p); Stichel (q – s); Kratzer (t); Unidirektional-konvergierend präparierte Levalloiskerne (u, ab, af, ag); Bidirektional präparierter Levalloiskern (ad); Zentripetal präparierter Levalloiskern (v, ac, ae); Unidirektionale Plattformkerne (x, z, aa). Zeichnungen nach Crew (1977: Abbildungen 5.3- 5.10).

165.7 ± 20.5. A TL date from Level 5 gave a reading of 105 ± 15 ka and an ESR date of 102.9 ± 12.9 ka (Bar-Yosef 1998: Table 1). Although Mustafa and Clark (2007) bracket the 'Ain Difla occupations between 90 and 180 ka, the technology and typology of levels 20 to 5 fully support the early uptake readings of ca.

100 ka. The undated strata above level 5, the assemblages of which so strongly resemble Boker Tachtit, Level 1, may be closer to 50 ka.

At the later Tabun B-like sites excavated on the Jordanian plateau (i.e., Tor Faraj and Tor Sabiha), the assemblages show a common use of bidirectional

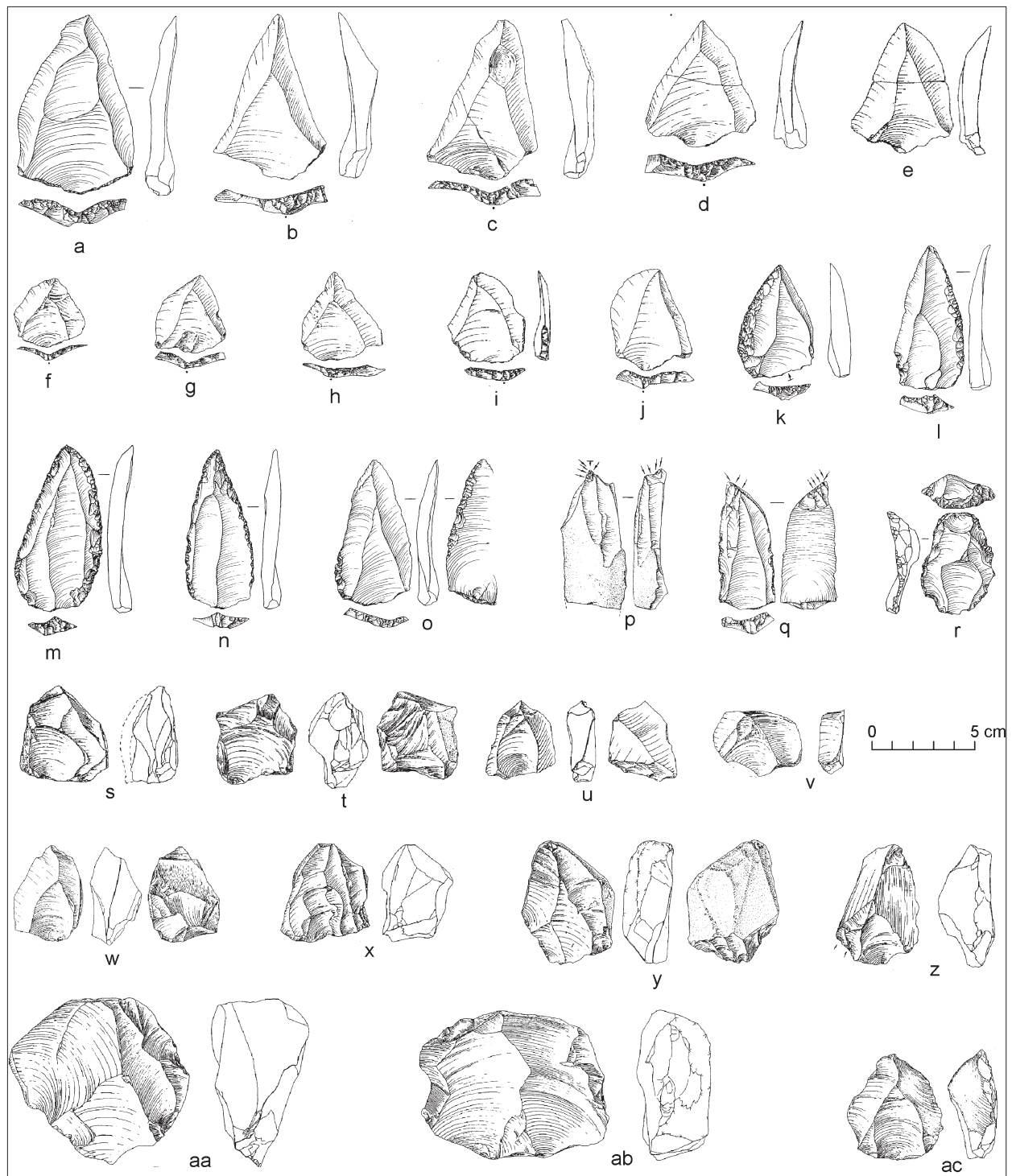


Fig. 5. Late Levantine Mousterian artifacts from the southern Levant: Levallois points from Nahal Aqev (a) and Tor Faraj (b-j); retouched Levallois points from Nahal Aqev (k-o); burins from Nahal Aqev (p,q); endscraper from Nahal Aqev (r); unidirectional-convergent Levallois cores from Tor Faraj (s-ac). Illustrations after Munday (1977: Figs. 2.5-2.7); Demidenko and Usik (2003: Figs. 6.1-6.26).

Abb. 5. Steinartefakte des spätlebantischen Moustérien aus der Südlichen Levante: Levalloisspitzen aus Nahal Aqev (a) und Tor Faraj (b-j); Retuschierte Levalloisspitzen aus Nahal Aqev (k-o); Stichel aus Nahal Aqev (p,q); Kratzer aus Nahal Aqev (r); Unidirektional-konvergierend präparierte Levalloiskerne aus Tor Faraj (s-ac). Zeichnungen nach Munday (1977: Abbildungen 2.5-2.7); Demidenko und Usik (2003: Abbildungen 6.1-6.26).

preparation (Henry 1997, 1998), the frequency of which increases as the point cores are reduced in size (Henry 2003: 71). At Tor Faraj, 25% of the Levallois point cores have bidirectional preparation, while from 53% to 49% of the Levallois points have bidirectional

scar patterns, depending upon the publication (Henry 1998 vs. Henry 2003). Groucutt (2014) provides different calculations for Tor Faraj: Levallois points with bidirectional scar patterns are said to comprise only 8%. The author does not address this discrepancy;

until independently confirmed, we adhere to the primary site reports published by Henry (1995, 1998). From these reports, it seems that bidirectional point preparation was a component of the later stages of the Tor Faraj core reduction strategy.

At Tor Sabiha, too few cores were recovered to be meaningful, but 51% of the 52 Levallois points have bidirectional dorsal scar patterns (Henry 1995, 1998), as do 26% of the blades (Monigal 2002: 452), which is consistent with Tor Faraj. There are the high percentages of Levallois points with right lateral retouch (Henry 1995: Figs. 5.13, 5.22), although retouch in other positions is more common at Tor Faraj than at Boker Tachtit. Data presented by Groucutt (2014: Fig. 12) for the same observations are radically different, perhaps owing to a different use of nomenclature.

In stark contrast to the other Tabun D-like assemblages, and particularly to Tabun itself (Shimelmitz & Kuhn 2013), the lower and middle levels of 'Ain Difla have over 50% bidirectional cores, while in the upper five levels they account for 49%. Blades from the lower levels (15 - 20) are similar to the cores: 44% have bidirectional scar patterns. This falls to 28% for the middle levels (6 - 14) but again rises to 43% in the top five levels (Mustafa & Clark 2007: Table 7). Thus, bidirectional preparation of cores is well represented from the earliest occupations at 'Ain Difla, making it distinct from Tabun D-like sites in the Negev, with which it may temporally overlap. In fact, a study of 'Ain Difla's blade technology led Monigal (2002: 488) to conclude that, in spite of the temporal discrepancies, all of the 'Ain Difla assemblages should be considered technologically the same as Boker Tachtit, Level 1. Typologically (Lindly & Clark 1987, 2000), the upper levels of 'Ain Difla exhibit the same pattern of retouched Levallois points as at Boker Tachtit.

While bidirectional core preparation alone might be found in unrelated contexts, the combination of bidirectional Levallois point core preparation with the use of cresting for initial core formation is unusual. Cresting is common in the Early Levantine UP (Monigal 2003; Davidzon & Goring-Morris 2003); yet, it is rare in MP assemblages such as Tabun, Unit IX (Shimelmitz & Kuhn 2013) or Hayonim, Lower E (Meignen 1998: 172), where the production of elongated blanks was well developed, and even where volumetric cores are present in some numbers (Marks & Monigal 1995). At Rosh Ein Mor, there was neither a single core suggesting the use of cresting, nor a single crested piece reported from the debitage (Crew 1976). The same is true for the Tabun D-like surface sites in the Nahal Zin area (Munday 1976). At Nahal Aqev (Munday 1977), there are a small number of core trimming elements, but these do not indicate cresting, *sensu stricto* (Monigal 2002: 411). There are a few core trimming elements reported from Tor Sabiha and Tor Faraj (Henry 1995, 1998), but they do not include crested blades. Rather, they tend to be "non-diagnostic flake-proportioned

elements that removed a part of a lateral or a distal end of the core" (Monigal 2002: 449). The only crested blades known in the southern Levant from a pre-UP context, aside from Boker Tachtit, are those from Levels 1 - 5 at 'Ain Difla (Demidenko & Usik 1993; Mustafa & Clark 2007). In addition, 'Ain Difla yielded six cores with crested backs (Mustafa & Clark 2007: 68-69), a type only known from the early Emiran at Boker Tachtit (Volkman 1983). Given both the qualitative and quantitative similarities between 'Ain Difla Levels 1 - 5 and Boker Tachtit, Level 1, it is difficult not to assign 'Ain Difla to the Emiran.

Northeast Africa

We define northeast Africa as the territory encompassed by the Nile Valley and flanking Eastern and Western deserts. This region has undergone some of the most intensive and extensive archeological investigations in all North Africa (for histories of research see Wendorf & Schild 1976; Van Peer & Vermeersch 1990; Van Peer 1998; Kleindienst 2006; Vermeersch 2012). The MP of this area is exceedingly complex, and investigations spread over almost 100 years have led to myriad industry names (e.g., Levalloisian, Mousterian, Denticulate Mousterian, Nubian Mousterian Type A, Nubian Mousterian Type B, Nubian Middle Palaeolithic, Khormusan, etc.). Van Peer and Vermeersch (2000, 2007) helped condense this ample array of taxa by organizing them all into three chronological stages - Early, Middle, and Late MP - that encompass two different technocomplexes, based primarily on variations in the Levallois method (Van Peer 1988, 1992). Although this organization has not been universally accepted and may require some modification (Wendorf & Schild 1992; Garcea 2001; Kleindienst 2006), it does provide a working structure based on specific technological criteria, thus, bringing some harmony to the cacophony of nomenclatures.

The Nubian Levallois method

In contrast to the Levantine Mousterian, which is dominated by unidirectional-convergent (Fig. 6: b) and centripetal Levallois (Fig. 6: a) methods, many northeast African assemblages exhibit a reduction strategy based upon a markedly different system of core preparation, referred to as Nubian Levallois. One of the key features of this technology is the use of bidirectional flaking to prepare and to rejuvenate a prominent median distal ridge (Usik et al. 2013: Fig. 3), enabling the toolmaker to remove a pointed and elongated endproduct. The "Type 1" strategy (*sensu* Guichard & Guichard 1968) relies on two distal-divergent, elongated debordant removals to form the pointed distal end of the core and to establish a central guiding arête (Fig. 6: c), with further shaping of the working surface mainly from the proximal end. Before a point is struck, the flaking surface shows a clear bidirectional scar pattern and a pronounced median distal ridge. Nubian "Type 2" cores exhibit

lateral-distal preparation to form the pointed tip (Fig. 6: d), but results in the same prominent distal ridge. At times, it is clear that both Type 1 and Type 2 preparations were used on the same core, particularly during stages of rejuvenation, called Nubian Type 1/2 (Chiotti et al. 2007, 2009; Olszewski et al. 2010). In evaluating the relationship between Type 1, 2, and 1/2 organizational systems and their efficacy as temporal markers, Usik et al. (2013: 251-252) consider these organizational systems simply as gradients within the Nubian Levallois technological spectrum; therefore, not useful as chronological indicators.

The Early MP

During the Early MP, there are two site groupings. The first - originally called "Nubian Middle Palaeolithic" by Guichard and Guichard (1965) - is characterized by assemblages with classic Levallois and Nubian Levallois (primarily Type 2) reduction strategies; along with the *façonnage* production of bifacial foliates. The second group is less abundant and lacks both Nubian Levallois and *façonnage* technology, referred to by Guichard and Guichard (ibid.) as "Non-Nubian Middle Palaeolithic." Neither group is dated, however, the weathering and position on the landscape suggest

they are quite old relative to other nearby MP sites. While Levallois reduction is prominent, Levallois points are sporadic and there is no tendency toward consistent blade production; laminar indices often fall below 10. Tools are largely limited to classic MP side scrapers, although occasional UP types are found (Guichard & Guichard 1965: Tables 4 and 5). Their typological and technological assemblage structures, limited distribution around the Upper Nile Valley, and apparent great age makes these industries unlikely candidates for the immediate progenitor of the Emiran.

The Middle MP

Two groups exist within the Middle MP: the "Lower Nile Valley Complex," characterized exclusively by centripetal Levallois reduction, and the "Nubian Complex," characterized by Nubian Levallois cores and, to a lesser extent, classic centripetal Levallois cores (Fig. 7). Both groups occur in the low and high deserts adjacent to the Nile Valley, but not in any of the Nilotic silt deposits. Lower Nile Valley Complex sites are found as far south as the Second Cataract in northern Sudan, and as far north as the Middle Nile Valley, as well as in the Western desert. The Nubian

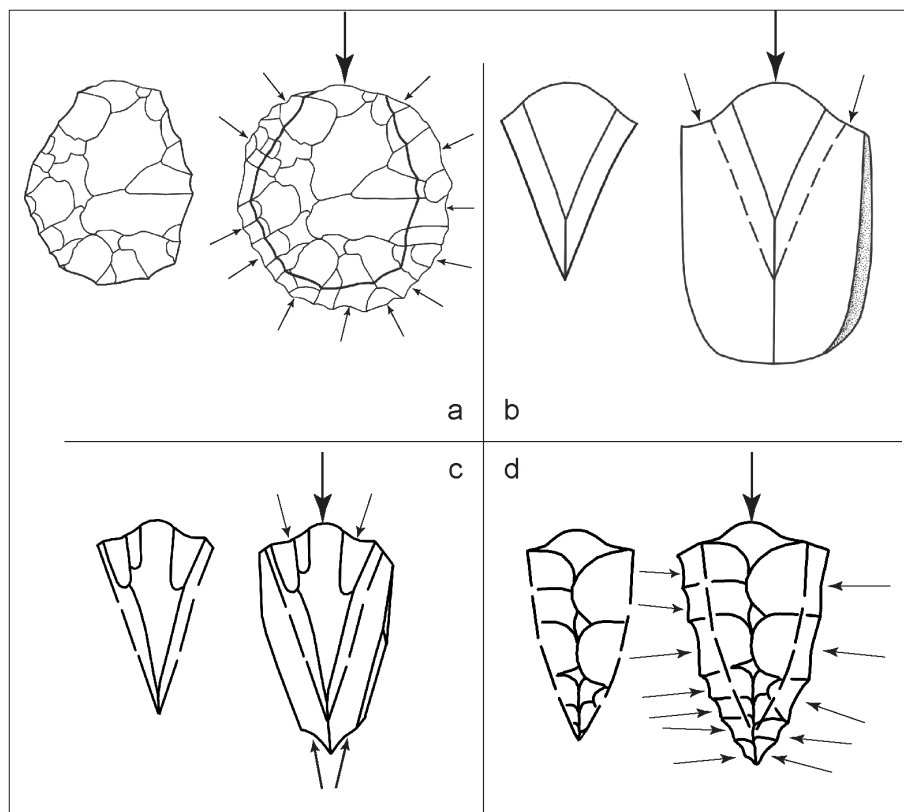


Fig. 6. Schematic of preferential Levallois core preparation strategies mentioned in text: centripetal (a), unidirectional-convergent (b), Nubian Type 1 (c), and Nubian Type 2 (d). After Rose et al. (2011: Fig. 2).

Abb. 6. Schematische Darstellung der im Text erwähnt Levalloiskern Präparations-Strategien: Zentripetal (a), Unidirektional konvergierend (b), Nubischer Type 1 (c), und Nubischer Type 2 (d). Aus Rose et al. (2011: Fig. 2).

Complex has a wider distribution; ranging from south of the Second Cataract to Middle Egypt, as well as the Western and Eastern high deserts.

The main phase of Nubian Complex occupation in northeast Africa occurred between ca. 130 ka and 70 ka (Huxtable 1993; Stokes 1993; Mercier et al. 1999; Van Peer et al. 2010). In Middle Egypt, the Nubian Complex site of Taramsa 1, Activity Phase II, has OSL ages as far back as 117 ka (Van Peer et al. 2010: 228), while on the eastern edge of Egypt, the Nubian Complex occupation at Sodmein Cave (Fig. 2: 33) produced two TL dates averaging 118 ± 8 ka (Mercier et al. 1999). Thus, it appears that the Nubian Complex was widespread across Egypt during the Last Interglacial.

In the south, the Nubian Complex includes most of the Nubian Mousterian Type A and B sites (Marks 1968a), while the Lower Nile Valley Complex include a few Nubian Mousterian Type A sites, as well as those called "Denticulate Mousterian" (Marks 1968a). Nubian Complex workshop sites are abundant in Middle Egypt on both the low (Vermeersch et al. 2000) and high deserts (Chiotti et al. 2009; Olszewski et al. 2010), as far north as Nazlet Khater (Van Peer 1988), and as far east as Sodmein Cave in the Red Sea Hills (Mercier et al. 1999). Actual living sites, however, with reasonable numbers of retouched tools, are virtually unknown (Vermeersch et al. 2000; Van Peer et al. 2010).

Lower Nile Valley Complex assemblages have been excavated in the Western desert (Fig. 2: 59-62) at Bir Sahara (Schild and Wendorf 1981) and Bir Tarfawi (Wendorf & Schild 1980; Close 1993). The Bir Tarfawi site of BT 14 was classified as Aterian (Wendorf & Schild 1980) based on the presence of a few bifacial foliates and pedunculates; however, this attribution may be questioned, as bifacial foliates are now known to be a standard element of the Lower Nile Valley Complex, while pedunculates are known to occur, albeit infrequently, in a number of non-Aterian contexts.

Since most MP sites in Upper Egypt tend to be small workshops with poor samples of artifacts, there are only a few where the relative frequency of bidirectional cores can be judged beyond just their mere presence or absence. One such site, El Gawanim I (Fig. 2: 43), produced 123 identifiable cores, of which 33% were bidirectionally prepared and, of these, 18% were Nubian Levallois (Vermeersch et al. 2000: 20-25). Another nearby site, El Ghineimiya 3 (ibid.: 38-39), with only 17 cores, had 41% bidirectional cores, of which 86% were Nubian Levallois. Nubian Complex workshop sites in the high desert of Middle Egypt show comparably important proportions of bidirectional cores: at ASPS 46a they account for 40%, at ASPS 49 they comprise 35%, and they average 50% from a series of random samples taken at various other locales (Olszewski et al. 2010: 196). Of the 15 cores recovered at Makhadma 6, 66% were bidirectional, primarily Nubian Type 1. (Van Peer 2000: 91-100).

Further south in Sudanese Nubia, the proportional occurrence of bidirectionally-prepared cores at Nubian Complex sites varies considerably, having consistently lower percentages than those from Middle and Upper Egypt. The highest percentages of Nubian cores are at 1035 (Fig. 2: 49) with 27%, at 1038 with 26%, and at 1010-8 (Fig. 2: 47) with 18%. Other Nubian Complex assemblages in northern Sudan exhibit a mixture of Nubian Levallois cores and recurrent bidirectional cores ranging between 6% and 15%, with the remaining identifiable types mainly centripetal Levallois, marginal (platform cores), and discoidal (Marks 1968a: 287, 291). Lower Nile Valley Complex sites in Sudanese Nubia lack Nubian technology, but occasionally exhibit bidirectional flake cores (Marks 1968a: 209, 215). In the Western desert, Bir Sahara 13 has neither Nubian Levallois nor other bidirectional cores (Schild & Wendorf 1981: 102-103), as is the case for site E-72-4 at Dakhla Oasis (Schild & Wendorf 1977: 111).

Crested blades are not found in the Nubian Complex assemblages of Sudanese Nubia (Marks 1968a) or in the Lower Nile Valley Complex assemblages of the Western desert. They do occur, however, at two Nubian Complex workshop sites in Upper Egypt: El Gawanim 1 and Beit Khallaf 3 (Fig. 2: 43, 44). In both assemblages, there are multiple examples associated with Nubian cores, although no refittings link them directly to that particular reduction strategy (Vermeersch et al. 2000).

The high frequency of Nubian Levallois cores at Nubian Complex sites might suggest that Levallois points would be abundant. This, however, is not the case. Levallois points are rare and usually quite poorly made (Fig. 7); in Sudanese Nubia they make up a very small portion of the toolkit, never reaching above 12% of the combined points, UP, and MP tool samples (Fig. 8). The same is true for those Lower Nile Valley Complex sites with reasonable diagnostic tool counts. In Middle Egypt, there are so few retouched tools that this comparison is moot. Among the unretouched Levallois artifacts from those sites with adequate samples, the percentage of Levallois points is extremely low: at ASPS 46a it is 3% and at ASPS 49 it is 4% (Olszewski et al. 2010: 196). At Makhadma 6 (Fig. 2: 42), where only six retouched tools were recovered from two discrete lithic concentrations, one was a Nubian point (Van Peer 2000).

The Late MP

The Late MP of northeast Africa is characterized by a diversification of industries stemming from the preceding Nubian Complex, including the Khormusan in Sudanese Nubia (Marks 1968b) and the Taramsan in Middle Egypt (Van Peer & Vermeersch 2007). In the Western desert, the Aterian is supposedly rooted in the Nubian Complex based on the occasional presence of Nubian Levallois cores (ibid.). Although Aterian assemblages in this zone have not been dated directly,

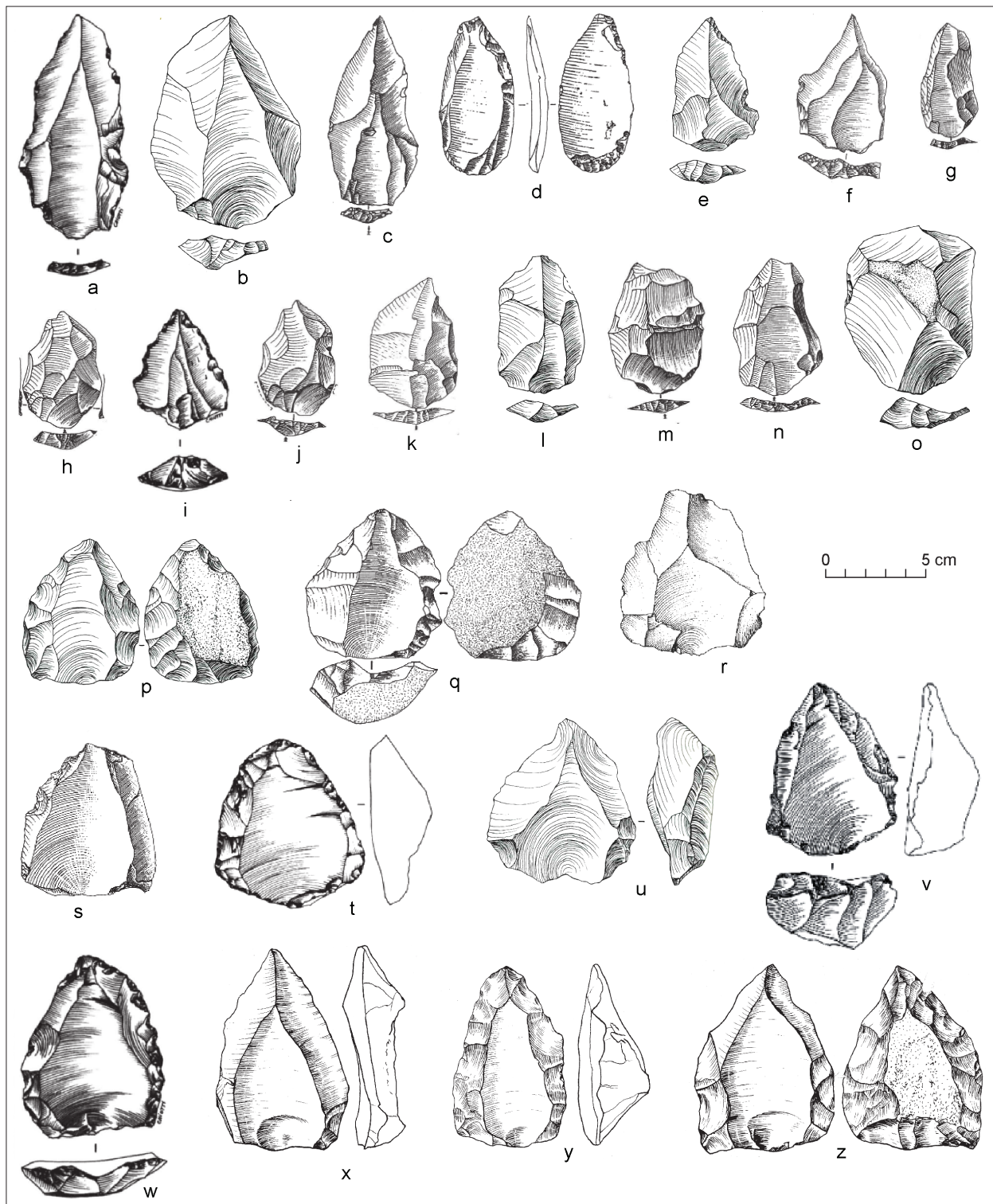


Fig. 7. Nubian Complex artifacts from the Nile Valley: Levallois endproducts from Abydos (a,i), 1038 (b,e,o), Makhadma 6 (c,f), Sodmein Cave (d), Nazlet Safaha 1 (g,h,j,k,m,n); Nubian Levallois cores from 1038 (p,u), Nazlet Safaha 1 (q), Taramsa Hill, Activity Phase III (r), Makhadma 6 (s), Abydos (t,v,w), Abu Simbel (x-z). Illustrations after Guichard and Guichard (1965: Fig. 22); Marks (1968a: Figs. 21, 28, 32, 33); Van Peer (2000: Figs. 4.14-4.16); Van Peer et al. (2002: Figs. 7.20-7.22, 7.46-7.51); Olszewski et al. (2005: Figs. 5, 6); Chiotti et al. (2007: Fig. 11); Van Peer et al. (2010: Fig. 5.13); Vermeersch (2012: Fig. 2.6).

Abb. 7. Steinartefakte des Nubischen Komplexes aus dem Niltal: Levalloisabschläge aus Abydos (a,i), 1038 (b,e,o), Makhadma 6 (c,f), Sodmein Cave (d), Nazlet Safaha 1 (g,h,j,k,m,n); Nubische Levalloiskerne aus 1038 (p,u), Nazlet Safaha 1 (q), Taramsa Hill, Activity Phase III (r), Makhadma 6 (s), Abydos (t,v,w), Abu Simbel (x-z). Zeichnungen nach Guichard und Guichard (1965: Abbildungen 22); Marks (1968a: Abbildungen 21, 28, 32, 33); Van Peer (2000: Abbildungen 4.14-4.16); Van Peer et al. (2002: Abbildungen 7.20-7.22, 7.46-7.51); Olszewski et al. (2005: Abbildungen 5, 6); Chiotti et al. (2007: Abbildungen 11); Van Peer et al. (2010: Abbildungen 5.13); Vermeersch (2012: Abbildungen 2.6).

palaeoenvironmental observations suggest human occupation in the Western desert was unlikely after 60 ka (Garcea 2001). Khormusan sites were found stratified in Dibeira-Jer Formation Nile silts or in sands inter-fingering within them (de Heinzelin 1968). While 34A, which is stratigraphically the earliest Khormusan site, is undated, 1017 (Fig. 2: 36) has Th/U measurements on associated teeth of ca. 84 ka (McKinney et al. unpl. data). Site ANW3 (Fig. 2: 35), found in situ in a downcut of the same formation, has Th/U dates on

wood remains indicating an age between 65 - 62.5 ka (ibid.), thus, the Khormusan appears to span MIS 5.1 and MIS 4. The Taramsan Industry of the central Nile is dated to 56.2 ± 5.5 ka (Van Peer et al. 2010), based on OSL age estimates from Taramsa Hill 1, Activity Phase IV (Fig. 2: 34).

The Khormusan is distributed around the Second Cataract (Marks 1968b), and possibly somewhat to the south. In a break with the earlier Nubian Complex, the Khormusan utilized a wide range of non-ferrocrete

Assemblage	Reference #	Pts, MP, & UP tools	% Levallois points	% MP tools	% UP tools	Blanks (n)	ILam	Cores (n)	IBi
Late Nubian Complex									
Sodmein Cave	33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Taramsa Hill 1	34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nazlet Safaha 1	41a	346	0	98	2	11634	N/A	427	N/A
Nazlet Safaha 2	41b	249	0	97	3	8887	N/A	298	N/A
Makhadma 6	42	N/A	N/A	N/A	N/A	284	N/A	16	78
El Gawanim 1	43	8	0	63	38	383	27	123	33
Beit Khallaf 3	44	3	0	0	100	334	28	20	40
1010-8	47	49	2	45	53	225	4	17	18
1033, upper	48a	47	11	51	38	1649	10	66	2
1033, lower	48b	29	22	44	33	1569	13	79	6
1035	49	40	5	45	50	670	8	138	34
1036	50	86	0	61	40	852	3	45	6
1037	51	79	3	46	51	299	6	36	10
1038	52	69	10	44	46	295	11	64	30
121	53	37	0	67	33	741	7	76	6
Early Nubian Complex									
6	55	90	7	53	40	1219	11	100	5
Jebel Brinikol	56	112	2	73	26	927	13	125	27
Arkin 5	57	33	0	93	3	4738	1	93	100
Sai Island	58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Khormusan									
ANW3	35	173	10	6	84	2989	30	330	11
1017	36	61	8	3	89	N/A	37	74	9
34D	37	88	4	5	90	4301	23	59	19
Aterian									
8708	38	24	4	42	54	482	9	12	N/A
8735	39	32	7	33	60	177	6	31	N/A
E-78-11	40	N/A	22	57	22	N/A	N/A	N/A	N/A
Lower Nile Valley Complex									
1000	45	20	0	45	55	749	14	30	0
36B	46	34	0	64	36	603	12	26	31
Dakhla Oasis E-72-4	59	25	8	92	0	412	8	5	0
Bir Sahara 13	60	29	10	69	21	368	6	9	0
Bir Tarfawi 14A, surface	61	105	5	84	11	1251	3	36	3
Bir Tarfawi 14B, surface	62	58	0	81	19	2203	2	55	0
Unknown Middle Palaeolithic									
Split Rock, upper	54a	26	5	77	18	1904	3	26	9
Split Rock, lower	54b	31	13	26	61	489	2	34	8

Fig. 8. Composite data for African sites included in the study. Site reference number corresponds to the map number on Figure 2 as well as the plot numbers on Figures 13 & 14.

Abb. 8. Aufgeführt sind die technischen Daten der Afrikanischen Fundstellen, die in der hiesigen Studie behandelt werden. Referenznummer der Fundstellen stimmen mit der Karte in Abbildung 2 und den Diagrammen in Abb. 13 & 14 überein.

sandstone raw materials that had been washed down the Nile. Technologically, it initially exhibits a preferential Levallois reduction strategy that resulted in the production of classic Levallois flakes from ovate-shaped cores. These flakes were mainly used as blanks for UP burins, although a few MP side scrapers were produced, as were large numbers of well-made denticulates. Point and blade production, on the other hand, was quite limited (Fig. 8). A special technique was used to flake small Nile pebbles (Sellet 1995), while bidirectional core preparation is quite rare (6% - 9%, including 1.6% Nubian at site ANW3). Through the duration of the Khormusan, the Levallois component remained strong; there was no tendency toward increasing amounts of blade or bidirectional core reduction strategies, only the increasing use of Nile pebbles as a source of raw material.

Compared to the western Egyptian and Libyan deserts (Ferring 1975; Wendorf & Schild 1992; Garcea 2001), there is a relative paucity of Aterian sites in or near the Nile Valley. No Aterian has been reported from the Eastern desert and only a single, poor surface site, E-78-11 (Fig. 2: 40), was discovered within the Nile Valley itself (Singleton & Close 1980). Little can be said of this assemblage since only a Bordian type list of the tools was published, but, typologically at least, it is consistent with other Egyptian Aterian assemblages (Fig. 8). There is a cluster of Aterian surface scatters and at least one workshop at Kharga Oasis (Caton-Thompson 1952; Wendorf & Schild 1992). Of eight surface scatters reported in the Libyan desert near Dungal Oasis, six had inadequate samples (<60) to make any observations (Hester & Hobler 1969: 80-81). Indeed, their attribution to the Aterian was solely based on the presence of at least one pedunculated tool (Hester & Hobler 1969: 83). Only two of the eight sites, 8708 (Fig. 2: 38) and 8735 (Fig. 2: 39), have reasonable tool assemblages (Ferring 1975: 116) that permit a view of typological patterning. Unlike the Khormusan, there is roughly a 40/60 split between MP and UP tools and Levallois points are extremely rare (Fig. 8). Neither site exhibits any evidence of bidirectional core reduction; however, this may be due to small core samples, the generalized typology used, or the nature of the sites themselves. While no Nubian Levallois cores were reported from any of these Aterian assemblages, small numbers of bidirectional and Nubian cores were found at Aterian sites further to the west, such as Uan Tabu (Garcea 1999: 173).

During Activity Phase IV at the Taramsa Hill 1 quarry site (Van Peer et al. 2010: 89-117), there is a shift observed in the core reconstructions from classic Nubian Levallois production in the preceding Activity Phase III to a "Taramsa blade production system" (ibid.: 234). This involved a modification of the Nubian Levallois reduction strategy to increase the convexity of the flaking surface, so that a series of elongated blanks could be bidirectionally struck from the core without the traditional need to rejuvenate the

convexities of the flaking surface (ibid.: 53). This resulted in the serial production of large numbers of elongated blanks (Fig. 9), mainly blades, although a few typical parallel-sided Nubian points were produced as well (ibid.: Fig. 6.24, 6.26, 6.28). Since both Nubian Levallois and Taramsa blade systems are co-associated, this Activity Phase is considered technologically "transitional" (ibid.: 241). Among the tools, fifteen blanks had some retouch, mainly simple, notched or denticulated, while the only formal tool was a single end scraper. OSL ages from Activity Phase IV are between 60 and 50 ka, while ages from the overlying archaeological stratum, Activity Phase V, cluster around 40 ka; as such, the Phase V assemblage cannot have been related to the early development of the Emiran.

The uppermost Middle Palaeolithic archaeological level at Sodmein Cave, MP1, produced a small collection of artifacts that was reported to include two Emireh points (Fig. 7: d) and two burins (Mercier et al. 1999). The points in question are described as having "basal thinning on the ventral face" (Mercier et al. 1999: 1340). These specimens, however, do not fit the definition of Emireh points, which must have bifacial basal thinning (Volkman & Kaufman 1983; Copeland 2001). Without a strict definition of this type fossil, there is a risk of expanding the classification to subsume all marginally retouched Levallois points, such as those from the "Tabun B" sites in southern Jordan. Hence, we maintain that the present evidence precludes classifying level MP1 at Sodmein Cave as Emiran.

In sum, the full suite of technological characteristics seen in the early Emiran is not found together in any Nilotic industry. Typologically, the dominance of UP tools, as well as the emphasis on Levallois points, is entirely missing from Africa. Yet, the emphasis on bidirectional preparation that is characteristic of the Nubian Levallois reduction strategy begs the question: could this be the source of Emiran opposed platform Levallois point production? It is certainly plausible that Emiran core technology may, ultimately, derive from the Early Nubian Complex in Africa; however, other Emiran features such as cresting and elongation are typically not found together in African assemblages. Crested blades have only been found at three Nubian Complex sites, while the lateral retouch ("lateralization" *sensu* Van Peer 1991), occurs at two Middle Nile Valley Complex sites: Nazlet Safaha 1 and 2 (Vermeersch et al. 1990). Crested blades and "lateralized" Levallois pieces have not been found together in the same assemblages, but their presence in Egypt might suggest similar approaches to core formation and hafting at roughly the same time as those seen at Boker Tachtit.

The Arabian Peninsula

For the last century, the Arabian Peninsula has been relegated to *terra incognita*, and is traditionally not

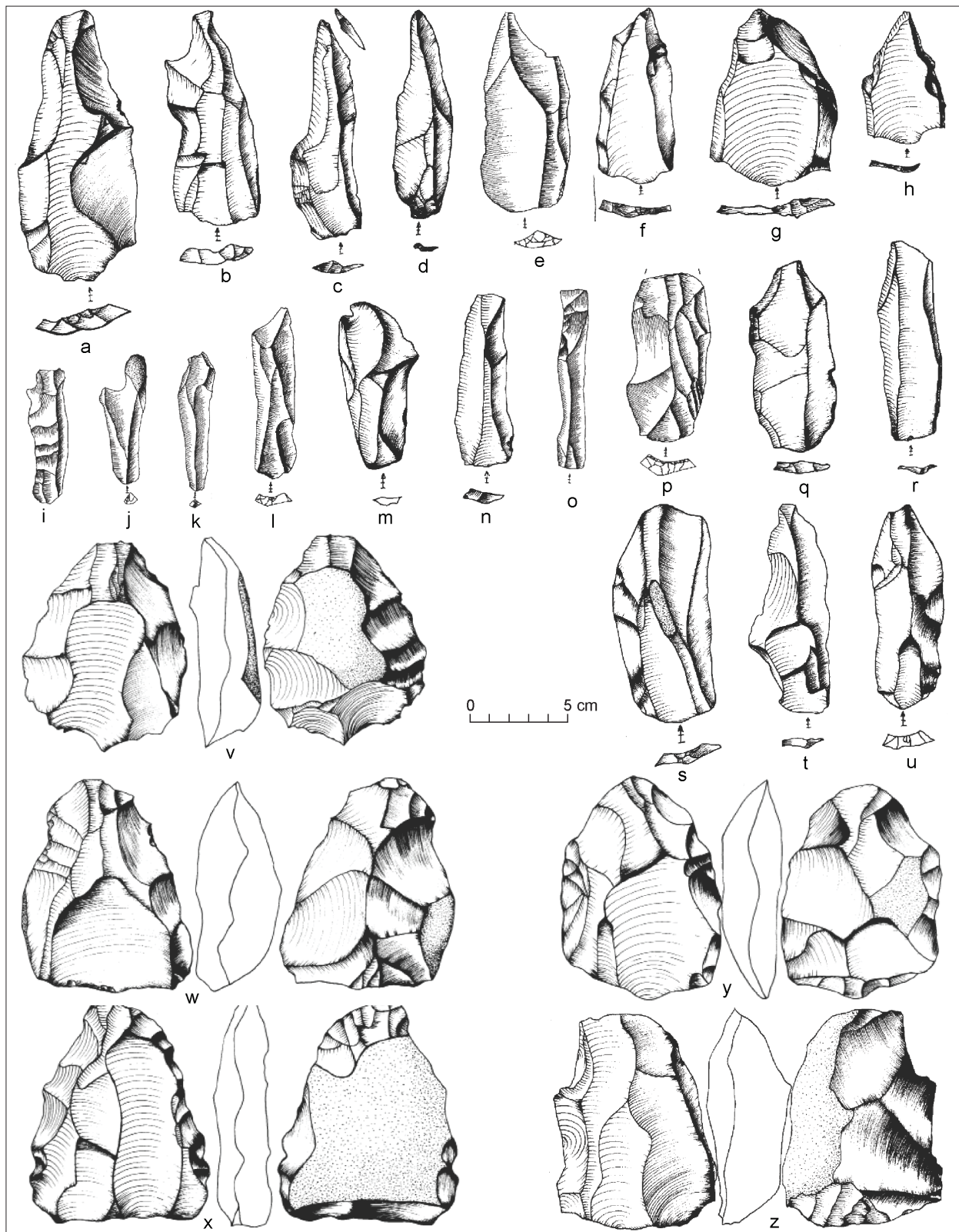


Fig. 9. Taramsan artifacts from Taramsa Hill 1, Activity Phase IV: Levallois points (a-h), Levallois blades (i-u), Nubian Levallois cores (v-z). Illustrations after Van Peer et al. (2010: Figs. 6.21-6.29).

Abb. 9. Steinartefakte des Taramsan aus Taramsa Hill 1, Activity Phase IV: Levalloisspitzen (a-h), Levalloisklingen (i-u), Nubische Levalloiskerne (v-z). Zeichnungen nach Van Peer et al. (2010: Abbildungen 6.21-6.29).

considered part of the Near Eastern MP archaeological record (e.g., Bar-Yosef 1994, 2000). Within the last decade, however, new research projects in Yemen (Crassard 2007, 2009; Crassard and Thiebaut 2011; Delagnes et al. 2012, 2013), Oman (Rose 2004, 2006, 2007; Rose et al. 2011; Usik et al. 2013; Hilbert et al. 2014; Rose & Hilbert 2014), Saudi Arabia (Petraglia et al. 2011, 2012; Crassard & Hilbert 2013; Crassard et al. 2013), and the UAE (Marks 2009; Armitage et al. 2011; Bretzke et al. 2013, 2014) have discovered a wide variety of MP lithic assemblages, some of which may be considered as potential demographic and/or cultural sources of the Emiran.

Early MIS 5

The earliest known post-Acheulean occupation of Arabia was discovered at the collapsed rockshelter site of Jebel Faya 1 (Fig. 2: 15) in Sharjah, UAE (Marks 2009; Armitage et al. 2011; Bretzke et al. 2013, 2014). While its Assemblage C is argued to stem from the East African MSA (Armitage et al. 2011), neither the technology nor typology shows any element even vaguely related to the Emiran. It is characterized, rather, by the co-association of bifacial, volumetric blade, and preferential Levallois flake reduction strategies; a techno-typological package that does not exist in the Levant. The two stratigraphically younger assemblages at Jebel Faya, Assemblages A and B (ibid.), seem to be strictly of local origin, having no bearing on the Emiran. Other sites around the Gulf and its hinterlands (Biglari et al. 2009; Scott-Jackson et al. 2009; Wahida et al. 2009) exhibit similar technological co-associations as Assemblage C and, as such, are not relevant to our investigation of the earliest Emiran.

The most abundant and distinct type of MP on the Arabian Peninsula is the Nubian Complex, attributed to a population dispersal from Africa during early MIS 5 (Rose et al. 2011; Beyin 2013; Crassard & Hilbert 2013; Usik et al. 2013). Two matching OSL measurements of ca. 106 ka from the Classic Dhofar Nubian site of Aybut al-Auwal (Fig. 2: 27) indicate that Nubian Complex toolmakers were present on the Peninsula by MIS 5.3 (Rose et al. 2011). Given its affinities to those assemblages found in Egypt, Usik et al. (2013: 244) propose the term "Afro-Arabian Nubian Technocomplex."

Hints of Nubian Levallois technology were first found in Arabia in the 1980s, from a handful of cores recovered at surface sites in Wadi Muqqah (Fig. 2: 25), western Hadramawt, Yemen (Inizan and Ortlieb 1987). Some years later, several surface scatters were reported from Wadi Sana and Wadi Wa'sha in central Hadramawt (Fig. 2: 26), where Crassard (2007: 7-8) noted a resemblance between bidirectionally-prepared Levallois point cores ("B2," "B3," and "B4" types; Fig. 10: s) and Nubian Levallois cores from Africa. Although over 20 sites were mapped exhibiting such technology, the assemblages' small sample sizes

precluded any conclusive determination of industry type. Between 2010 and 2013, the Dhofar Archaeological Project mapped over 250 surface sites with Nubian Levallois technology on the Nejd plateau in southern Oman, ranging from large-scale workshops (>2000 artifacts) to isolated points and discarded Nubian Levallois cores (Rose et al. 2011; Usik et al. 2013). Most recently, additional Nubian/Nubian-derived assemblages have been reported on interdunal gravels in the Rub' al Khali desert (Rose & Hilbert 2014), near Al Kharj (Fig. 2: 24) in central Saudi Arabia (Crassard & Hilbert 2013), and in the Al Jawf (Fig. 2: 18) region of northern Saudi Arabia (Hilbert et al. unpubl. data). No Nubian Complex assemblages have yet been found in eastern Arabia. We discount the single Nubian core reported by Wahida et al. (2009), which comprises less than 2% of the total cores and does not exhibit any of the essential characteristics of Nubian Levallois technology (*sensu* Usik et al. 2013).

In Dhofar, Nubian Complex sites are almost exclusively characterized by the standardized production of large, elongated points (Fig. 10: a-l) via preferential bidirectional Nubian Levallois core preparation (Fig. 10: m-o, q-r), typically comprising well over 50% of total cores (Rose et al. 2011: Table 3; Usik et al. 2013: Table 4). In the most extreme case, of the 172 cores collected from the site of Aybut ath-Thani, 155 (90%) were Nubian Levallois. The lowest percentage of Nubian Levallois cores comes from Jebel Markhashik 1, where 65 (57%) of the 115 specimens were classified as such. Core technology is based on opposed platform preparation; the only other type of reduction found in any significant amounts is a simple-unidirectional strategy for the production of elongated blanks, ranging from 10% to 20%. The classic centripetal Levallois strategy is quite rare, comprising less than 3% of cores at most sites. Typologically, retouched tools are uncommon, but when found in reasonable numbers are weighted toward MP forms, primarily side scrapers, with a low number of end scrapers on flakes present. Nubian points are numerous (Fig. 11) and show some morphological variability: both classic Nubian points with a pitched shape, as well as true triangular Levallois points, are common in this industry.

Late MIS 5 – Early MIS 3

The Nubian Levallois tradition endured in Dhofar for some time, encompassing at least two separate technological phases: the Classic Dhofar Nubian and its derivative, the Mudayyan Industry (Usik et al. 2013). Although the Mudayyan has no absolute dates, assemblages are consistently found on landscape surfaces post-dating the Classic Dhofar Nubian, and consistently exhibit far less patination and chemical dissolution than artifacts from Classic Dhofar Nubian assemblages. The industry's more limited distribution around fossil springs speckling the Nejd plateau, as opposed to the Classic Dhofar Nubian, which is

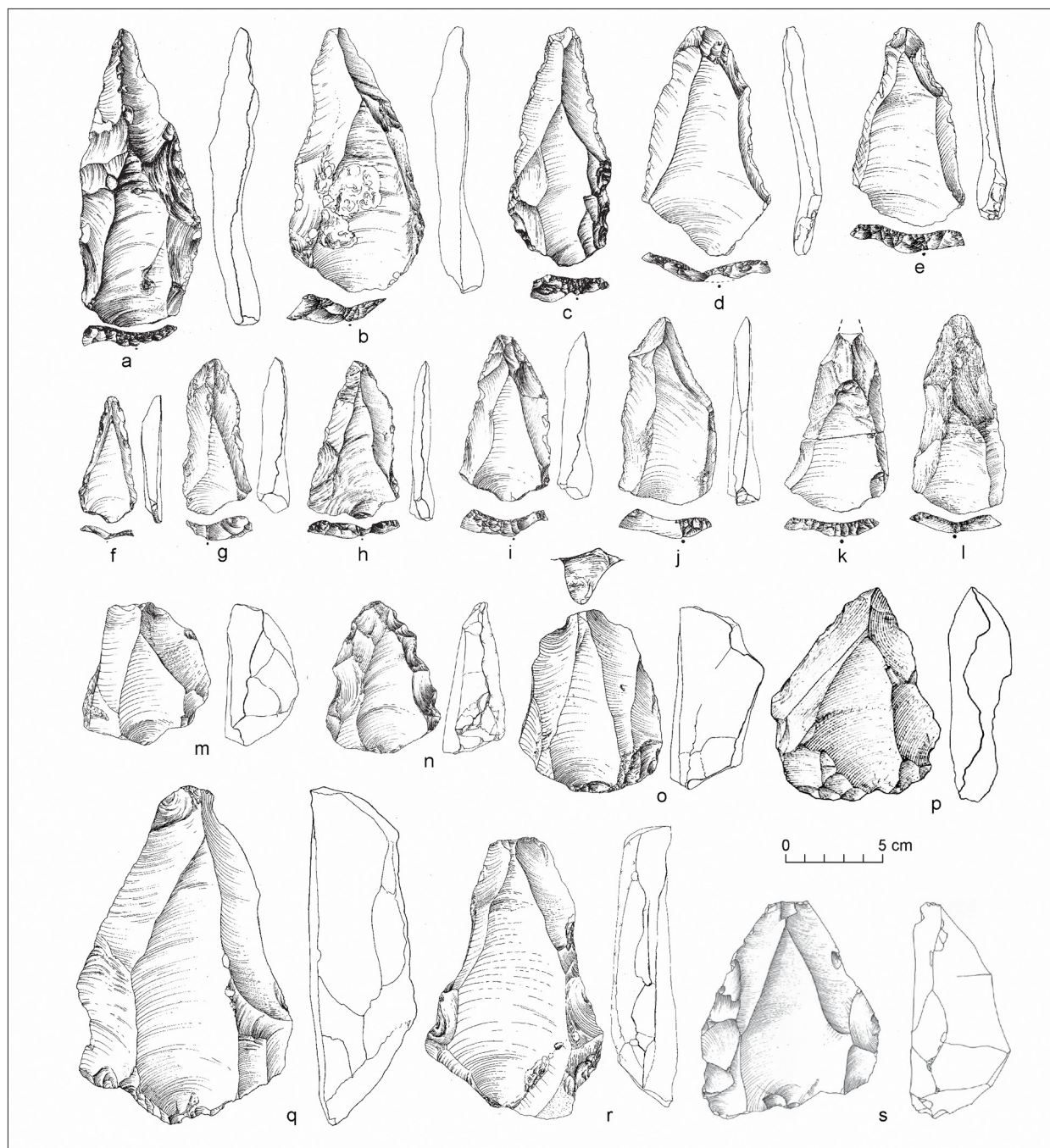


Fig. 10. Nubian Complex artifacts from the Arabian Peninsula: Levallois points from TH.236 (a), TH.323 (b), TH.238 (c), Jebel Markhashik 1 (d,e), Aybut ath-Thani (f), Aybut al-Auwal (g,i), TH.173 (h), TH.258 (j), Mudayy as-Sodh 1 (k), Jebel Sanoora 1 (l); Nubian Levallois cores from Aybut al-Auwal (m,n), Mudayy as-Sodh 1 (o), Al Kharj 22 (p), Jebel Markhashik 1 (q), TH.323 (r), Wadi Wa'shah (s). Illustrations after Crassard (2009: Fig. 7); Rose et al. (2011: Figs. 9, 10, 14); Crassard and Hilbert (2013: Fig. 7); Usik et al. (2013: Figs. 2, 7).

Abb. 10. Steinartefakte des Nubischen Komplexes aus der Arabischen Halbinsel: Levalloisspitzen aus TH.236 (a), TH.323 (b), TH.238 (c), Jebel Markhashik 1 (d,e), Aybut ath-Thani (f), Aybut al-Auwal (g,i), TH.173 (h), TH.258 (j), Mudayy as-Sodh 1 (k), Jebel Sanoora 1 (l); Nubische Levalloiskerne aus Aybut al-Auwal (m,n), Mudayy as-Sodh 1 (o), Al Kharj 22 (p), Jebel Markhashik 1 (q), TH.323 (r), Hadramawt (s). Zeichnungen nach Crassard (2009: Abbildung 7); Rose et al. (2011: Abbildungen 9, 10, 14); Crassard und Hilbert (2013: Abbildung 7); Usik et al. (2013: Abb. 2, 7).

ubiquitous from the Dhofar escarpment to the Rub' al-Khali desert (Rose & Hilbert 2014), is suggestive of diminished mobility in response to environmental desiccation. Hence, we surmise that the Mudayyan may coincide with a phase of weakened Indian Ocean Monsoon activity after 75 ka (e.g., Fleitmann et al. 2003, 2011; Stokes & Bray 2005; Preusser, 2009).

Based on a sample of five seemingly typical Mudayyan assemblages found on the Nejd plateau, including Jebel Kochab 1 (Fig. 2: 23), Umm Mudayy 1 (Fig. 2: 21), Umm Mudayy 2 (Fig. 2: 22), Jebel Dahsha (Fig. 2: 19), and Burj Dakin (Fig. 2: 20), it is clear that the most prominent reduction strategy is preferential "Micro-Nubian" Levallois (Fig. 12: a-e), ranging from

Assemblage	Reference #	Pts, MP, & UP tools (n)	% Levallois points	% MP tools	% UP tools	Blanks (n)	ILam	Cores (n)	IBi
Mudayyan Industry									
Jebel Dahsha	19	22	18	5	77	169	16	143	51
Burj Dakin	20	15	47	0	53	228	9	53	82
Umm Mudayy 1	21	24	58	0	42	402	25	143	55
Umm Mudayy 2	22	39	33	7	60	128	37	166	73
Jebel Kochab	23	7	43	0	57	516	21	157	33
Afro-Arabian Nubian Technocomplex (general)									
Al Jawf	18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Al Kharj 22	24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wadi Muqqah	25	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Wadi Sana/Wadi Wa'shah	26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Classic Dhofar Nubian Industry									
Aybut al-Auwal	27	102	59	23	19	407	26	297	75
Aybut ath-Thani	28	56	38	61	2	1503	12	157	85
Mudayy as-Sodh 1	29	32	56	22	22	804	16	92	77
Jebel Sanoora 1	30	7	71	29	0	330	38	104	74
Jebel Markhashik 1	31	35	100	0	0	693	22	115	79
TH.377	32	22	46	27	18	126	34	45	88
Unknown Middle Palaeolithic									
Wadi Surdud Complex	14	N/A	N/A	N/A	N/A	4793	22	39	N/A
Jebel Faya, assemblage A	15a	17	0	29	71	1081	16	72	4
Jebel Faya, assemblage B	15b	37	0	43	57	1295	19	84	13
Jebel Qattar 1	16	N/A	N/A	N/A	N/A	79	4	9	0
Jebel Katefeh 1	17	N/A	N/A	N/A	N/A	765	3	98	9

Fig. 11. Composite data for Arabian sites included in the study. Site reference number corresponds to the map number on Figure 2 as well as the plot numbers on Figures 13 & 14.

Abb. 11. Aufgeführt sind die technischen Daten der Arabischen Fundstellen, die in der hiesigen Studie behandelt werden. Referenznummer der Fundstellen stimmen mit der Karte in Abbildung 2 und den Diagrammen in Abb. 13 & 14 überein.

19% to 37% of all cores found in these assemblages (Rose et al. unpubl. data). At every site, these diminutive Nubian Levallois cores grade into a bidirectional Levallois variant (from 4% to 23%), in which the medial distal ridge is flat and the shape of the core ranges from sub-triangular to ovate, producing ovate endproducts. These types, in turn, grade into rectangular, opposed platform Levallois cores (from 6% to 23%) that enabled the serial production of elongated pointed endproducts (Fig. 12: f-i). In addition to these different types of bidirectional core reduction, Mudayyan assemblages exhibit an entirely separate reduction strategy (from 13% to 29%), in which blanks were unidirectionally struck from the narrow, elongated working surface of the core (Fig. 12: k). In only a few cases (n=8) is there technological overlap, in which a Nubian Levallois strategy was applied to the narrow working surface of the core (Fig. 12: j); for the most part, it seems these reduction strategies were applied separately (ibid.).

Crested blades, albeit rare (1% - 7% of debitage), were found in four of the Mudayyan assemblages. While it is possible that these are lateral byproducts of Nubian Levallois preparation, the presence of six pre-cores at Jebel Dahsha, exhibiting coarse bifacial flaking followed by a single blade struck from the

narrow working surface of the core, suggests that some kind of rudimentary cresting technique was employed within the Mudayyan blade reduction strategy (ibid.).

The shift from classic Nubian Levallois to Mudayyan core reduction is characterized, in part, by a change from preferential Nubian Levallois to recurrent bidirectional point production systems. In the Classic Dhofar Nubian (as well as the Late Nubian Complex in Africa), the Nubian core's prominent median distal ridge enabled toolmakers to control distal convexity and achieve an elongated point. Within some Classic Dhofar Nubian assemblages, there are occasional cases in which the distal ridge is flat and generates two or three points from the opposed platform, rather than the twisted débordant blades that are typical of Type 1 Nubian Levallois reduction. In Mudayyan assemblages, conversely, these aberrant bidirectional point cores become increasingly common, as Nubian Levallois toolmakers de-emphasized preferential core preparation, in favor of a flat flaking surface with opposed platforms that enabled them to serially produce points from both ends of the prepared core. Consequently, rectangular-shaped cores replace the distinctive triangular/sub-triangular classic Nubian Levallois morphology. In both industries, the

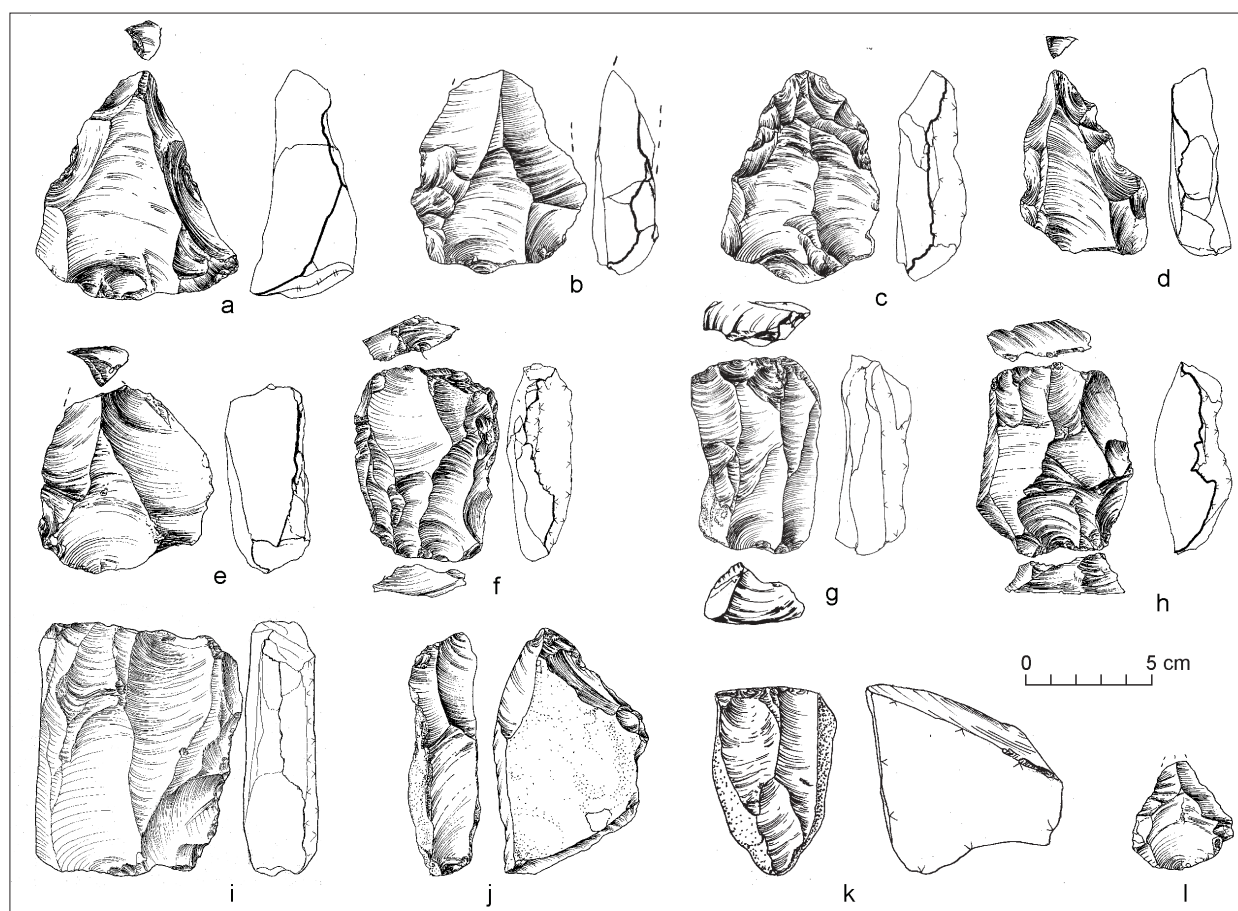


Fig. 12. Mudayyan artifacts from Jebel Kochab 1, Jebel Dahsha, and Nubi as-Saghir: Micro-Nubian cores (a-e); bidirectional Levallois cores (f-i); single and opposed platform blade cores (j, k); Levallois point (l). Illustrations after Usik et al. (2013: Figs. 15 & 16) and Hilbert et al. (unpubl. data).

Abb. 12. Steinartefakte des Mudayyan aus Jebel Kochab 1, Jebel Dahsha, and Nubi as-Saghir: Micro-nubische Levalloiskerne (a-e); Bidirektional präparierte Levalloiskerne (f-i); Klingkerne mit Abbaufäche an Schmalseite (j, k); Levalloisspitzen (l). Zeichnungen nach Usik et al. (2013: Abbildungen 15 & 16) und Hilbert et al. (unpubl. Daten).

endproducts are Levallois points (from 18% to 58% of tools at Mudayyan sites); however, Mudayyan Levallois points are categorically smaller (Usik et al. 2013).

In contrast to the Classic Dhofar Nubian, in which retouched tools are few and poorly made, Mudayyan assemblages exhibit a higher percentage of tools and greater range of retouched tool types. Diagnostic MP types were only found in two assemblages, and account for less than 7% of tool types (Figure 11). UP types comprise the vast majority, accounting for between 42% and 77% of Mudayyan tool assemblages, including a variety of convex, nosed, straight, and atypical endscrapers, as well as burins and perforators (Rose et al. unpubl. data).

There are three published MP sites associated with ancient lake deposits around the Jubbah palaeo-lake basin (Fig. 2: 16-17) in northern Saudi Arabia (Petraglia et al. 2011, 2012). Potentially the oldest, Jebel Umm Sanman, is roughly bracketed between 100 and 60 ka. Excavations produced only 77 buried artifacts, mainly non-diagnostic debitage but including 10 centripetal Levallois cores. At another locality,

Jebel Katefeh 1, the artifact-bearing layer, Unit H, yielded two clusters of equally probable OSL ages around 85 - 90 ka or 50 ka. Although 300 artifacts were excavated from Jebel Katefeh, 270 of these are chips. An additional 923 artifacts were collected from the surface and included together with the buried assemblage counts. In total, there were 39 Levallois cores, the majority of which have unidirectional-convergent or centripetal preparation. In addition, a number of broad-based Levallois points were recovered (Petraglia et al. 2012: fig. 10). The site of Jebel Qattar 1 has OSL ages of 75 ± 5 ka. A total of 114 artifacts were recovered, including small discoids and centripetally prepared Levallois cores, as well as ten informally retouched tools.

Survey around the Mundafan palaeolake in south-western Saudi Arabia yielded a surface scatter of MP artifacts including preferential, centripetal Levallois cores and their products. In spite of its small assemblage size, sufficient cores were recovered for researchers to observe that the Mundafan assemblage shows some overlap with the MP material from Jubbah

(Crassard et al. 2013). In all of these cases, not one of the diagnostic Emiran elements is present, suggesting the antecedents of the Emiran are unrelated to any of the Jubba or Mundafan assemblages.

The only dated evidence for human occupation in the Arabian Peninsula during MIS 3 comes from the aforementioned Jebel Faya 1 rockshelter in eastern Arabia, and from the Wadi Surdud Complex (Fig. 2: 14) in Yemen, where two assemblages dating between 63 and 42 ka were found interstratified within a six-meter fluvial accretion (Delagnes et al. 2012; Sitzia et al. 2012). Over 5,000 artifacts were excavated, and in both archaeological horizons, the most prominent reduction system was, by far, a simple unidirectional-convergent strategy producing elongated pointed flakes and blades (Delagnes et al. 2012: 13). The excavators assigned both the upper (SD2) and lower (SD1) assemblages to the Late MP, noting that it is primarily a non-Levallois strategy, since most striking platforms (>70%) are either unafaceted or cortical, and less than 10% exhibit any kind of faceting. Elongated pointed blank production was flexible, grading from occasional instances of preferential, unidirectional-convergent Levallois preparation to the more frequent use of recurrent "frontal" or "semi-tournant" core exploitation (ibid.: Fig. 12). There are just 25 retouched pieces (<1%), none of which is considered a formal tool. The paucity of retouched tools is not necessarily a characteristic of the Wadi Surdud industry; rather it may be due to "the physical properties of rhyolite, which rendered the transformation of blank edges difficult and/or unnecessary" (ibid.:14). The Wadi Surdud assemblages share a single overlapping feature with the Emiran in the manufacture of elongated pointed blanks. Their predominantly unidirectional-parallel/unidirectional-convergent laminar production system, however, does not suggest any direct connection to the Emiran.

Discussion

A local origin?

If the Emiran arose from a local, southern Levantine base, without external influences, we should expect that its technology and typology could be traced back into its ancestry. Certainly, the emphasis on the production of triangular Levallois points and their associated elongated debitage seems to be the continuation of a deeply rooted pattern reaching back to the Early Levantine Mousterian; this is even the case when the points themselves were not elongated, as at Tor Faraj and Tor Sabiha (Henry 1997, 1998). The one significant technological discontinuity between the Emiran and all other Levantine Mousterian industries, however, is the use of a bidirectional Levallois strategy associated with extensive cresting in core preparation and rejuvenation. This stands out in contrast to the unidirectional-convergent Levallois strategy and use of débordant removals to rejuvenate flaking surfaces,

which is ubiquitous throughout the Levantine Mousterian. In short, the Emiran assemblages (Bokerian I, *sensu* Leder 2013) employed a foreign Levallois strategy to produce points and some blanks for UP retouched tools that were fully consistent with long-term Levantine patterns.

The local, pre-Emiran examples of bidirectional reduction are mainly found in Middle and Late Levantine Mousterian contexts across the Arava Valley in southern Jordan. Although some bidirectional scar patterns do occur on debitage in northern Levantine Mousterian assemblages (e.g., Kebara, Units VII, XI, XII), the cores and Levallois points themselves exhibit unipolar convergent preparation (Meignen 1995; Meignen & Bar-Yosef 1988). The "Tabun D-type" assemblages from D40, 'Ain Difla, Levels 6 - 20, and "Tabun B-type" assemblages from Tor Faraj and Tor Sabiha, all exhibit an unusually high index of bidirectionality among the cores (Fig. 3); in the case of 'Ain Difla, at least 50 ka before it is seen at Boker Tachtit. That this apparently non-Levantine reduction strategy appears in both Tabun D and B-type assemblages mainly in southern Jordan suggests it was either introduced from further south or was an autochthonous development emphasized in this area, perhaps in attempts to increase core productivity (Henry 1998: 32). On the other hand, the ubiquitous truncated/faceted cores of the MP virtually disappear in the Emiran, with only three in Boker Tachtit, Level 1, comprising less than 1% of Boker Tachtit cores.

The tool types found in the Emiran match those of the southern Levantine Mousterian in several aspects. The high frequency of Levallois points characterizes most Tabun D and B-type assemblages, which is visually represented in a ternary plot of the relative percentages of Levallois points versus MP tools versus UP tools from each assemblage in this analysis (Fig. 13). This trend stands out in contrast to some Tabun C type assemblages, such as those at Ksar Akil (Marks & Volkman 1986), as well as virtually all the African and Sinai sites. The significant presence of UP tool types, as opposed to MP types, is part of a general trend in the southern Levant, reaching as far back as the Early Levantine Mousterian. UP tools are also found in significant proportions in some northern Levantine sites of very different ages, from the Amudian of Qesem Cave (Shimelmitz et al. 2011), through Tabun D at Tabun level 39 (Jelinek 1975), to the Mousterian of Qafzeh (Hovers 2009). With the exception of some Tabun C assemblages, this is a widespread Levantine MP trait. The significant presence of Levallois points with lateral retouch adjacent to the proximal platform, on the other hand, is one Emiran characteristic that is not widespread in the preceding Levantine Mousterian. In the south, this trait is not present at Nahal Aqev (<80 ka) and is only found in the uppermost levels at 'Ain Difla above Level 5 (<100 ka). Thus, it may represent either an Emiran innovation or a foreign trait adopted by the Emiran.

Viewed solely within a Levantine context, the technological and typological patterning of the early Emiran might suggest it derived from local innovation without significant external demographic input. Meignen (2012), for instance, sees a "stimulus for new combinations of pre-existing technologies." If locally restricted to the southern Levant, one possible explanation is that this stimulus came from decreased landscape carrying capacity in the central and southern Negev during MIS 4 (Vaks et al. 2007; Frumkin et al. 2011), at which time aridification may have encouraged higher mobility and a more efficient system of point and blade production (e.g., Marks & Freidel 1977). The problem with this scenario, however, is that bidirectional Levallois point production was well established at 'Ain Difla before the onset of MIS 4, and the extensive use of crestring that is associated with this reduction strategy is no more efficient than the removal of débordant blades to shape and rejuvenate core surfaces.

So, with no clear antecedents in the Levant, do the three Emiran technological traits that have no deep Levantine ancestry (i.e., bidirectional core preparation, the use of crestring, and the presence of lateral modification on Levallois points), have demonstrable origins elsewhere? Conversely, do those deeply rooted Levantine characteristics of the Emiran (i.e., elongated Levallois point production and abundant UP tool manufacture) have comparable analogues in adjacent areas?

Through the Nile Corridor?

Any model that predicts the dispersal of AMHs out of northeast Africa directly through Sinai into the southern Levant, a matter of only a few days walk (in one case, as much as 40 years), must also accept that those AMHs would have brought their culture with them. Therefore, the degree and extent of technological and typological parallels between Boker Tachtit, Levels 1 - 3, and Nilotic industries is a crucial test for the Out of Africa model through the Levantine Corridor. The African Nubian Complex, *sensu lato*, is the most obvious antecedent for Emiran bidirectional point production. Yet, 100,000 years separate the initial known manifestation of Nubian Levallois technology at 150 ka at Sai Island, (Van Peer et al. 2003) and possibly at Arkin 5, near the Second Cataract (Chmielewski 1968) from the Emiran around 50 ka. To examine their relationship, we must chart the development of Nubian Levallois technology over this interval of time.

During MIS 5, the geographic center of the Nubian Complex in Africa appears to be the Egyptian Middle Nile Valley and its hinterlands (Van Peer & Vermeersch 2007; Chiotti et al. 2009; Olszewski et al. 2010). The absence of Nubian Complex sites in Lower Egypt may be due to the thick mantle of post-MIS 5 sediments covering more ancient landscapes (Vermeersch 2009: 72). Bidirectional indices are relatively high (Fig. 3), although, in nearly every case, do not approach the levels seen at Boker Tachtit, Levels 1 - 3 (Marks 1983a)

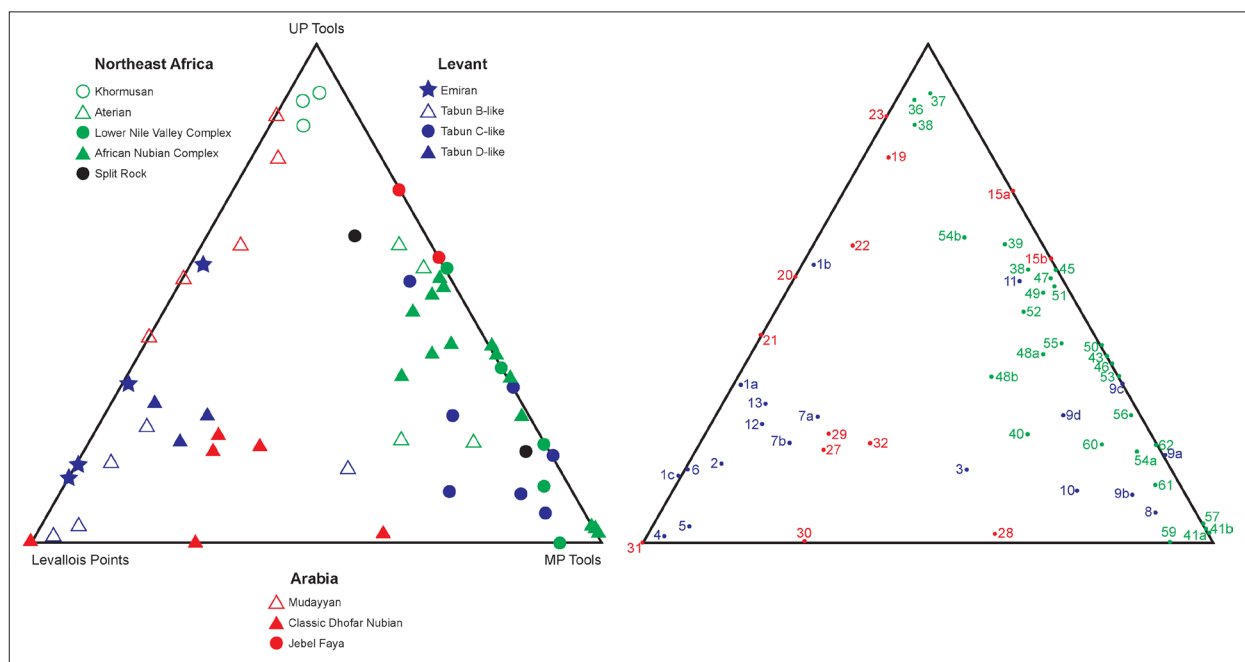


Fig. 13. Ternary plot showing relative percentages of Levallois points versus Middle Palaeolithic tools versus Upper Palaeolithic tools.

Abb. 13. Ternärdiagramm zur Gegenüberstellung der relativ prozentualen Anteile von Levalloisspitzen, mittelpaläolithischer sowie jungpaläolithischer Werkzeugformen.

or 'Ain Difla, 1 - 5 (Mustafa & Clark 2007). The frequency of bidirectional technology in the African Nubian Complex tends to be the same as that as the

"Tabun D" and "Tabun B" assemblages from southern Jordan (Fig. 14), which is in contrast to the almost exclusively unidirectional-convergent core preparation

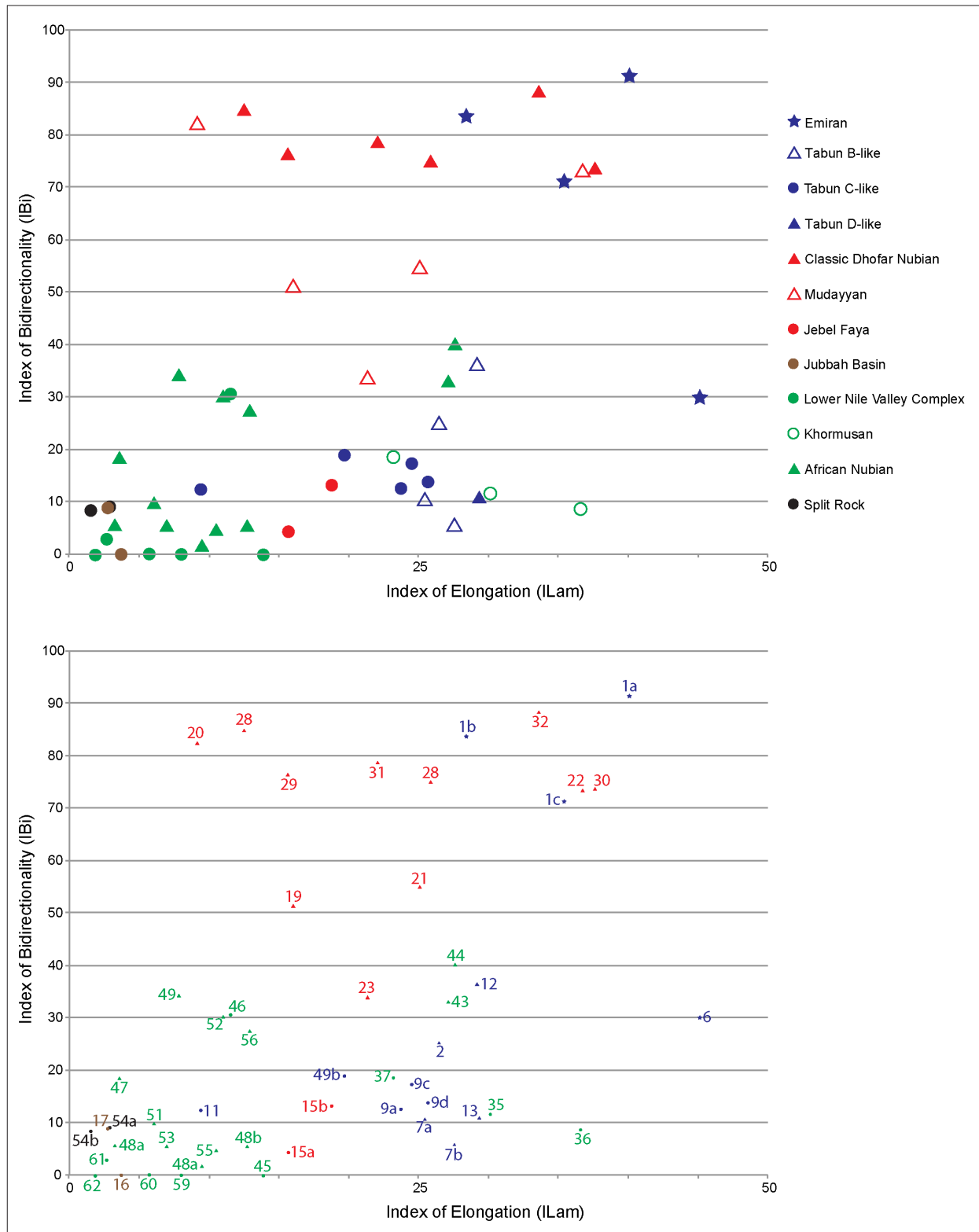


Fig. 14. Scatterplot showing indices of bidirectionality versus elongation.

Abb. 14. Streudiagramm zur Gegenüberstellung der Indices zur Bidirektionalität und Länge Artefakten.

strategies of the classic Tabun D and B assemblages found in the Mediterranean zone. In this sense, the late MP material from southern Jordan is technologically closer to the African Nubian Complex than the Levantine Mousterian of the Carmel.

In both the Nubian Complex and the Lower Nile Valley Complex, there is a tendency toward the production of Levallois flakes, rather than Levallois/Nubian points that are typical of the Emiran (Fig. 7). Laminar indices are also quite low (Fig. 14) and MP tools are predominant relative to UP types (Fig. 13). There is also a strong trend toward the production of denticulates in Lower Nile Valley Complex assemblages, in some cases comprising the majority of the combined UP/MP tool assemblage (Marks 1992: 242), a pattern that is absent in the Levantine MP (*ibid.*).

Given these technological and typological considerations, we find no *direct* relationship between any northeast African MIS 5 industry and the early Emiran. The African data do suggest that the Emiran's preferential bidirectional Levallois point production strategy ultimately arose in northeast Africa during late MIS 6. This reduction strategy became increasingly widespread during MIS 5, where it spread as far south as the Ethiopian Rift and east into the Arabian Peninsula. This wide distribution suggests extensive cultural contact, either direct or indirect, along the Nile Valley and across the Red Sea during the Last Interglacial, when climatic conditions were optimal.

If Nubian Levallois technology reached the K'One crater in Ethiopia, some 2300 km south of Middle Egypt, bidirectional reduction at 'Ain Difla, some 600 km to northeast should not be a surprise. Yet, while some Nubian-like cores have been sparsely documented at a few sites (Crew 1975; Vermeersch 2001) the intensive use of Nubian Levallois technology does not appear to have reached any further into the Levant. As importantly, the consistent technological patterns seen among all northeast African MIS 5 assemblages (i.e., a paucity of Levallois points, roughly equivalent UP and MP retouched tools, and a lack of significant laminar production), is not present at 'Ain Difla. At most, the high frequency of bidirectional core preparation in Levels 6 - 20, represents the selective adaptation of an originally African trait.

The three northeast African MP industries extending into MIS 4 - the Khormusan, Taramsan, and Aterian - are the most likely African candidates to have contributed to the development of the Emiran. The Khormusan's limited distribution around and south of the Second Cataract (Marks 1968b), however, makes any direct connection to the southern Levant highly unlikely. The only aspect of the Khormusan that parallels the Emiran is the clear dominance of UP tools, relative to MP ones (Fig. 13). Yet, when Khormusan technology is considered, with its emphasis on ovate Levallois core reduction, paucity of Levallois points, minor blade component, and rarity of bidirectional core preparation (Fig. 14), there is no demonstrable relationship to the Emiran.

Among the Aterian (or Atero-Mousterian *sensu* Dibble et al. 2013) of northeast Africa, the ratio of UP tools to MP ones is only slightly higher than in other coeval assemblages found in the region. The trivial production of Levallois points is fully consistent with other northeast African MP assemblages, and radically different from the Emiran (Fig. 13). In addition, its geographic distribution is not documented east of the Nile Valley and it is barely present in the valley itself. If those signature aspects of the Atero-Mousterian - pedunculates and bifacial foliates - had expanded through the Sinai into the Negev, they would surely appear in at least one MIS 5 or MIS 4 context somewhere in the southern Levant, which they do not.

The lithic workshops excavated at Makhadma 6 and Taramsa 1, Activity Phases IV demonstrate that the Nubian Levallois reduction strategy persisted through MIS 4 and into MIS 3, while undergoing technological modifications leading to serial blade production. Given this technological trajectory, similar to that of the Emiran, and the age range immediately preceding it, it is conceivable that this assemblage could represent the progenitor of the Emiran (Meignen & Bar-Yosef 2005). Indeed, it does seem to belong to a technologically transitional stage, where an increase in flaking surface convexity on Nubian Levallois cores shifted them to volumetric reduction, permitting serial production of blades, while maintaining the necessary flaking surface convexities. In that sense, the Taramsan blade production system shares two critical elements with the Emiran: bidirectional reduction and the recurrent production of elongated blanks.

On the other hand, there are a number of technological differences between the Taramsan and the Emiran. The assemblage from Boker Tachtit, Level 1, includes one example of true prismatic blade technology (Volkman 1983: 133-136), which never occurs at Taramsa Hill. At the same time, the bidirectional Levallois point system at Boker Tachtit was modified so that a greater numbers of blades were produced both before and after the removal of the Levallois point. Unlike Taramsan technology, however, this did not result in increased flaking surface convexity and a shift toward volumetric reduction on the bidirectional Levallois point cores. Rather, non-Levallois bidirectional volumetric reduction, first appearing in Level 1, gradually replaced the bidirectional Levallois point strategy. Thus, while both the Taramsan and the Emiran exhibit technological transitions from preferential, bidirectional Levallois systems to recurrent, non-Levallois systems, the means by which these trajectories developed were quite different.

While MIS 4 - MIS 3 data from Egypt show developmental trajectories heading toward the UP, and even a few specific traits found in the Emiran, there is not a single Egyptian assemblage that can be recognized as directly related to the Emiran (Vermeersch 2009).

Out of Arabia?

From an ecological perspective, hunter-gatherer populations in Arabia are the most likely candidates to have contributed to the development of the Emiran, as there are no natural physiographic borders separating nomadic groups in the Arabian Peninsula from those in the southern Levant. Given their location, should we consider sites such as 'Ain Difla, Tor Faraj, and Tor Sabiha as Levantine or Arabian? Certainly, MP inhabitants of the region were not aware of crossing from the Arabian Peninsula into the Levant at the Jordanian border.

By MIS 5.3, perhaps as early as the Last Interglacial, the African Nubian Complex was widespread in Arabia, from the Yemeni Hadramawt to the eastern edge of the Nejd plateau in southern Oman. Additional manifestations of this technocomplex have been found in the Rub' al Khali, central Saudi Arabia, and the Al Jawf basin of northern Saudi Arabia, less than 300 km southeast of 'Ain Difla. While most Nilotic Nubian Complex assemblages tend to have low laminar indices under 13, the Classic Dhofar Nubian exhibits a wide range (Fig. 14), overlapping with both low levels of elongation in Africa (e.g., Aybut ath-Thani and Mudayy as-Sodh 1), and the more elongated southern Levantine Mousterian assemblages (e.g., Jebel Sanoora 1, TH.377, Jebel Markhashik 1). Like Africa, the frequency of MP versus UP tool types is roughly equivalent, skewed somewhat toward the MP (Fig. 13). Differing from the African Nubian Complex, however, Levallois point production is far more common, although not quite as prevalent as found in the southern Levant. These Arabian variations on the Nubian Complex suggest that, even in MIS 5, technological and typological differentiation was occurring between Africa and Arabia.

At least five distinct assemblage types have been documented in Arabia from MIS 5.1 to early MIS 3 (ca. 90 - 50 ka). In the central and southwestern parts of the Peninsula, both surface and buried sites have been found around the Jubba and Mundafan palaeolakes. Although these assemblages have inadequate tool and core counts to discern detailed technological or typological patterns, it is apparent that none is related to the Afro-Arabian Nubian Technocomplex, and none is a likely precursor of the Emiran. Rather, the predominantly radial forms of core reduction resemble those found in the roughly contemporary Tabun C-type assemblages from the Levant (Crassard & Hilbert 2013: 1-2), while the short, broad based Levallois points struck from unidirectional converging flaking surfaces at Jebel Katefeh 1 are far more reminiscent of Tabun B-type Levallois points (*ibid.*) than anything coeval in northeast Africa.

In eastern Arabia, Assemblages A and B from Jebel Faya are sufficiently similar to one another to think they are temporally different manifestations of the same, as yet, undefined industry. The absence of any purposeful Levallois or volumetric blade technologies

in either, among other reasons, leads to a reasonable interpretation that they are strictly local (Marks 2009), perhaps representing an autochthonous development associated with the Gulf "Oasis" region of eastern Arabia (Rose 2010). Consequently, they can be discounted from this discussion.

The stratified Wadi Surdud assemblages in western Yemen, dating between 60 and 40 ka, are radically different from those in central Arabia and around the Gulf. Delagnes et al. (2012) observe that the use of an unafaceted, unidirectional-convergent reduction strategy to produce large numbers of elongated blanks is superficially reminiscent of those Tabun D-like southern Levantine Mousterian assemblages with high laminar indices, however, they caution that:

"the Levallois debitage at Wadi Surdud differs significantly, both qualitatively and quantitatively, from the Levantine Levallois debitage. Some affinities between the SD1 assemblage and the Levantine Mousterian are still plausible, but would relate more to indirect temporal and geographical connections between the two regions, rather than any direct cultural affiliation" (*ibid.*: 20).

While SD1 has some Levantine technological proclivities, the absence of bidirectional reduction, cresting, and true Levallois points makes it an unlikely antecedent of the Emiran. Moreover, the SD1 date ranges overlap with Boker Tachtit, Level 1; it is not necessarily earlier than the Emiran. That is not to say, however, that we discount SD1 as representing some descendant form of the Arabian Nubian Complex. Virtually nothing is known of the MP in western Arabia, where any connections between Levantine Mousterian and the Wadi Surdud assemblages might be found. There are reports of numerous MP and UP sites mapped by the Comprehensive Archaeological Survey of Saudi Arabia along the flanks of the Asir mountain chain, as well as on the Red Sea coastal plain (Adams et al. 1977; Zarins et al. 1979, 1980, 1981, 1982; Zarins & Zahrani 1985; Zarins & al-Badr 1986), which are likely to be fruitful areas of future research.

As discussed in the preceding section, there is ample evidence indicating that the Mudayyan Industry is a late aspect of the Classic Dhofar Nubian (Usik et al. 2013; Hilbert et al. 2014). In comparison to the technological shifts seen in the late Nubian Complex industries of the Nile Valley (e.g., Taramsan, Safahan, Khormusan), however, the changes that brought about the Mudayyan follow a different trajectory. Mudayyan toolmakers continued to use the Nubian Levallois strategy, but to produce diminutive points. Additionally, there was a modification to the preferential Nubian Levallois system that de-emphasized the formation of a pronounced median distal ridge, in favor of a recurrent, bidirectional flaking strategy. Such cores produced points and blades struck from opposed, faceted platforms across both a broad working surface, as well as from the narrow edges

adjacent to the primary flaking surface. At Jebel Dahsha and Umm Mudayy 1 and 2, crested blades (2% - 7%) and pre-cores with crest preparation (1% - 13%) were identified among the cores and debitage, suggesting the presence of a cresting technique in the Mudayyan (Rose et al unpubl. data). The emergence of these technologies may well have been an adaptive response to the more challenging environmental conditions that beset Arabia after 75 ka that required smaller armatures and a more efficient flaking strategy. Given the statistically significant difference between the large Levallois points that are found in the Classic Dhofar Nubian, and the diminutive variants found in Mudayyan assemblages (Usik et al. 2013), it is tempting to associate this change with the shift in projectile hunting technology proposed by Sisk and Shea (2011). Although not an exact match, Mudayyan technological (Fig. 13) and typological (Fig. 14) patterning is closer to the early Emiran than to any other assemblage type considered in this study.

With such parallels between the Mudayyan and the early Emiran, is it reasonable to claim one led directly to the other? Not at this time, as the presently known distribution of the Mudayyan is far from the Negev. Taking into account the age of 'Ain Difla, Levels 6 - 20, it is more likely that the Emiran derived, in part, from a northern Arabian variant of the Nubian Complex that had expanded into the region by MIS 5.3, if not during MIS 5.5. The recent discovery of surface scatters with Nubian Levallois technology in northern Saudi Arabia, just under 300 km southeast of 'Ain Difla, warrants additional research in this area.

There is also evidence of non-Nubian demographic interactions between Arabia and the Levant in the Late MP. At the Jubbah palaeolake, Tabun C-like and B-like technological features (Crassard & Hilbert 2013) suggest either cultural diffusion, or southward forays of Levantine Mousterian groups at times of optimal climatic conditions. It is likely that there were other such demographic/cultural overlaps, but still little is known of the Palaeolithic in northern and western Arabia.

The Emiran through the admixture prism

The techno-typological patterns we have observed point to an origin of the Emiran that was neither wholly rooted in the Levant nor the result of a complete demographic replacement from groups expanding out of Africa; rather, the Emiran combines elements of the Nubian Levallois system with typological elements from the southern Levantine Mousterian. Our proposed scenario envisions a zone stretching across the interface of northwestern Arabia and the southern Levant, where the territories of Levantine and Arabian hunter-gatherer populations overlapped during MIS 5. Bilateral exchange over time resulted in the incorporation of an Afro-Arabian core reduction strategy with a Levantine tool-making tradition that extends back to the Early Mousterian. At the same time, some

late MP Arabian tool-making traditions show a trend toward Levantine characteristics: the adoption of a unidirectional-convergent reduction strategy for blade and point production at the Wadi Surdud Complex; the production of short, broad-based Levallois points at Jebel Katefeh 1; and, Tabun C-like centripetal Levallois reduction strategies around the Mundafan and Jubbah palaeolakes. Neither the interior Nubian Complex findspots at Al-Jawf and Al Kharj, nor the Mudayyan assemblages from the geographically isolated Dhofar refugium absorbed any discernable Levantine traits. Rather, the Mudayyan appears to exclusively be a late expression of the Nubian Complex - a sympatric development alongside the Emiran, Safahan, Aterian, and Taramsan Industries.

Palaeoanthropological evidence suggests African Nubian Complex toolmakers were modern humans. AMH specimens have been documented in North Africa from 150 ka onward (Smith et al. 2007b; Hublin & McPherron 2012), while no other species has yet been found there. An AMH child burial was excavated from an extraction pit associated with Activity Phase III at Taramsa Hill 1 (Vermeersch et al. 1998; Van Peer et al. 2010), with a *terminus post quem* of ca. 70 ka. Although there is some question as to whether this specimen was intrusive from a later occupation at the site, the overlying assemblages from Activity Phases IV and V are both later stages of the Nubian Complex, therefore, would suggest demographic continuity at the site. Given the technological similarity of the Classic Dhofar Nubian and the Late Nubian Complex of the Middle Nile Valley in Egypt, as well as the fact that there is no evidence for prior MP human occupation in southern Oman, it is reasonable to associate the distribution of Nubian Complex sites with a population of AMHs spread across northeast Africa and the Arabian Peninsula. The presence of Nubian Levallois technology in southern Arabia and the Horn of Africa (Clark 1954; Kurashina 1978; Clark 1988; Beyin 2013), as well as northern Arabia and in the Red Sea hills of Egypt, suggests that early human groups could have traveled to and from Africa via both the Arabian and Levantine Corridors.

In the Levant, the taxonomies of Levantine Mousterian toolmakers are not easy to distinguish. It was previously thought that Tabun C toolmakers were AMHs, and that their presence at Skhul and Qafzeh provided a specific route and window of time for an African dispersal between 110 - 90 ka (e.g., Bar-Yosef 1987, 1994, 2000; Tostevin 2000). Just as the Tabun sequence has been found to be non-linear and not pan-Levantine, the classification of Neanderthal and modern human specimens as distinct species in the Levant has been questioned by some researchers (e.g., Trinkaus 1986; Clark & Lindly 1989). For nearly thirty years, scholars have urged the decoupling of Tabun industries to distinguish AMH and Neanderthals (e.g. Ahrensburg & Belfer-Cohen 1998; Kaufman 2001; Hovers & Belfer-Cohen 2013).

Our scenario is in agreement with the proposition of an intermediate stage of expansion out of Africa, which led to the partial divergence of African and non-African populations between 120 - 60 ka, followed by a later divergence between Europeans and Asians after 60 ka (Scally & Durbin 2012; Schiffels & Durbin 2014). The current body of ancient DNA evidence indicates multiple admixture events between AMH and other archaic species (e.g., Fu et al. 2014; Hellenthal et al. 2014; Sankararam et al. 2014). Modeling the the period of genetic exchange between AMHs and Neanderthals, Sankararam et al. (2012) propose a window between 86 - 37 ka, while Fu et al. (2014) further refine this timeframe to 60 - 50 ka, using a fully sequenced AMH femur from Ust' Ishim in western Siberia. Stringer (2012: 198-199) also considers the Near East as the most likely place of genetic exchange, but questions whether there could have been an earlier period of mixing:

"...the interbreeding might even have happened when people like those from Skhul-Qafzeh and Tabun were in the Middle East 120,000 years ago. If a thousand of those early moderns mixed with just fifty Neanderthals and then survived somewhere in Arabia or North Africa, could they have subsequently interbred with the Out of Africa emigrants 60,000 years later, and passed on their hidden component of Neanderthal genes?"

The initial dispersal of Nubian Complex toolmakers out of Africa seems to have occurred during early MIS 5, perhaps in response to the well-documented "greening" of the Saharo-Arabian phytogeographic zone (e.g., Anton 1984; McClure 1984; Sanlaville 1992; Rose 2000, 2006, 2007; Parker & Rose 2008; Rosenberg et al. 2011; Drake et al. 2013). Although our understanding of the timing and extent of Late Pleistocene environmental oscillations remains somewhat coarse, evidence from speleothems growth (Vaks et al. 2003, 2007, 2010; Frumkin et al. 2008, 2009, 2011; Fleitmann & Matter 2009; Sorin et al. 2010; Fleitmann et al. 2011; Ayalon et al. 2013), fluvial deposits (McClaren et al. 2008; Abouelmagd et al. 2014), dune formation (Preusser et al. 2002; Radies et al. 2004; Stokes & Bray 2005; Preusser 2009), deep sea cores (Bar-Matthews et al. 2003, 2006; Langgut et al. 2011), and lacustrine and tufa deposits (Smith et al. 2007a; Torfstein et al. 2009; Brookes 2010; Petit-Maire et al. 2010; Waldmann et al. 2010; Rosenberg et al. 2011, 2012; Parton et al. 2013; Barrows et al. 2014) indicates that North Africa, Arabia, and the Levant all experienced greatly increased precipitation during the Last Interglacial.

After the Last Interglacial, however, the magnitude of rainfall supplied by Atlantic-Mediterranean Westerlies versus Indian Ocean monsoon regimes became asynchronous (Fig. 15), resulting in variable conditions that may have had both "pushing" and "pulling" effects on hunter-gatherer mobility patterns in these regions. North Africa experienced widespread

drying out after 115 ka (Carto et al. 2009; Blome et al. 2012; Drake et al. 2013); in contrast, speleothems (Fleitmann et al. 2011) and lacustrine deposits (Rosenberg et al. 2011, 2012) from southern Arabia are indicative of a humid episode associated with sub-stage 5.3 (110 - 100 ka). In the Negev, speleothem growth did not resume until ca. 90 ka (Vaks et al. 2007, 2010; Frumkin et al. 2009, 2011), while Lake Amora (Dead Sea) levels show low stands throughout all of MIS 5 (Torfstein et al. 2009; Waldmann et al. 2010).

By MIS 5.1 (90 - 75 ka), there was, again, greater activity in the Indian Ocean monsoon, and, to a lesser extent, Mediterranean storms. Pluvial proxy signals are found throughout Arabia, northeast Africa, and the southern Levant. The interior basins of Arabia, such as Jubbah (Petraglia et al. 2012), Al Jafr (Davies 2005), Khujaymah and Mundafan (Rosenberg et al. 2011), and Mudawwara (Petit-Maire et al. 2010), all exhibit lacustrine deposition, while cave speleothems in the Negev indicate a short pulse of humidity. Given these widespread and generally favorable conditions, one might expect the expansion of multiple hunter-gatherer territories and the resulting cultural/genetic exchange between different groups coming into contact with one another. The extent to which the climate deteriorated in the intervening sub-stages 5.4 (120 - 110 ka) and 5.2 (100 - 90 ka) is uncertain, as sediment accumulation was quite limited. Some records of dune accumulation, however, point to a dramatic increase in aridity at these times (e.g., Radies et al. 2004; Preusser 2009).

During MIS 4 (75 - 60 ka), Frumkin et al. (2008: 365) observe that "the depositional periods at Oman, within the South Arabian desert, are almost all chronologically distinct from the wet periods of the North Arabian desert." Rainfall regimes across the Arabian Peninsula and the Levant have a negative correlation at this time. Arabia was beset by prolonged aridity caused by the southward displacement of the Intertropical Convergence Zone; records from the Arabian Sea indicate a period characterized by cooler sea surface temperatures, low productivity, and increased aeolian input (e.g., Reichert et al. 1997; Pattan & Pearce 2009; Banakar et al. 2010), corroborated by studies of dune formation (e.g., Radies et al. 2004; Stokes & Bray 2005; Preusser 2009). Conversely, to the north, Lake Amora shows a substantial highstand (Waldmann et al. 2009) and speleothem records from the northern Negev indicate increased humidity (Vaks et al. 2006; Frumkin et al. 2011). This disparity between rainfall in the north and south of the Peninsula might have drawn Arabian Nubian Complex toolmakers northward, into the region affected by Mediterranean precipitation. This process might have also been affected by a subsequent wet pulse documented in eastern and central Arabia between approximately 60 and 50 ka (McClaren et al. 2008; Parton et al. 2013), which, presumably, would have again triggered hunter-gatherer range expansions.

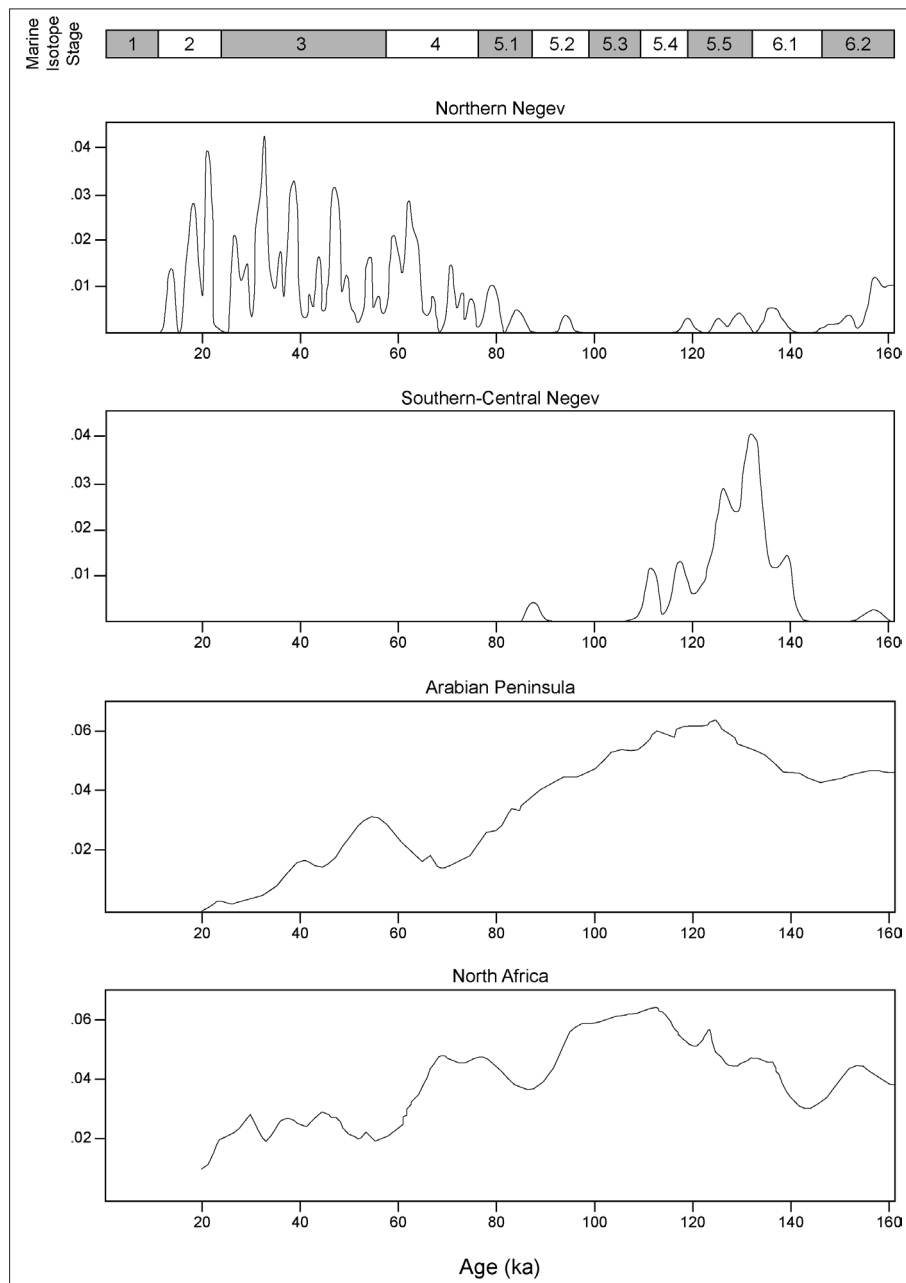


Fig. 15. Sum probability curves showing the likelihood of wet conditions from MIS 6 to MIS 2 in the northern Negev (Frumkin et al. 2011), central-southern Negev (Frumkin et al. 2011), the Arabian Peninsula (Drake et al. 2013), and North Africa (Drake et al. 2013).

Abb. 15. Die Kurven der Summenwahrscheinlichkeit stellen die Wahrscheinlichkeit von Feuchtphasen im Zeitraum zwischen MIS 6 und MIS 2 in der nördlichen Wüste Negev (Frumkin et al. 2011), in der zentral-südlichen Wüste Negev (Frumkin et al. 2011), der Arabischen Halbinsel (Drake et al. 2013), und Nordafrika (Drake et al. 2013)

We suggest that over tens of thousands of years, genetic and cultural information mingled across expanding and contracting contextual areas in Arabia and the southern Levant, driven by the asynchronous rhythm of Indian Ocean, Atlantic, and Mediterranean weather patterns. These bidirectional corridors of exchange could have extended into Africa as well, hinted at by the seemingly intrusive Hargeisan assemblages in the Horn of Africa (Clark 1954; Rose & Usik 2009) and the genetic signature of a back migration

from the Levant into northeast Africa during the early Upper Palaeolithic (e.g., Cruciani et al. 2002; Olivieri et al. 2006). We consider the proposed zone of interaction in northwestern Arabia as overlapping "contextual areas," defined as "an array of adaptive relationships between natural and socio-cultural factors within a human habitat" (Weissmüller 1995: 53-57). Such interactions between the contextual areas presented in this paper might resemble the meteorological maps of Bantu migration patterns

documented in northern Namibia (Richter et al. 2012: 7), which chart movement not with vector arrows, but with shifting high and low pressure systems.

For this reason, we will probably never find a single, direct antecedent for the Emiran. Rather, the Emiran should be viewed as one manifestation of a widespread, long-term transformation from Nubian Levallois technology to recurrent, bidirectional, elongated point producing technologies that took place from early MIS 5 to early MIS 3. This is evident in the Taramsan, Safahan, Mudayyan, and Emiran industries. The ultimate success of the Emiran (as opposed to the other three Nubian Complex-derived industries), which eventually transformed into a true UP and spread northward into the territories of modern-day Lebanon and Turkey, seems to rest on relatively favorable environmental conditions in the southern Levant throughout MIS 4 and MIS 3 (Fig. 15).

This model of Arabian-Levantine interaction during the late MP can be verified by archaeological research in northwestern Arabia and southern Jordan. Late MP assemblages found within the overlapping Afro-Arabian Nubian Complex and southern Levantine contextual areas should exhibit technotypological features resembling the early Emiran: bidirectional core preparation, Levallois point production, crested blades, a predominance of UP tools, and, perhaps, even Emireh points. MP surface sites found around palaeolakes in this zone, such as the Jafr basin (Davies 2005), Mudawwara depression (Petit-Maire et al. 2010), and Al Jawf basin (Hilbert et al. unpubl. data), are all promising starting points for this endeavor.

ACKNOWLEDGEMENTS: We are grateful to the Dhofar Archaeological Project (DAP) team including Dr. Vitaly Usik, Dr. Yamandú Hilbert, and Mr. Mohammed Jabooob for their integral role in mapping, studying, and illustrating the Classic Dhofar Nubian and Mudayyan lithic assemblages. We thank Mrs. Jeanne Marie Geiling for translating the title, abstract, and captions into German and Dr. Yamandú Hilbert, Prof. Erella Hovers, and Prof. Chris Stringer for their valuable feedback while preparing the manuscript. We are grateful to the Ministry of Heritage and Culture in Oman for granting permission to carry out this archaeological fieldwork and providing logistical support for DAP. From 2009 to 2012, DAP was funded by a UK Early Career Research Grant (AH/G012733/1) awarded to J. Rose and a 2013 National Geographic Waitt Grant awarded to J. Rose.

Literature cited

- Adams, R., Parr, P., Ibrahim, M. & al-Mughannum, A. S. (1977). Preliminary report on the first phase of the Comprehensive Survey Program. *Atlat* 1: 21-40.
- Abouelmagd, A., Sultan, M., Sturchio, N. C., Soliman, F., Rashed, M., Ahmed, M., Kehew, A. E., Milewski, A. & Chouinard, K. (2014). Paleoclimate record in the Nubian Sandstone Aquifer, Sinai Peninsula, Egypt. *Quaternary Research* 81: 158-167.
- Al Nafie, A. H. (2008). Phytogeography of Saudi Arabia. *Saudi Journal of Biological Sciences* 15: 159-176.
- Alves, I., Hanulová, S., Foll, M. & Excoffier, L. (2012). Genomic data reveal a complex making of humans. *PLoS Genetics* 8 (7): e1002837.

- Ahrensburg, B. & Belfer-Cohen, A. (1998). Sapiens and Neanderthals: Rethinking the Levantine Middle Palaeolithic Hominids. In: T. Akazawa, K. Aoki, O. Bar-Yosef (Eds.) *Neanderthals and modern Humans in Western Asia*. New York, Plenum Press, 311-322.
- Armitage, S. J., Jasim, S. A., Marks, A. E., Parker, A. G., Usik, V. I. & Uerpman, H.-P. (2011). The southern route "Out of Africa": evidence for an early expansion of modern humans into Arabia. *Science* 331: 453-456.
- Aton, D. (1984). Aspects of geomorphological evolution: paleosols and dunes in Saudi Arabia. In: A. R. Jado, & J. G. Zötl (Eds.) *Quaternary period in Saudi Arabia, Vol. II, Sedimentological, Hydrogeological, Hydrochemical, Geomorphological, and Climatological Investigations of Western Saudi Arabia*. Springer, Vienna, 275-296.
- Ayalon, A., Bar-Matthews, M., Frumkin, A. & Matthews, A. (2013). Last Glacial warm events on Mount Hermon: the southern extension of the Alpine karst range of the east Mediterranean. *Quaternary Science Reviews* 59: 43-56.
- Azoury, I. (1986). *Ksar Akil, Lebanon. A Technological and Typological Analysis of the Transitional and Early Upper Paleolithic Levels of Ksar Akil and Abu Halka*. BAR International Series 289, Oxford.
- Bailey, G. N. (2009). The Red Sea, coastal landscapes and hominin dispersals. In: M. Petraglia & J. I. Rose (Eds.) *The evolution of human populations in Arabia: Paleoenvironments, Prehistory, and Genetics*. Springer Academic Publishers, Netherlands, 15-37.
- Banakar, V. K., Mahesh, B. S., Burr, G. & Chodankar, A. R. (2010). Climatology of the Eastern Arabian Sea during the last glacial cycle reconstructed from paired measurement of foraminiferal $\delta^{18}\text{O}$ and Mg/Ca. *Quaternary Research* 73: 535-540.
- Bar-Matthews, M., Ayalon, A., Gilmour, M., Matthews, A. & Hawkesworth, C. J. (2003). Sea-land oxygen isotopic relationships from planktonic foraminifera and speleothems in the eastern Mediterranean region and their implication for paleorainfall during interglacial intervals. *Geochimica et Cosmochimica Acta* 67: 3181-3199.
- Barrows, T. T., Williams, M. A. J., Mills, S. C., Duller, G. A. T., Fifield, L. K., Haberlah, D., Tims, S. G. & Williams, M. F. (2014). A White Nile megalake during the last interglacial period. *Geology* 42: 163-166.
- Bar-Yosef, O. (1980). Prehistory of the Levant. *Annual Review of Anthropology* 9: 101-133.
- Bar-Yosef, O. (1987). Pleistocene connections between Africa and Southwest Asia: an archaeological perspective. *African Archaeological Review* 5: 29-38.
- Bar-Yosef, O. (1994). The Contributions of Southwest Asia to the study of the origin of modern humans. In: M. H. Nitecki & D. V. Nitecki (Eds.) *Origins of Anatomically Modern Humans*. Plenum Press, New York, 23-66.
- Bar-Yosef, O. (1998). The Chronology of the Middle Palaeolithic of the Levant. In: T. Akazawa, K. Aoki & O. Bar-Yosef (Eds.) *Neanderthals and Modern Humans in Western Asia*. Plenum Press, New York, 39-56.
- Bar-Yosef, O. (2000). The Middle and early Upper Palaeolithic in southwest Asia and neighboring regions. In: O. Bar-Yosef & D. Pilbeam (Eds.) *The Geography of Neanderthals and Modern Humans in Europe and the greater Mediterranean*. Peabody Museum, Harvard University, Cambridge, 107-156.
- Bar-Yosef, O. & Belfer-Cohen, A. (1988). The Early Upper Paleolithic in Levantine Caves. In: J. F. Hoffecker & C. A. Wolf (Eds.) *The Early Upper Paleolithic: evidence from Europe and the Near East*. British Archaeological Reports, International Series 437, Oxford, 23-42.
- Beyin, A. (2011). Upper Pleistocene Human Dispersals out of Africa: A Review of the Current State of Debate. *International Journal of Evolutionary Biology* 2011: 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.
- Biagi, P. (1994).** An Early Palaeolithic site near Saiwan (Sultanate of Oman). *Arabian Archaeology and Epigraphy* 5: 81-88.
- Biagi, P. & Starnini, E. (2011).** Neanderthals at the South-Easternmost Edge: The Spread of Levalloisian Mousterian in the Indian Subcontinent. In: K. Biró & M. András (Eds.) *Emlékkönyv Violának: Papers in Honor of Viola T. Dobosi*. Hungarian National Museum, Budapest, 5-14.
- Biglari, F., Javeri, M., Mashkour, M., Yazdi, M., Shidrang, S., Tengberg, M., Taheri, K. & J. Darvish (2009).** Test excavations at the Middle Paleolithic sites of Qaleh Bozi, southwest of central Iran, a preliminary report. In: M. Otte, F. Biglari & J. Jaubert (Eds.) *Iran Paleolithic*. BAR International Series S1968. Archaeopress, Oxford, 29-38.
- Blome, M. W., Cohen, A. S., Tryon, C. A., Brooks, A. S. & J. Russell (2012).** The environmental context for the origins of modern human diversity: a synthesis of regional variability in African climate 150,000-30,000 years ago. *Journal of Human Evolution* 62 (5): 563-592.
- Bordes, F. (1950).** Principes d'une méthode d'étude des techniques de débitage et de typologie du Paléolithique ancien et moyen. *L'Anthropologie* 54 (1-2): 19-34.
- Bordes, F. (1953).** Levalloisien et Moustérien. *Bulletin de la Société Préhistorique Française* 50 (4): 226-234.
- Bordes, F. (1961).** *Typologie du paléolithique ancien et moyen*. Delmas, Bordeaux.
- Brookes, A. I. (2010).** Spatially variable sedimentary responses to orbitally driven pluvial climate during Marine Oxygen Isotope Stage 5.1, Dakhla Oasis region, Egypt. *Quaternary Research* 74: 252-264.
- Bretzke, K., Armitage, S., Parker, A., Walkington, H. & Uerpmann, H.-P. (2013).** The environmental context of Palaeolithic settlement at Jebel Faya, Emirate Sharjah, UAE. *Quaternary International* 300: 83-93.
- Bretzke, K., Conard, N. J. & Uerpmann, H.-P. (2014).** Excavations at Jebel Faya — The FAY-NE1 shelter sequence. *Proceedings of the Seminar for Arabian Studies* 44: 69-82.
- Carto, S. L., Weaver, A. J., Hetherington, R., Lam, Y. & Wiebe, E. C. (2009).** Out of Africa and into an ice age: on the role of global climate change in the late Pleistocene migration of early modern humans out of Africa. *Journal of Human Evolution* 56: 139-151.
- Caton-Thompson, G. (1952).** *Kharga Oasis in Prehistory*. Athlone Press, London.
- Chiotti, L., Olszewski, D. I., Dibble, H. L., McPherron, S. P., Schurmans, U. A. & Smith, J. R. (2007).** Paleolithic Abydos: reconstructing individual behaviors across the high desert landscape. In: Z. Hawass & J. Richards (Eds.) *The Archaeology and Art of Ancient Egypt: Essays in Honor of David B. O'Connor*. Supreme Council of Antiquities Press (distributed by American University in Cairo Press), Cairo, 169-183.
- Chiotti, L., Dibble, H. L., Olszewski, D. I., McPherron, S. P. & Schurmans, U. A. (2009).** Lithic technologies of the western high desert in Egypt (Abydos, Egypt). *Journal of Field Archaeology* 34: 307-318.
- Chmoelewski, W. (1968).** Early and Middle Palaeolithic Sites near Arkin, Sudan. In: F. Wendorf (Ed.) *The Prehistory of Nubia*. Southern Methodist University Press, Dallas, 110-147.
- Clark, G. A. & Lindly, J. M. (1989).** Modern Human Origins in the Levant and Western Asia: The Fossil and Archeological Evidence. *American Anthropologist* 91: 962-985.
- Clark, G. A., Schuldenrein, J., Donaldson, M. L., Schwarcz, P., Rink, W. J. & Fish, S. K. (1997).** Chronostratigraphic contexts of Middle Palaeolithic horizons at the 'Ain Difla rockshelter (WHS 634), west-central Jordan. In: H. G. K. Gebel, Z. Kafafi & G. O. Rollefson (Eds.) *The Prehistory of Jordan, II. Perspectives from 1997*. Ex Oriente, Berlin, 77-100.
- Clark, J. D. (1954).** *The Prehistoric Cultures of the Horn of Africa*. 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.
- Close, A. (1993).** BT-14, a stratified Middle Palaeolithic site at Bir Tarfawi, Western Desert of Egypt. In: L. Krzyżaniak, M. Kobusiewicz & J. Alexander (Eds.) *Environmental Change and Human Culture in the Nile Basin and Northern Africa until the Second Millennium B.C.* Poznań Archeological Museum, Poznań, 115-122.
- Copeland, L. (1975).** The Middle and Upper Palaeolithic of Lebanon and Syria in the light of recent research. In: F. Wendorf & A. E. Marks (Eds.) *Problems in Prehistory: North Africa and the Levant*. Southern Methodist University Press, Dallas, 317-350.
- Copeland, L. (2001).** Forty-six Emireh points from the Lebanon in the context of the Middle to Upper transition in the Levant. *Paléorient* 26 (1): 73-92.
- Crassard, R. (2007).** *Apport de la technologie lithique à la définition de la Préhistoire du Hadramawt, dans le contexte du Yémen et de l'Arabie du Sud*. Ph.D., dissertation, Université Paris, Paris.
- Crassard, R. (2009).** The Middle Palaeolithic of Arabia: the view from the Hadramawt region, Yemen. In: M. Petraglia & J. I. Rose (Eds.) *The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*. Springer Academic Publishers, Netherlands, 151-168.
- Crassard, R. & Thiébaud, C. (2011).** *Levallois points production from eastern Yemen and some comparisons with assemblages from East-Africa, Europe and the Levant*. ERAUL 999, Liège, 1-14.
- Crassard, R., Petraglia, M. D., Drake, N. A., Breeze, P., Gratuze, B., Alsharekh, A., Arbach, M., Groucutt, H., Khalidi, L., Michelsen, N., Robin, C. J. & Schiettecatte, J. (2013).** Middle Palaeolithic and Neolithic Occupations around Mundafan Palaeolake, Saudi Arabia: Implications for Climate Change and Human Dispersals. *PLoS One* 8: e69665.
- 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.
- Crew, H. L. (1975).** An evaluation of the Relationship between the Mousterian Complexes of the Eastern Mediterranean: A Technological Perspective. In: F. Wendorf & A. E. Marks (Eds.) *Problems in Prehistory: North Africa and the Levant*. Southern Methodist University Press, Dallas, 427-438.
- Crew, H. L. (1976).** The Mousterian site of Rosh Ein Mor. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments in the Central Negev, Israel, vol. 1, The Avdat/Aqev Area, Part 1*. Southern Methodist University Press, Dallas, 75-111.
- Cruciani, F., Sanolamazza, P., Shen, P., Macaulay, V., Moral, P., Olckers, A., Modiano, D., Holmes, S., Destro-Bisol, G., Coia, V., Wallace, D. C., Oefner, P. J., Torroni, A., Cavalli-Sforza, L. L., Scozzari, R. & Underhill, P. A. (2002).** A Back Migration from Asia to Sub-Saharan Africa Is Supported by High-Resolution Analysis of Human Y-Chromosome Haplotypes. *American Journal of Human Genetics* 70: 1197-1214.
- Davidzon, A. & Goring-Morris, N. (2003).** Sealed in Stone: The Upper Palaeolithic Early Ahmarian Knapping Method in the Light of Refitting Studies at Nahal Nizzana XIII, Western Negev, Israel. *Journal of the Israel Prehistoric Society* 33: 75-205.
- Davies, P. C. (2005).** Quaternary Paleoenvironments and Potential for Human Exploitation of the Jordan Plateau Desert Interior. *Geoarchaeology: An International Journal* 20: 379-400.
- Delagnes, A., Tribolo, C., Bertran, P., Brenet, M., & Crassard, R. (2012).** Inland human settlement in southern Arabia 55,000 years ago. New evidence from the Wadi Surdud Middle Palaeolithic site complex, western Yemen. *Journal of Human Evolution* 63 (3): 452-474.

- Delagnes, A., Crassard, R., Bertran, P. & Sitzia, L. (2013). Cultural and human dynamics in southern Arabia at the end of the Middle Palaeolithic. *Quaternary International* 300: 234-243.
- Demidenko, Y. & Usik, V. (1993). The problem of changes in Levallois technique during the technological transition from the Middle to the Upper Palaeolithic. *Paléorient* 19 (2): 5-15.
- Demidenko Y. & Usik, V. (2003). Into the mind of the maker: Refitting study and technological reconstruction. In: D. Henry (Ed.) *Neanderthals in the Levant*. Continuum, London, 107-155.
- Dibble, H., Aldeias, V., Jacobs, Z., Olszewski, D., Rezek, Z., Lim, S., Alvarez-Fernández, E., Barshay-Szmidt, C., Hallett-Desguez, E., Reed, D., Reed, K., Richter, D., Steele, T., Skinner, A., Blackwell, B., Doronicheva, E. & El-Hajraoui, M. (2013). On the industrial attributions of the Aterian and Mousterian of the Maghreb. *Journal of Human Evolution* 64: 194-210.
- Douka, K., Bergman, C. A., Hedges, R. E. M., Wesselingh, F. P. & Higham, T. F. G. (2013). Chronology of Ksar Akil (Lebanon) and implications for the colonization of Europe by anatomically modern humans. *PLoS ONE* 8 (9): e72931.
- Drake, N. A., Breeze, P. & Parker, A. (2013). Palaeoclimate in the Saharan and Arabian Deserts during the Middle Palaeolithic and the potential for hominin dispersals. *Quaternary International* 300: 48-61.
- Durand, E. Y., Patterson, N., Reich, D. & Slatkin, M. (2011). Testing for ancient admixture between closely related populations. *Molecular Biology and Evolution* 28: 2239-2252.
- Ewing, J. F. (1947). Preliminary note on the excavations at the Palaeolithic site of Ksar 'Akil, Republic of Lebanon. *Antiquity* 84: 186-196.
- Fernandes, V., Alshamali, F., Alves, M., Costa, M. D., Pereira, J. B., Silva, N. M., Cherni, L., Harish, N., Černý, V., Soares, P., Richards, M. B. & Pereira, L. (2012). The Arabian Cradle: Mitochondrial relicts of the first steps along the southern route out of Africa. *American Journal of Human Genetics* 90 (2): 347-355.
- Ferring, R. (1975). The Aterian in North African Prehistory. In: F. Wendorf & A. E. Marks (Eds.) *Problems in Prehistory: North Africa and the Levant*. SMU Press, Dallas, 113-126.
- Fleitmann, D. & Matter, A. (2009). The speleothem record of climate variability in Southern Arabia. *Comptes Rendus Geoscience* 341: 633-642.
- Fleitmann, D., Burns, S. J., Pekala, M., Mangini, A., Al-Subbary, A., Al-Aowah, M., Kramers, J. & Matter, A. (2011). Holocene and Pleistocene pluvial periods in Yemen, Southern Arabia. *Quaternary Science Reviews* 30: 783-787.
- Fleitmann, D., Burns, S. J., Neff, U., Mangini, A. & Matter, A. (2003). Changing moisture sources over the last 330,000 years in northern Oman from fluid-inclusion evidence in speleothems. *Quaternary Research* 60: 223-232.
- Forster, P. & Matsumura, S. (2005). Evolution: Did early humans go north or south? *Science* 308: 965-966.
- Frumkin, A., Bar-Matthews, M. & Vaks, A. (2008). Paleoenvironment of Jawa basalt plateau, Jordan, inferred from calcite speleothems from a lava tube. *Quaternary Research* 70: 358-367.
- Frumkin, A., Bar-Yosef, O. & Schwarcz, H. P. (2011). Possible paleohydrologic and paleoclimatic effects on hominin migration and occupation of the Levantine Middle Paleolithic. *Journal of Human Evolution* 60: 437-451.
- Fu, Q., Li, H., Moorjani, P., Jay, F., Slepchenko, S. M., Bondarev, A. A., Johnson, P. L. F., Aximu-Petri, A., Prüfer, K., de Filippo, C., Meyer, M., Zwyns, N., Salazar-García, D. C., Yaroslav V. K., Keates, S. G., Kosintsev, P. A., Razhev, D. I., Richards, M. P., Peristov, N. V., Lachmann, M., Douka, K., Higham, T. F. G., Slatkin, M., Hublin, J. -J., Reich, D., Kelso, J., Viola, T. B. & Pääbo, S. (2014). Genome sequence of a 45,000-year-old modern human from western Siberia. *Nature* 514: 445-450.
- Garcea, E. (1999). Aterian and "Early" and "Late Acacus" from the Uan Tabu rockshelter, Tadrart Acacus (Libyan Sahara). In: M. Cremaschi & S. Di Lernia (Eds.) *Wadi Teshuinat: Palaeoenvironment and Prehistory in south-western Fezzan (Libyan Sahara)*. Edizioni All'Insegna del Giglio, Florence, 155-182.
- Garcea, E. (2001). A reconsideration of the Middle Palaeolithic/Middle Stone Age in north Africa after the evidence from the Libyan Sahara. In: E. Garcea (Ed.) *Uan Tabu in the Settlement history of the Libyan Sahara*. Edizioni All'insegna del Giglio, Rome, 69-96.
- Garrod, D. A. E. (1951). A transitional industry from the base of the Upper Palaeolithic in Palestine and Syria. *Journal of the Royal Anthropological Institute* 81: 121-129.
- Garrod, D. A. E. (1955). The Mugharat el-Emireh in lower Galilee: type station of the Emiran industry. *Journal of the Royal Anthropological Institute* 85: 141-62.
- Ghirotto, S., Penso-Dolfin, L. & Barbujani, G. (2011). Genomic evidence for an African expansion of anatomically modern humans by a southern route. *Human Biology* 83: 477-489.
- Gilead, I. (1985). The settlement patterns at Gebel Maghara (northern Sinai) in the Upper Palaeolithic. *Mitekufat Haeven* 18: 67-69.
- Gilead, I. & Grigson, C. (1984). Farah II: a Middle Palaeolithic open-air site in the northern Negev, Israel. *Proceedings of the Prehistoric Society* 50: 71-97.
- Goren-Inbar, N. & Belfer-Cohen, A. (1998). The Abilities of the Levantine Mousterians: Culture and Mental Capacities. In: T. Akazawa, K. Aoki & O. Bar-Yosef (Eds.) *Neanderthal and Modern Human in Western Asia*. Plenum Press, New York, 205-222.
- Green, R. E., Krause, J., Briggs, A. W., Maricic, T. & Stenzel, U. (2010). A draft sequence of the Neandertal genome. *Science* 328: 710-722.
- Groucutt, H. (2014). Middle Paleolithic point technology with a focus on the site of Tor Faraj (Jordan, MIS 3). *Quaternary International* 350: 205-226.
- Guichard, J. & Guichard, G. (1965). The Early and Middle Palaeolithic of Nubia: Preliminary Results. In: F. Wendorf (Ed.) *Contributions to the Prehistory of Nubia*. Fort Burgwin Research Center and Southern Methodist University Press, Dallas, 57-116.
- Guichard, J. & Guichard, G. (1968). Contributions to the Study of the Early and Middle Palaeolithic of Nubia. In: F. Wendorf (Ed.) *The Prehistory of Nubia, vol. 1*. Southern Methodist University Press, Dallas, 148-193.
- Hammer, M. F., Woerner, A. E., Mendez, F. L., Watkins, J. C. & Wall, J. D. (2011). Genetic evidence for archaic admixture in Africa. *Proceedings of the National Academy of Sciences of the USA* 108: 15123-15128.
- Hauck, T. (2011). Mousterian technology and settlement dynamics in the site of Hummal (Syria). *Journal of Human Evolution* 61: 519-537.
- Hawks, J. & Wolpoff, M. (2001). The four faces of Eve: hypothesis compatibility and human origins. *Quaternary International* 75: 41-50.
- de Heinzelin, J. (1968). Geological History of the Nile Valley in Nubia. In: F. Wendorf (Ed.) *The Prehistory of Nubia, Vol. 1*. Southern Methodist University Press, Dallas, 19-55.
- Hellenthal, G., Busby, J. B. J., Band, G., Wilson, J. F., Capelli, C., Falush, D. & Myers, S. (2014). A Genetic Atlas of Human Admixture History. *Science* 343: 747-751.
- Henry, D. (1979). Palaeolithic sites within the Ras en Naqb Basin, Southern Jordan. *Palestine Exploration Quarterly* 3: 79-85.
- Henry, D. (1982). The Prehistory of Southern Jordan and relationships with the Levant. *Journal of Field Archaeology* 9 (4): 417-444.

- Henry, D. (1983). Adaptive Evolution within the Epipaleolithic of the Near East. In: F. Wendorf & A. Close (Eds.) *Advances in World Archaeology*, vol. 2. Academic Press, New York, 99-160.
- Henry, D. (1985). Late Pleistocene environment and Palaeolithic adaptations in the Southern Levant. In: A. Hadidi (Ed.) *Studies in the History and Archaeology of Jordan*, vol. 2. Routledge and Kegan Paul, London, 67-78.
- Henry, D. (1988). Summary of prehistoric and paleoenvironmental research in the Northern Hisma. In: A. Garrod & H. Gebel (Eds.) *The Prehistory of Jordan: The State of the Research in 1986*. BAR International Series 396 (1), Oxford, 7-37.
- Henry, D. (1992). Transhumance During the Late Levantine Mousterian. In: H. Dibble & P. Mellars (Eds.) *The Middle Paleolithic: Adaptation, Behavior, and Variability*. University Museum, University of Pennsylvania, Philadelphia, 143-162.
- Henry, D. (1994). Prehistoric cultural ecology in southern Jordan. *Science* 265: 336-341.
- Henry, D. (1995). *Prehistoric Cultural Ecology and Evolution: insights from southern Jordan*. Plenum Press, New York.
- Henry, D. (1997). Cultural and Geologic Successions of Middle and Upper Palaeolithic Deposits in the Jebel Qalkha Area of southern Jordan. In: H. Gebel, Z. Kafafi & G. O. Rollefson (Eds.) *The Prehistory of Jordan II: Perspectives from 1996. Studies in Early Near Eastern Production, Subsistence, and Environment 4*. Ex Oriente, Berlin, 69-76.
- Henry, D. (1998). The Middle Palaeolithic of Jordan. In: D. Henry (Ed.) *The Prehistoric Archaeology of Jordan*. BAR International Series 705, Oxford, 23-39.
- Henry, D. (2003). *Neandertals in the Levant*. Continuum, London.
- Hester, J. & Hobler, P. (1969). *Prehistoric Settlement Patterns in the Libyan Desert*. Anthropological Papers 42 (4). University of Utah Press, Salt Lake City
- Hilbert Y. H., Marks, A. E., Usik, V. I. & Rose J. I. (2014). *Grasping temporal variability and landscape evolution: spatial analysis of surface scatters from the Nejd Plateau, Oman*. Paper presented at UISPP Session A21C, Burgos, Spain, September 4, 2014.
- Hovers, E. (1998). The lithic assemblages of Amud Cave: implications for the end of the Mousterian in the Levant. In: T. Akazawa, K. Aoki & O. Bar-Yosef (Eds.) *Neandertals and Modern Humans in Southwest Asia*. Plenum Press, New York, 143-163.
- Hovers, E. (2009). *Lithic Assemblages of Qafzeh Cave*. Oxford University Press, Oxford.
- Hovers, E. & Belfer-Cohen, A. (2013). On Variability and Complexity: Lessons from the Levantine Middle Paleolithic Record. *Current Anthropology* 54: 337-357.
- Howell, F. C. (1959). Upper Pleistocene stratigraphy and early man in the Levant. *Proceedings of the American Philosophical Society* 103 (1): 1-65.
- Hublin, J.-J. (2000). Modern-nonmodern Hominid interactions: A Mediterranean perspective. In: O. Bar-Yosef & D. Pilbeam (Eds.) *The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean*, Peabody Museum of Archaeology and Ethnology, Bulletin No. 8, Cambridge, 157-182.
- Hublin, J. - J. & McPherron, S. (2012). *Modern Origins: A North African Perspective*. Springer, New York.
- Huxtable, J. (1993). Thermoluminescence dates for burnt earth samples from Bir Sahara East and a burnt core from Bir Tarfawi. In: F. Wendorf, R. Schild & A. Close (Eds.) *Egypt During the Last Interglacial: The Middle Palaeolithic of Bir Tarfawi and Bir Sahara East*. Plenum Press, New York and London, 227-228.
- Inizan, M. L. & Ortlieb, L. (1987). Prehistoire dans la region de Shabwa au Yemen du sud. *Paléorient* 13: 5-22.
- Jelinek, A. J. (1975). A Preliminary report on some Lower and Middle Palaeolithic industries from the Tabun Cave. In: F. Wendorf & A. E. Marks (Eds.) *Problems in Prehistory*. Southern Methodist University Press, Dallas, 297-31.
- Jelinek, A. J. (1981). The Middle Palaeolithic in the southern Levant from the Perspective of the Tabun Cave. In: J. Cauvin & P. Sanlaville (Eds.) *Préhistoire du Levant*. C.N.R.S., Paris, 265-285.
- Kaufman, D. (2001). Comparisons and the Case for Interaction Among Neanderthals and Early Modern Humans in the Levant. *Oxford Journal of Archaeology* 20: 219-240.
- Kivisild, T., Maere, R., Metspalu, E., Rosa, A., Antonio, A., Pennarun, E., Parik, J., Geberhiwot, T., Usanga, E. & Villems, R. (2004). Ethiopian mitochondrial DNA heritage: tracking gene flow across and around the Gate of Tears. *American Journal of Human Genetics* 75: 752- 770.
- Kleindienst, M. (2006). On Naming Things: Behavioral Changes in the Later Middle to Earlier Late Pleistocene, Viewed from the Eastern Sahara. In: E. Hovers & S. Kuhn (Eds.) *Transitions Before the Transition*. Springer, New York, 13-28.
- Kobusiewicz, M. (1999). *Excavations at Sinai-20, The Split Rock Site, Zarnoq Locality. An Archaeological Investigation of the Central Sinai, Egypt*. University Press of Colorado, Niwot.
- Kobusiewicz, M., Schild, R., Bluszcz, A. & F. Wendorf (2001). Reassessing chronostratigraphic position of the Split Rock Site, Sinai. In: B. Gehlen, M. Heinen & A. Tillmann (Eds.) *Zeit-Räume, Gedenkschrift für Wolfgang Taute, Band 1*, Bonn, 227-236.
- Kuhn, S. L., Stiner, M. C. & Güleç, E. (1999). Initial Upper Palaeolithic in south-central Turkey and its regional context: a preliminary report. *Antiquity* 73: 505-517.
- Kuhn, S. & Zwyns, N. (2014). Rethinking the initial Upper Paleolithic. *Quaternary International* 347: 29-38.
- Kurashina, H. (1987). *An Examination of Prehistoric Lithic Technology in East-Central Etheopia*. Ph.D., dissertation, University of California, Berkeley.
- Lahr, M. M. & Foley, R. A. (1994). Multiple dispersals and modern human origins. *Evolutionary Anthropology* 3: 48-60
- Langgut, D., Almogi-Labin, A., Bar-Matthews, M. & Weinstein-Evron, M. (2011). Vegetation and climate changes in the South Eastern Mediterranean during the Last Glacial-Interglacial cycle (86 ka): new marine pollen record. *Quaternary Science Reviews* 30: 3960-3972.
- Leder, D. (2013). *Technological and typological changes at the Middle to Upper Palaeolithic boundary in Lebanon*. Ph.D., dissertation, University of Köln, Köln.
- Lindly, J. M. & Clark, G. A. (1987). A Preliminary lithic analysis of the Mousterian site of 'Ain Difla (WHS site 634) in the Wadi Ali, West Central Jordan. *Proceedings of the Prehistoric Society* 53: 279-292.
- Lindly, J. & Clark, G. A. (2000). The 'Ain Difla Rockshelter and Middle Palaeolithic systematics in the Levant. In: N. R. Coinman (Ed.) *The Archaeology of the Wadi Al-Hasa, West-Central Jordan, Volume 2: Excavations at Middle, Upper, and Epipaleolithic Sites*. Arizona State University Anthropological Research Papers, Tempe, 111-117.
- 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.
- Marks, A. E. (1968a). The Mousterian Industries of Nubia. In: F. Wendorf (Ed.) *The Prehistory of Nubia, Vol. 1*. Southern Methodist University Press, Dallas, 194-314.
- Marks, A. E. (1968b). The Khormusan: An upper Pleistocene Industry in Sudanese Nubia, In: F. Wendorf (Ed.) *The Prehistory of Nubia, Vol. 1*. Southern Methodist University Press, Dallas, 315-391.
- Marks, A. E. (1983a). *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 3*. Southern Methodist University Press, Dallas.

- Marks, A. E. (1983b).** The Sites of Boker and Boker Tachtit: A Brief Introduction. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. 3, the Avdat/Aqev Area, Part 3*. Department of Anthropology, Southern Methodist University, Dallas, 15-37.
- Marks, A. E. (1990).** The Middle and Upper Palaeolithic of the Near East and Nile Valley: the problems of cultural transformations. In: P. Mellars (Ed.) *The Emergence of Modern Humans: An Archaeological Perspective*. Edinburgh University Press, Edinburgh, 57-80.
- Marks, A. E. (1992).** Upper Pleistocene Archaeology and the Origins of Modern Man: A View from the Levant and Adjacent Areas. In: T. Akazawa, K. Akoi, & T. Kimura (Eds.) *The Evolution and Dispersal of Modern Humans in Asia*. Hokusen-sha, Tokyo, 229-252.
- Marks, A. E. (2003).** Reflections on Levantine Upper Palaeolithic Studies: Past and Present. In: A. N. Goring-Morris & A. Belfer-Cohen (Eds.) *More than Meets the Eye*. Oxbow Books, Exeter, 249-264.
- Marks, A. E. (2009).** The Palaeolithic of Arabia in an inter-regional context. In: M. Petraglia & J. I. Rose (Eds.) *Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*. Springer, Dordrecht, 293-309.
- Marks, A. E. & Crew, H. L. (1972).** Rosh Ein Mor, Central Negev, Israel. *Current Anthropology* 13: 591-593.
- Marks, A. E. & Ferring, C. R. (1988).** The early Upper Palaeolithic of the Levant. In: J. F. Hoffecker (Ed.) *The Early Upper Palaeolithic: evidence from Europe and the Near East*. BAR International Series 437, Oxford, 43-72.
- Marks, A. E. & Freidel, D. A. (1977).** Prehistoric settlement patterns in the Avdat/Aqev area. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. II: The Avdat/Aqev Area, Part 2 and the Har Harif*. Department of Anthropology, Southern Methodist University, Dallas, 131-158.
- Marks, A. E. & Kaufman, D. (1983).** Boker Tachtit: The Artifacts. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. III, the Avdat/Aqev Area, Part 3*. Department of Anthropology, Southern Methodist University, Dallas, 69-126.
- Marks, A. E. & Monigal, K. (1995).** Modeling the Production of Elongated Blanks from the Early Levantine Mousterian at Rosh Ein Mor. In: H. Dibble & O. Bar-Yosef (Eds.) *The Definition and Interpretation of Levallois Technology*. Prehistory Press, Madison, 267-268.
- Marks, A. E., & Rose, J. I. (2014).** A century of research into the origins of the Upper Paleolithic in the Levant. In: M. Otte (Ed.) *Néandertal/Cro-Magnon: la Rencontre*. Editions Errance, Arles, 221-266.
- Marks, A. E. & Volkman, P. (1983).** Changing core reduction strategies: a technological shift from the Middle to the Upper Palaeolithic. In: E. Trinkaus (Ed.) *The Mousterian Legacy: Human Biocultural Change in the Upper Pleistocene*. BAR International Series S164, Oxford, 35-51.
- Marks, A. E. & Volkman, P. (1985).** Technological variability and change seen through core reconstruction. *Proceedings of the 4th International Flint Symposium, Vol. 1*. Cambridge University Press, Cambridge.
- Marks, A. E. & Volkman, P. (1986).** The Mousterian of Ksar Akil: Levels XXVIA through XXVIII B. *Paléorient* 12 (1): 5-20.
- Marks, A. E., Shiner, J., & Hays, T. R. (1968).** Survey and excavations in the Dongol Reach, Sudan. *Current Anthropology* 9 (4): 319-323.
- McClure, H. A. (1984).** *Late Quaternary Paleoenvironments of the Rub' al Khali*. Ph.D., dissertation, University of London, London.
- McLaren, S. J., Al-Juaidi, F., Bateman, M. D. & Millington, A. C. (2008).** First evidence for episodic flooding events in the arid interior of central Saudi Arabia over the last 60 ka. *Journal of Quaternary Science* 24: 198-207.
- Meignen, L. (1995).** Levallois Lithic Production Systems in the Middle Palaeolithic of the Near East: The Case of the Unidirectional Method. In: H. Dibble, & O. Bar-Yosef (Eds.) *The Definition and Interpretation of Levallois Technology*. Prehistory Press, Madison, 361-380.
- Meignen, L. (1998).** Hayonim Cave Lithic Assemblages in the Context of the Near Eastern Middle Palaeolithic: A Preliminary Report. In: T. Akazawa, K. Akoi & O. Bar-Yosef (Eds.) *Neandertals and Modern Humans in Western Asia*. Plenum Press, New York, 163-180.
- Meignen, L. (2011).** The contribution of Hayonim cave assemblages to the understanding of the so-called Early Levantine Mousterian. In: J. M. Le Tensorer, R. Jagger & M. Otte (Eds.) *The Lower and Middle Palaeolithic in the Middle East and Neighboring Regions*. ERAUL 126, Liège, 85-100.
- Meignen, L. (2012).** Levantine Perspectives on the Middle to Upper Palaeolithic "Transition." *Archaeology, Ethnology and Anthropology of Eurasia* 40 (3): 12-21.
- Meignen, L. & Bar-Yosef, O. (1988).** Variabilité technologique au Proche Orient: L'exemple de Kabara. In: L. Binford & J. P. Rigaud (Eds.) *L'Homme de Néandertal, Vol. 4 La Technique*. ERAUL 30, Liège, 81-95.
- Meignen, L. & Bar-Yosef, O. (2005).** The Lithic Industries of the Middle and Upper Palaeolithic of the Levant: Continuity of Break? In: A. P. Derevianko (Ed.) *The Middle to Upper Palaeolithic Transition in Eurasia: Hypotheses and Facts*. Institute of Archaeology and Ethnology Press, Novosibirsk, 166-175.
- Mellars, P. (1996).** *The Neanderthal Legacy*. Princeton University Press, Princeton.
- Mellars, P. (2006).** Why did modern humans populations disperse from Africa ca. 60,000 year ago? A new model. *Proceedings of the National Academy of Sciences of the USA* 103: 9381-9386.
- Mellars, P., Goric, K. C., Carre, M., Soares, P. A. & Richards, M. B. (2013).** Genetic and archaeological perspectives on the initial modern human colonization of southern Asia. *Proceedings of the National Academy of Sciences of the USA* 110 (26): 10699-10704.
- Mercier, N., Valladas, H., Froget, L., Joron, J. L., Vermeersch, P. M., Van Peer, P. & Moeyersons, J. (1999).** Thermoluminescence dating of a Middle Palaeolithic occupation at Sodmein Cave, Red Sea Mountains (Egypt). *Journal of Archaeological Science* 26: 1339-1345.
- Metspalu, M., Kivisild, T., Metspalu, E., Parik, J. & Hudjashov, G. (2004).** Most of the extant mtDNA boundaries in south and southwest Asia were likely shaped during the initial settlement of Eurasia by anatomically modern humans. *BMC Genetics* 5: 26.
- Meyer, M., Kircher, M., Gansauge, M. T. & Racimo, H. L. F. (2012).** A High-Coverage Genome Sequence from an Archaic Denisovan Individual. *Science* 338: 222-226.
- Monigal, K. (2002).** *The Levantine Leptolithic: Blade production from the Lower Paleolithic to the dawn of the Upper Paleolithic*. 2 vols. Ph.D. dissertation, Southern Methodist University, Dallas.
- Monigal, K. (2003).** Technology, Economy and Mobility at the Beginning of the Levantine Upper Palaeolithic. In: A. N. Goring-Morris & A. Belfer-Cohen (Ed.) *More than Meets the Eye*. Oxbow Books, Exeter, 118-133.
- Munday, F. C. (1976).** Intersite variability in the Mousterian occupation of the Avdat/Aqev area. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. I, The Avdat/Aqev Area, Part 1*. Southern Methodist University Press, Dallas, 57-68.
- Munday, F. C. (1977).** Nahal Aqev (D35): a stratified, open-air Mousterian occupation in the Avdat/Aqev area. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments of the Central Negev, Israel, Vol. II, The Avdat/Aqev Area, Part 2 and the Har Harif*. Southern Methodist University Press, Dallas, 35-60.
- Munday, F. C. (1979).** Levantine Mousterian technological variability: a perspective from the Negev. *Paléorient* 5: 87-104.

- Mustafa, M. & Clark, J. (2007). Quantifying diachronic variability: the 'Ain Difla Rockshelter (Jordan) and the evolution of Levantine Mousterian technology. *Eurasian Prehistory* 5 (1): 47-84.
- Nami, M. & Moser, J. (2010). *La Hrotte d'Ifrin n'Amman; Tome 2: Le Paléolithique Moyen. Forschungen zur Archäologie Aussereuropäischer Kulturen, Vol. 9.* Reichert Verlag, Wiesbaden.
- Neves, A. & Serva, M. (2012). Extremely rare interbreeding events can explain Neanderthal DNA in living humans. *PLoS ONE* 7 (10): e47076.
- Newcomer, M. (1970). The Chamfered pieces from Ksar Akil (Lebanon). *Bulletin of the Institute of Archaeology University of London* 8-9: 177-191.
- Ohnuma, K. (1988). *Ksar 'Akil, Lebanon. A Technological Study of the Earlier Upper Paleolithic Levels of Ksar 'Akil, Vol. III. Levels XXV-XIV.* BAR International Series 426, Oxford.
- Olivieri, A., Achilli, A., Pala, M., Battaglia, V., Fornarino, S., Al-Zahery, N. & Scozzari, R. (2006). The mtDNA legacy of the Levantine early Upper Palaeolithic in Africa. *Science* 314: 1767-1770.
- Olshewski, 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 (3): 283-303.
- Olshewski, D. I., Dibble, H. L., McPherron, S. P., Schurmans, U. A., Chiotti, L. & Smith, J. R. (2010). Nubian Complex strategies in the Egyptian high desert. *Journal of Human Evolution* 59: 188-201.
- Oppenheimer, S. (2009). The great arc of dispersal of modern humans: Africa to Australia. *Quaternary International* 202: 2-13.
- Parr, P., Zarins, J., Ibrahim, M., Waechter, J., Garrard, A., Clarke, C., Bidmead, M. & Al-Badr, H. (1978). Preliminary report on the second phase of the Northern Province Survey. *Atlat* 2: 29-50.
- Parker, A. G. & Rose, J. I. (2008). Climate change and human origins in southern Arabia. *Proceedings of the Seminar for Arabian Studies* 38: 25-42.
- Parton, A. P., Farrant, A. R., Leng, M. L., Schwenninger, J. L., Rose, J. I., Uerpman, H. P. & Parker, A. G. (2013). An Early MIS3 Pluvial Phase Within Southeast Arabia: Climatic and Archaeological Implications. *Quaternary International* 300: 62-74.
- Pattan, J. N. & Pearce, N. J. G. (2009). Bottom water oxygenation history in southeastern Arabian Sea during the past 140 ka: Results from redox-sensitive elements. *Palaeogeography, Palaeoclimatology, Palaeoecology* 280: 396-405.
- Petit-Maire, N., Carbonel, P., Reyss, J. L., Sanlaville, P., Abed, A., Bourrouilh, R., Fontugne, M. & Yasin, S. (2010). A vast Eemian palaeolake in southern Jordan (29 N). *Global and Planetary Change* 72: 368-373.
- Petraglia, M., Alsharekh, A., Crassard, R., Drake, N., Groucutt, H., Parker, A. & Roberts, R. (2011). Middle Palaeolithic occupation on a last interglacial lakeshore in the Nefud Desert, Saudi Arabia. *Quaternary Science Reviews* 30: 1555-1559.
- Petraglia, M., Alsharekh, A., Breeze, P., Clarkson, C. & Crassard, R. (2012). Hominin Dispersal into the Nefud Desert and Middle Palaeolithic Settlement along the Jubbah Palaeolake, Northern Arabia. *PLoS ONE* 7(11): e49840.
- Potter, J. (1995). Lithic Technology and Settlement Pattern Variability within the Levantine Mousterian: a Comparison of Sites WHS 621 and WHS 634 from Wadi al-Hasa. *Studies in the History and Archaeology of Jordan V: Art and Technology Through the Ages.* Department of Antiquities, Amman, 497-504.
- Preusser, F. (2009). Chronology of the impact of Quaternary climate change on continental environments in the Arabian Peninsula. *Comptes Rendus Geoscience* 34: 621-632.
- Quintana-Murci, L., Semino, O., & Bandelt, H. J. (1999). Genetic evidence of an early exit of Homo sapiens sapiens from Africa through eastern Africa. *Nature Genetics* 23: 437-441.
- Radies, D., Preusser, F., Matter, A. & Mange, M. (2004). Eustatic and climatic controls on the development of the Wahiba Sand Sea, Sultanate of Oman. *Sedimentology* 51: 1359-1385.
- Reich, D., Patterson, N., Kircher, M., Delfin, F. & Nandineni, M. (2011). Denisova admixture and the first modern human dispersals into southeast Asia and Oceania. *American Journal of Human Genetics* 89: 516-528.
- Reichart, G. J., den Dulk, M., Visser, H. J., van der Weijden, C. H. & Zachariasse, W. J. (1997). A 225 kyr record of dust supply, paleoproductivity and the oxygen minimum zone from the Murray Ridge (northern Arabian Sea). *Palaeogeography, Palaeoclimatology, Palaeoecology* 134: 149-169.
- Richter, J., Hauck, T., Vogelsang, R., Widlok, T., Le Tensorer, J.-M. & Schmid, P. (2012). "Contextual areas" of early Homo sapiens and their significance for human dispersal from Africa into Eurasia between 200 ka and 70 ka. *Quaternary International* 274: 5-24.
- Rink, W., Richter, D., Schwarcz, H., Marks, A. E., Monigal, K. & Kaufman, D. (2003). Age of the Middle Palaeolithic Site of Rosh Ein Mor, Central Negev, Israel: Implications for the Age Range of the Early Levantine Mousterian of the Levantine Corridor. *Journal of Archaeological Science* 30 (2): 195-204.
- Rose, J. I. (2000). *A Reconstruction of Pleistocene Arabia: the state of research and avenues for further inquiry.* M.A., dissertation, Boston University, Boston.
- Rose, J. I. (2004). The Question of Upper Pleistocene Connections between East Africa and South Arabia. *Current Anthropology* 45: 551-555.
- Rose, J. I. (2006). *Among Arabian Sands. Defining the Paleolithic of Southern Arabia.* Ph.D, dissertation, Southern Methodist University, Dallas.
- Rose, J. I. (2007). The Arabian Corridor Migration Model: archaeological evidence for hominin dispersals into Oman during the Middle and Upper Pleistocene. *Proceedings of the Seminar for Arabian Studies* 37: 219-237.
- Rose, J. I. (2010). New light on human prehistory in the Arabo-Persian Gulf Oasis. *Current Anthropology* 51 (6): 849-883.
- Rose, J. I. & Petraglia, M. (2009). Tracking the origin and evolution of human populations in Arabia. In: M. Petraglia & J. I. Rose (Eds.) *The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics.* Springer Academic Publishers, Netherlands, 1-14.
- Rose, J. I. & Usik, V. I. (2009). The "Upper Palaeolithic" of southern Arabia. In: M. Petraglia & J. I. Rose (Eds.) *The Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory, and Genetics.* Springer Academic Publishers, Netherlands, 169-185.
- Rose, J. I. & Hilbert, Y. H. (2014). New prehistoric sites in the southern Rub' al Khali desert, Oman. *Antiquity* 88 (381): Project Gallery.
- Rose, J. I., Usik, V., Marks, A., Hilbert, Y. H., Galletti, C., Parton, A., Geiling, J. M., Cerny, V., Morley, M. & Roberts, R. (2011). The Nubian Complex of Dhofar, Oman: an African Middle Stone Age industry in southern Arabia. *PLoS ONE* 6 (11): e28239.
- Rosenberg, T., Preusser, F., Fleitmann, D., Schwab, A., Penkman, K., Schmid, T. W., Al-Shanti, M. A., Kadi, K. & Matter, A. (2011). Humid periods in southern Arabia: Windows of opportunity for modern human dispersal. *Geology* 39: 1115-1118.
- Rosenberg, T. M., Preusser, F., Blechschmidt, I., Fleitmann, D., Jagher, R. & Matter, A. (2012). Late Pleistocene palaeolake in the interior of Oman: a potential key area for the dispersal of anatomically modern humans out-of-Africa? *Journal of Quaternary Science* 27: 13-16.
- Sánchez-Quinto, F., Botigué, L. R., Civit, S., Arenas, C., Ávila-Arcos, M., Bustamante, C. D., Comas, D. & Lalueza-Fox, C. (2012). North African Populations Carry the Signature of Admixture with Neandertals. *PLoS ONE* 7: e47765.

- Sankararaman, S., Patterson, N., Li, H., Pääbo, S. & Reich, D. (2012). The date of interbreeding between Neandertals and modern humans. *PLoS ONE* 8: e1002947.
- Sankararaman, S., Mallick, S., Dannemann, M., Prüfer, K., Kelso, J., Pääbo, S., Patterson, N. & Reich, D. (2014). The genomic landscape of Neanderthal ancestry in present-day humans. *Nature* 507: 354-357.
- Sanlaville, P. (1992). Changements climatiques dans la péninsule Arabique durant le pléistocène supérieur et l'holocène. *Paléorient* 18:5-25.
- Scally, A. & Durbin, R. (2012). Revising the human mutation rate: implications for understanding human evolution. *Nature Review Genetics* 13: 824.
- Schiffels, S. & Durbin, R. (2014). Inferring human population size and separation history from multiple genome sequences. *Nature Genetics* 46: 919-925.
- Schild, R. (1998). Comments on Van Peer: The Nile Corridor and the Out-of-Africa Model: An Examination of the Archaeological Record. *Current Anthropology* 39: S134-S135.
- Schild, R., & Wendorf, F. (1977). *The Prehistory of Dakhla Oasis and Adjacent Desert*. Polish Academy of Sciences, Warsaw.
- Schild, R. & Wendorf, F. (1981). *The Prehistory of an Egyptian Oasis*. Polish Academy of Sciences, Warsaw.
- Schwarcz, H., Blackwell, B., Goldberg, P. & Marks, A. E. (1979). Uranium Series dating of travertine from archeological sites, Nahal Zin, Israel. *Nature* 277: 558-560.
- Scott-Jackson, J., Scott-Jackson, W., Rose, J. I. (2009). Paleolithic stone tool assemblages from Sharjah and Ras al Khaimah in the United Arab Emirates. In: M. Petraglia & J. I. Rose (Eds.) *Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*. Springer Academic Publishers, Netherlands, 125-138.
- Sellet, F. (1995). Levallois or not Levallois: Does it Really Matter? In: H. Dibble & O. Bar-Yosef (Eds.) *The Definition and Interpretation of Levallois Technology*. Prehistory Press, Madison, 25-40.
- Shea, J. (2003). Neandertals, Competition, and the Origin of Modern Human Behavior in the Levant. *Evolutionary Anthropology* 12: 173-187.
- Shea, J. (2007). Behavioral differences between Middle and Upper Palaeolithic *Homo sapiens* in the East Mediterranean Levant. *Journal of Anthropological Research* 63 (4): 449-488.
- Shea, J. (2008). Transitions or turnovers? Climatically-forced extinctions of *Homo sapiens* and Neanderthals in the east Mediterranean Levant. *Quaternary Science Reviews* 27: 2253-2270.
- Shea, J. & Sisk, M. (2010). Complex Projectile Technology and *Homo sapiens* Dispersal into Western Asia. *Paleoanthropology* 2010: 100-122.
- Shimelmitz, R. & Kuhn, S. (2013). Early Mousterian Technology in Unit IX of Tabun Cave. *Paleoanthropology* 2013: 1-27.
- Shimelmitz, R., Barkai, R. & Gopher, A. (2011). Systematic blade production at late Lower Palaeolithic (400-200 kyr) Qesem cave, Israel. *Journal of Human Evolution* 61: 458-479.
- Singleton, W. & Close, A. (1980). Report on Site E-78-11. In: F. Wendorf & R. Schild (Eds.) *Loaves and Fishes: The Prehistory of Wadi Kubbania*. SMU Press, Dallas, 229-237.
- Sisk, M. & Shea, J. (2011). The African Origin of Complex Projectile Technology: An Analysis Using Tip Cross-Sectional Area and Perimeter. *International Journal of Evolutionary Biology* 2011: 1-8.
- Sitzia, L., Bertran, P., Boulogne, S., Brenet, M. & Crassard, R. (2012). The paleoenvironment and lithic taphonomy of Shi'bat Dihya 1, a Middle Palaeolithic site in Wadi Surdud, Yemen. *Geoarchaeology* 27: 471-491.
- Skoglund, P. & Jakobsson, M. (2011). Archaic human ancestry in East Asia. *Proceedings of the National Academy of Sciences of the USA* 108 (45): 18301-18306.
- Smith, J. R., Hawkins, A. L., Asmerom, Y., Polyak, V. & Giegengack, R. (2007a). New age constraints on the Middle Stone Age occupations of Kharga Oasis, Western Desert, Egypt. *Journal of Human Evolution* 52: 690-701.
- Smith, T. M., Tafforeau, P., Reid, D. J., Grün, R., Eggins, S., Boutakiout, M. & Hublin, J.-J. (2007b). Earliest evidence of modern human life history in North African early *Homo sapiens*. *Proceedings of the National Academy of Sciences of the USA* 104: 6128-6133.
- de Sonneville-Bordes, D. & Perrot, J. (1954). Lexique typologique du Paléolithique supérieur. *Bulletin de la Société préhistorique française* 51: 327-335.
- Sorin, L., Vaks, A., Bar-Matthews, M., Porat, R. & Frumkin, A. (2010). Late Pleistocene palaeoclimatic and palaeo-environmental reconstruction of the Dead Sea area (Israel), based on speleothems and cave stromatolites. *Quaternary Science Reviews* 29: 1201-1211.
- Stokes, S. (1993). Optical dating of sediments samples from Bir Tarfawi and Bir Sahara East: an initial report. In: F. Wendorf, R. Schild & A. Close (Eds.) *Egypt During the Last Interglacial: The Middle Palaeolithic of Bir Tarfawi and Bir Sahara East*. Plenum Press, New York and London, 229-233.
- Stokes, S. & Bray, H. E. (2005). Late Pleistocene eolian history of the Liwa region, Arabian Peninsula. *Geological Society of America Bulletin* 117: 1466-1480.
- Stringer, C. & Andrews, P. (1988). Genetic and Fossil Evidence for the Origin of Modern Humans. *Science* 239: 1263-1268.
- Stringer, C. (1994). Out of Africa - a personal history. In: M. H. Nitecki & D. V. Nitecki (Eds.) *Origins of Anatomically Modern Humans*. Plenum Press, New York, 150-174.
- Stringer, C. (2000). Coasting out of Africa. *Nature* 405: 24-26.
- Stringer, C. (2012). *The Origin of Our Species (published in the USA as Lone Survivors: how we came to be the only Humans on Earth)*. Penguin, New York.
- Torfstein, A., Haase-Schramm, A., Waldmann, N., Kolodny, Y. & Stein, M. (2009). U-series and oxygen isotope chronology of the mid-Pleistocene Lake Amora (Dead Sea basin). *Geochimica et Cosmochimica Acta* 73: 2603-2630.
- Tostevin, G. (2000). The Middle Upper Palaeolithic Transition from the Levant to Central Europe: in situ development or diffusion. In: J. Orschiedt & G. Weniger (Eds.) *Neanderthals and Modern Humans - Discussing the Transition*. Neanderthal Museum, Mettmann, 92-111.
- Tostevin, G. (2003). A quest for Antecedents: A Comparison of the Terminal middle Palaeolithic and Early Upper Palaeolithic of the Levant. In: A. N. Goring-Morris & A. Belfer-Cohen (Eds.) *More than Meets the Eye*. Oxbow Books, Exeter, 54-67.
- Trinkaus, E. (1986). The Neandertals and modern human origins. *Annual Review of Anthropology* 15: 193-218.
- Usik, V. I., Rose, J. I., Hilbert, Y. H., Van Peer, P. & Marks, A. E. (2013). Nubian Complex reduction strategies in Dhofar, southern Oman. *Quaternary International* 300: 244-266.
- Vaks, A., Bar-Matthews, M., Ayalon, A., Mathews, A., Frumkin, A., Dayan, U., Halicz, L., Almogi-Labin, A. & Schilman, B. (2006). Paleoclimate and location of the border between Mediterranean climate region and the Saharo-Arabian desert as revealed by speleothems from the northern Negev desert. *Earth and Planetary Science Letters* 249: 384-399.
- Vaks, A., Bar-Matthews, M., Ayalon, A., Mathews, A., Frumkin, A. & Halicz, L. (2007). Desert speleothems reveal climatic window for African exodus of early modern humans. *Geology* 35: 831-834.
- Vaks, A., Bar-Matthews, M., Ayalon, A., Schilman, B., Gilmour, M., Hawkesworth, C. J., Frumkin, A., Kaufman, A. & Mathews, A. (2003). Paleoclimatic reconstruction based on the timing of speleothem growth and carbon isotope composition in a cave located in the rain shadow in Israel. *Quaternary Research* 59: 182-193.

- Vaks, A., Bar-Matthews, M., Matthews, A., Ayalon, A. & Frumkin, A. (2010). Middle-Late Quaternary paleoclimate of northern margins of the Saharan-Arabian desert: reconstruction from speleothems of Negev desert, Israel. *Quaternary Science Reviews* 29: 2647-2662.
- Van Peer, P. (1988). *A model for studying the variability of Levallois technology and its application to the Middle Palaeolithic of northern Africa*. Ph.D., dissertation, Catholic University, Leuven.
- Van Peer, P. (1991). New observations about the Nile Valley Middle Palaeolithic: Safaha method and lateralization of Levallois flakes. *Paléorient* 17 (2): 133-140.
- Van Peer, P. (1992). *The Levallois Reduction Strategy*. Madison: Prehistory Press.
- Van Peer, P. (1998). The Nile corridor and the out-of-Africa model. *Current Anthropology* 39: S115-S140.
- Van Peer, P. (2000). Makhadma 6, a Nubian Complex site. In: P. M. Vermeersch (Ed.) *Palaeolithic Living Sites in Upper and Middle Egypt*. Leuven University Press, Leuven, 91-103.
- Van Peer, P. & Vermeersch, P. (1990). Middle to Upper Palaeolithic Transition: the Evidence from the Nile Valley. In: P. Mellars (Ed.) *The Emergence of Modern Humans*. Edinburgh University Press, Edinburgh, 139-159.
- Van Peer, P. & Vermeersch, P. M. (2000). The Nubian Complex and the dispersal of modern humans in North Africa. *Studies in African Archaeology* 7: 47-60.
- Van Peer, P. & Vermeersch, P. M. (2007). The Place of Northeast Africa in the Early History of Modern Humans: New Data and Interpretations on the Middle Stone Age. In: P. Mellars, K. Boyle, O. Bar-Yosef & C. Stringer (Eds.) *Rethinking the Human Revolution*. McDonald Institute for Archaeological Research, Cambridge, 187-198.
- Van Peer, P., Vermeersch, P. M., & Paulissen, E. (2010). *Chert Quarrying, Lithic Technology and a Modern Human Burial at the Palaeolithic Site of Taramsa 1, Upper Egypt*. Leuven University Press, Leuven.
- Van Peer, P., Fullagar, R., Stokes, S., Bailey, R. M., Moeyersons, J., Steenhoudt, F., Geerts, A., Vanderbeken, T., De Dapper, M. & Geus, F. (2003). The Early to Middle Stone Age transition and the emergence of modern human behaviour at site 8-B-11, Sai Island, Sudan. *Journal of Human Evolution* 45: 187-193.
- Vermeersch, P. M., Paulissen, E., Stokes, S., Charlier, C., Van Peer, P., Stringer C. & Lindsay, W. (1998). A Middle Palaeolithic burial of a modern human at Taramsa Hill, Egypt. *Antiquity* 72: 475-484.
- Vermeersch, P. M. (2001). Out of Africa from an Egyptian point of view. *Quaternary International* 75: 103-112.
- Vermeersch, P. M. (2009). Egypt from 50 to 25 ka : a scarcely inhabited region? In: M. Camps & C. Szmíd (Eds.) *The Mediterranean from 50,000 to 25,000: Turning Points and New Directions*. Oxbow Books, Oxford, 67-89.
- Vermeersch, P. M. (2012). Contribution to the Prehistory of the Eastern Desert in Egypt. In: H. Barnardt & K. Duistermant (Eds.) *The History of the Peoples of the Eastern Desert*. Cotsen Institute of Archaeology, Monograph 73, University of California, Los Angeles, 26-41.
- Vermeersch, P., Gijssels, G. & Paulissen, E. (2000). Surface Sites. In: P. M. Vermeersch (Ed.), *Palaeolithic Living Sites in Upper and Middle Egypt*. Leuven University Press, Leuven, 19-55.
- Vermeersch, P., Paulissen, E. & Van Peer, P. (1990). Palaeolithic Chert exploitation in the limestone stretch of the Egyptian Nile Valley. *African Archaeological Review* 8: 77-102.
- Vermeersch, P. M., Paulissen, E., Stokes, S., Charlier, C., Van Peer, P., Stringer C. & Lindsay, W. (1998). A Middle Palaeolithic burial of a modern human at Taramsa Hill, Egypt. *Antiquity* 72: 475-484.
- Vernot, B. & Akey, J. M. (2014). Resurrecting surviving Neandertal lineages from modern human genomes. *Science* 343: 1017-1021.
- Volkman, P. (1983). Boker Tachtit: core reconstructions. In: A. E. Marks (Ed.) *Prehistory and Paleoenvironments in the Central Negev, Israel, Vol. III, the Avdat/Aqev Area, Part 3*. Department of Anthropology, Southern Methodist University, Dallas, 127-190.
- Volkman, P. (1989). *Boker Tachtit: the technological shift from the Middle to the Upper Palaeolithic in the Central Negev, Israel*. Ph.D., dissertation, Southern Methodist University, Dallas.
- Volkman, P. & Kaufman, D. (1983). A reassessment of the Emireh point as a possible type fossil for the technological shift from the Middle to the Upper Palaeolithic in the Levant. In: E. Trinkaus (Ed.) *The Mousterian Legacy*. BAR International Series 167, Oxford, 631-644.
- Wahida, G., al-Tikriti, W. Y., Beech, M. & al-MuQbali, A. (2009). Early Middle Paleolithic assemblage in Abu Dhabi Emirate. In: M. Petraglia & J. I. Rose (Eds.) *Evolution of Human Populations in Arabia: Paleoenvironments, Prehistory and Genetics*. Springer, Dordrecht, 117-124.
- Waldmann, N., Torfstein, A. & Stein, M. (2010). Northward intrusions of low- and midlatitude storms across the Saharo-Arabian belt during past interglacials. *Geology* 38: 567-570.
- Weissmüller, W. (1995). *Sesselfelsgrötte II - Die Silexartefakte der Unteren Schichten der Sesselfelsgrötte. Ein Beitrag zum Problem des Moustérien*. SDV, Saarbrücken.
- Wendorf, F. & Schild, R. (1976). *Prehistory of the Nile Valley*. Academic Press, New York.
- Wendorf, F. & Schild, R. (1980). *Prehistory of the Eastern Sahara*. Academic Press, New York.
- Wendorf, F. & Schild, R. (1992). The Middle Palaeolithic of North Africa: A Status Report. In: F. Klees & R. Kuper (Eds.) *New Light on the Northeast African Past*. Heinrich-Barth-Institut, Cologne, 39-80.
- Yotova, V., Lefebvre, J. F., Moreau, C., Gbeha, E. & Hovhannesian, K. (2011). An X-linked haplotype of Neandertal origin is present among all non-African populations. *Molecular Biology and Evolution* 28: 1957-1962.
- Zaidner, Y., Frumkin, A., Porat, N., Tsatskin, A., Yeshurum, R. & Weissbrod, L. (2014). A Series of Mousterian occupations in a new type of site: The Nesher Ramla karst depression, Israel. *Journal of Human Evolution* 66:1-17.
- Zarins, J., Muhammed, I., Potts, D. & Edens, C. (1979). Preliminary report on the third phase of the archaeological survey program - the Central Province. *Atlat* 3: 9-42.
- Zarins, J., Murad, A. & al-Yish, K. (1981). Comprehensive archaeological survey program: the second preliminary report on the Southwestern Province. *Atlat* 5: 9-42.
- Zarins, J., Rahbini, A. & Kamal, M. (1982). Preliminary report on the archaeological survey of the Riyadh area. *Atlat* 6: 25-38.
- Zarins, J., Whalen, N., Ibrahim, M., Mursi, A. & Khan, M. (1980). Comprehensive archaeological survey program: preliminary report on the Central and Southwestern Province Survey: 1979. *Atlat* 4: 9-36.
- Zarins, J. & Zahrani, J. (1985). Recent archaeological investigations in the southern Tihama Plain. *Atlat* 9: 65-108.
- Zarins, J. & al-Badr, H. (1986). Archaeological investigation in the southern Tihama Plain, part II. *Atlat* 10: 36-57.