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Umm al-Quwain 2

A Neolithic settlement and graveyard in the United Arab Emirates

Edited by

Sophie Méry and Kevin Lidour

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Cover: UAQ2 Tomb 1, second half of the 6th millennium BCE; Projectile point (chalcedony) found in the rib cage of Individual D from Tomb 1.

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Preface

The recent excavations at UAQ2 (2011–2017), conducted by the French Archaeological Mission in the United Arab Emirates, represent a significant milestone in the study of the Neolithic period in Eastern Arabia. Nearly two decades after the initial investigations led by C. S. Phillips in the early 1990s, this renewed exploration has revealed the dual function of UAQ2 as both a residential and funerary site. The primary occupation of the site spans from the late 6th to the end of the 5th millennium BCE, with additional evidence suggesting later activity. A comprehensive series of radiocarbon (14C) and optically stimulated luminescence (OSL) dates has enabled the establishment of a precise chronology. These findings shed new light on the economy and material culture of the Arabian Neolithic, particularly in the northern UAE—a region that remains under-documented despite its archaeological richness. The data from UAQ2 provide valuable insights into the lifestyles, subsistence strategies, and cultural practices of Neolithic communities, presenting a detailed picture of dynamic and interconnected societies.

The discoveries at UAQ2 challenge several long-standing assumptions about Neolithic societies in the Arabian Peninsula. The site contains the oldest and most extensive graveyard of its kind in coastal UAE, offering evidence of intergroup violence and ritual practices associated with pearling. The material culture, including Ubaid pottery, pearls, and other ornaments, indicates that UAQ2 was integrated into broader exchange networks linking Eastern Arabia to Mesopotamia. Furthermore, the faunal remains from the settlement suggest a more complex economic system than previously understood, combining maritime resource exploitation, herding, and hunting. This points to reduced residential mobility and possibly a partially sedentary lifestyle. These findings necessitate a reassessment of the Neolithic in Eastern Arabia, highlighting the diversity and adaptability of its communities as they followed distinct micro-regional trajectories.

This monograph is structured into five chapters, each addressing a specific aspect of the site and its broader implications. The **Introduction** situates the UAQ2 excavations within their historical and scientific context, outlining the objectives of the project and the significance of revisiting the site after two decades. It also frames UAQ2 within the larger scope of Neolithic studies in Eastern Arabia, summarising the key research questions and methodologies employed.

Chapter 1 provides an overview of the site, detailing its geographical and environmental setting and the history of archaeological investigations, including the methods and strategies employed during recent excavations. **Chapter 2** focuses on the graveyard, analysing burial practices, associated grave goods, and the social and ritual behaviours inferred from the burials. **Chapter 3** examines the site's chronological framework, presenting the results of 14C and OSL dating alongside geoarchaeological studies that contextualise UAQ2 within the broader environmental and climatic changes of the Holocene. **Chapter 4** explores the material culture, including lithic industries, ornaments, and imported goods such as Ubaid pottery, situating these finds within local and regional economic and cultural networks. **Chapter 5** investigates subsistence strategies and the animal economy, with particular attention to the exploitation of marine and terrestrial resources, as well as evidence for herding and hunting practices.

The **Conclusion** synthesises the key findings of the UAQ2 excavations and their implications for understanding the Neolithic in Eastern Arabia. It underscores the importance of UAQ2 as a unique site bridging settlement and funerary practices, offering new perspectives on social organisation, economic strategies, and exchange networks in the region. The conclusion also identifies areas for future research, emphasising the need for continued interdisciplinary studies to further explore the complexities of the Arabian Neolithic in the UAE and beyond.

Through these chapters, this monograph aims to provide a comprehensive account of UAQ2 and its significance for understanding the Neolithic in Eastern Arabia. The findings presented not only deepen our knowledge of the region's past but also underscore the importance of continued research in UAQ and the northern UAE.

Introduction

S. Méry, K. Lidour

The Archaeology of the United Arab Emirates (UAE) remains relatively unknown today compared to the neighbouring great civilisations of Mesopotamia, Iran, and the Indus. The ancient past of the UAE is characterised by continuous human occupation since the Middle Palaeolithic, as recent excavations at the Jebel Faya rock shelter in the Emirate of Sharjah have revealed. At this same site, the stratified layers dated as early as 210 ka BP ultimately provide little information about the ancient lifestyles of their occupants, which are mainly documented by lithic tools.

The sites dating from the Arabian Neolithic period (*c.* 6500-3300 BCE) offer the oldest architectural structures as well as material cultures and zooarchaeological assemblages allowing for a detailed analysis of ancient human societies. This period is still poorly understood in the Arabian Gulf, particularly in the UAE. Prehistoric research has mainly focused in Saudi Arabia, the Sultanate of Oman and Yemen since the 1970s, with these regions seeing the first identification of substantial stratified Neolithic sites—notably the shell middens of Muscat and the Ja'alan in the Sultanate of Oman and those of the Tihama in southwest Yemen. This focus is also due in part to the continuation of major multi-year excavation and survey campaigns such as the Joint Hadd project, initially directed by S. Cleuziou (University of Paris 1 Pantheon-Sorbonne) and M. Tosi (University of Bologna). Nevertheless, the recent research is also greatly indebted to the excavations and detailed publications of the sites of as-Sabiyah H3 (2010) in Kuwait and Dosariyah (2018) in Saudi Arabia, within the framework of which this monograph is positioned. This momentum has, in fact, led to significantly greater attention being paid to the recent prehistory of the Arabian Gulf, which had been neglected for several decades.

In 1977, French archaeologists, led by S. Cleuziou, were invited for the first time by UAE authorities and under the patronage of HH Sheikh Zayed bin Sultan Al Nahyan (1st President of the UAE and former ruler of Abu Dhabi) to undertake excavations with local teams at Hili (Emirate of Abu Dhabi), at sites dating from the 3rd and the 1st millennia BCE – in particular, Hili 8, one of the significant key sites for the development of oasis agricultural-based societies during the Early Bronze Age. R. Boucharlat, after that, joined the team to investigate prominent Iron Age sites such as Rumeilah and Hili 14. At that time, the UAE represented almost virgin territory for archaeology, with the very first scientific research being initiated by the Danes at the end of the 1950s, which involved the excavation of Early Bronze Age sites in the Emirate of Abu Dhabi, such as Umm an-Nar (close to Abu Dhabi city) and the Jebel Hafit tombs (near Al Ain).

Since its inception, the UAE-France archaeological cooperation has been characterised by a desire for cultural and scientific openness – manifested by the UAE authorities within Museums and Departments of Antiquities of the emirates of Abu Dhabi (from 1977, in Al Ain, with S. Cleuziou, R. Boucharlat, S. Méry, and others), Sharjah (from 1986, with R. Boucharlat and M. Mouton), Umm al-Quwain (from 1987, with O. Lecomte, V. Charpentier, S. Méry, and K. Lidour), Ras al-Khaimah (from 1986, with C. Hardy-Guilbert), and Fujairah (from 2001, with A. Benoist and J. Charbonnier). Nearly 50 years of continuous collaborative research between the UAE and France has allowed archaeologists to shed light on the richness and diversity of the UAE's historical heritage over more than 7,500 years – from the Neolithic to the present.

The first archaeological cooperation between the Emirate of Umm al-Quwain (UAE) and France lasted from 1987 to 1993, when O. Lecomte conducted excavations at ed-Dur (occupied during the first centuries CE) in the framework of a European collaborative project bringing together Belgian, British, Danish, and French teams (see, for example, Boucharlat *et al.* 1988; 1991a; 1991b). O. Lecomte also initiated excavations at the Neolithic site of Akab, located on the Al Ghallah island (Jousse 1999; Prieur & Guérin 1991; Jousse *et al.* 2002).

In 2002, the French Archaeological Mission in the UAE resumed archaeological research on the Neolithic Period in the Emirate of Umm al-Quwain. New excavations at Akab were conducted by V. Charpentier (for the settlement area, Charpentier and Méry 2008) and S. Méry (for the *Dugong Bone Mound*, see, for example, Méry *et al.* 2009). From 2009 onwards, a survey began that aimed to better understand the patterns of the coastal Neolithic occupation of the Emirate of Umm al-Quwain. In 2011, the excavation of Umm al-Quwain UAQ2, a site recovered and excavated in the early 1990s by C.S. Phillips (2002), was resumed by a joint UAQ-French team led by S. Méry. The excavations were conducted each year between 2011 and 2014, plus the last season that took place in 2017. Post-excavation study was done from 2011 to 2018 in the field. Two other sites were excavated in 2018 at a smaller scale, UAQ36 and UAQ38 (Méry *et al.* 2019; Degli Esposti *et al.* 2019).

Contextualising Research and Excavation Narrative at UAQ2

S. Méry, K. Lidour, D. Gasparini

Background and the 2002-2007 Neolithic fieldwork at Umm al-Quwain

The livelihoods and lifestyle of the Neolithic coastal populations in the Arabian Gulf were based on pastoralism and the exploitation of marine resources. From the end of the 7th millennium BCE onwards, evidence of herding occurs in the region and along the Arabian and Oman seas. Even though goats, sheep, and cattle were fully domesticated then, the origin and date of their domestication are still debated, particularly for cattle and goats (Chapter 5). Today, our information on the livelihood and lifestyle of the Neolithic coastal populations in the Arabian Gulf remains scattered and uneven. Still, it appears that the local Neolithisation process differed from scenarios documented in other Southeast and Central Asian regions. Several distinct mobility models seem to have existed in Umm al-Quwain during the Neolithic period (Méry 2015; Degli Esposti *et al.* 2019; Méry *et al.* 2019).

Around the mid 4th millennium BCE, the first evidence of irrigation using flood diversion channels occurred on the western al-Hajar foothills. The possibility of long-term habituation and, thus, acclimation to the local crops during the Neolithic period has been formulated (Desruelles *et al.* 2016). Solid data on water acquisition methods is represented by constructed wells and open water channels from the beginning of the Early Bronze Age (around 3000 BCE), together with solid data of two distinct non-intensive agrosystems: 1) at Hili 8 (Emirate of Abu Dhabi, UAE); and 2) at Salut 1 and Bat (Sultanate of Oman) (Cleuziou & Costantini 1980; 1982; Cremaschi *et al.* 2018). Along the al-Hajar foothills, both technologies seem likely interdependent (regarding their origins and diffusion) and related to the possibility of arable land formation. Some Bronze Age domesticated crops, such as barley and wheat, were imported from other regions. Still, there is no more reason today to argue that the date palm (*Phoenix dactylifera*) was not domesticated in Eastern Arabia, as wild date palms are present in the region (Gros-Balthazard *et al.* 2017). Datestones found in 6-5th-millennium BCE contexts at Delma (Emirate of Abu Dhabi, UAE) (Beech & Shepherd 2001) raise the issue of their local diffusion from the hinterland towards coastal territories and islands. Further, mineralised date stones have been found at as-Sabiyah H3 (Kuwait) (Carter & Crawford 2010). Nevertheless, an origin from the Mesopotamian or Susiana lowlands cannot be excluded – old date palm cultivation centres have been attested in this region since the 5th millennium BCE (Tengberg 2012).

From the mid 6th millennium BCE, trade drew pottery vessels from the Mesopotamian villages to the coastal regions of the Arabian Gulf: almost 30 coastal sites (mostly surface sites) of the emirates of Umm al-Quwain and Ras al-Khaimah delivered pottery sherds which have been associated, since the 1980s, with the Ubaid culture (among others Boucharlat *et al.* 1988; Charpentier & Méry 2008; Degli Esposti *et al.* 2019; Haerinck 1991a; Méry 2015; Mashkour *et al.* 2016; Vogt 1994; Uerpmann & Uerpmann 1996) – the 'Ubaid' culture emerged in Southern Mesopotamia by the end of the 7th and the 6th millennia BCE (Middle Chalcolithic in this region), whose chronology and the associated pottery productions are defined mainly on the stratigraphical sequences and material culture from the well-known sites of Eridu, Ur, Uruk, Hajji Muhammad, and Tell el-Oueili. To date, no Ubaid sherds were found in the interior of the UAE, nor in the al-Buhais BHS18 graveyard (Emirate of Sharjah, UAE) which is only 55 km as the crow flies east of the coast of the Arabian Gulf. However, bioarchaeological research has provided evidence of a possible link between the inhabitants of the latter site and the northern coast of the Emirate of Ras al-Khaimah (Kutterer & Uerpmann 2017). Although small-scaled and short-lived industries of pottery and plaster vessel making emerged respectively in the Northern Arabian Gulf and on the islands of Abu Dhabi during the 6th and 5th millennia BCE (see, for example, Carter & Crawford 2010: 36, 47; Kainert 2018: fig 7.2; Smogorzewska 2015; 2016), no pottery production is attested in South-East Arabia before the Early Bronze Age (Cleuziou 1989; Méry 2000); first (native?) copper metallurgy seems older, dated from the 4th millennium BCE, as defended by Giardino (2019: 29-39).

An already well-elaborated, structured and complex cultural and technological 'shared background' is recognisable from the 6th millennium BCE across Eastern Arabia (Méry & Charpentier 2013) (Figure 1.1), and the recent results of bioarchaeological analyses showed that contacts between groups included some process of mixing of populations (Kutterer & Uerpmann 2017). Contacts may have been made in a peaceful context (exchange of women or children) or on the occasion of violent events (e.g. raids, kidnappings), the extent of which is well documented in the identification of skull fractures or defence wounds in skeletons, namely at al-Buhais BHS18 and Ras al-Hamra RH5 during the 5th and

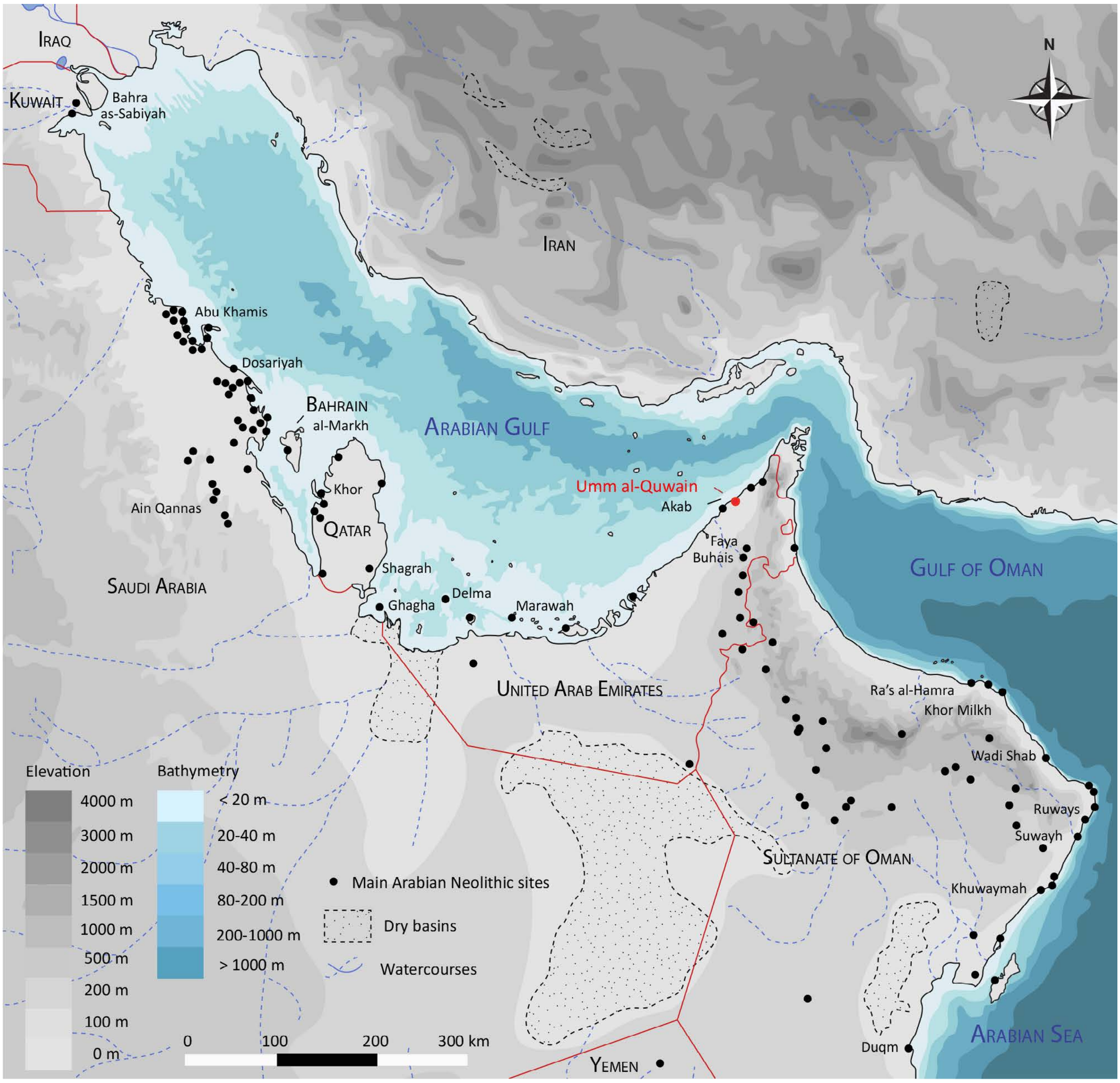


Figure 1.1. Map of the Arabian Gulf and northern Oman with the main Neolithic sites.

4th millennia BCE (see, for example, Kiesewetter 2006; Munoz 2014) – the circulation of materials and objects and technology sharing provide evidence of material and conceptual exchanges. At UAQ2 (Mashkour *et al.* 2016), this is associated with proven cases of individuals from distinct origins buried within the same graveyard – as evidenced by the analysis of strontium (Sr) isotopic ratios from their teeth (Kutterer & Uerpmann 2017). It has been suggested that some individuals have spent their childhood elsewhere than on the Arabian Gulf coast. The subject of societal forms of organisation largely remains to be explored. In the Ja'alan (Muscat and as-Sharqiyyah regions, Sultanate of Oman), the assumption of an endogamous organisation of society seems appropriate, in particular at Ras al-Hamra (Coppa *et al.* 1985: 100; Bondioli *et al.* 1998) – although we lack tangible elements to apply this hypothesis on the scale of Eastern Arabia.

Considering this specific scientific context, the French mission undertook research, beginning in 2002, on the coastal Neolithic of the UAE, concentrating primarily in the Emirate of Umm al-Quwain, later in the Emirate of Ras al-Khaimah (Charpentier *et al.* 2017). The first excavation program was carried out on the settlement site of Akab (4 campaigns between 2002 and 2008, under the responsibility of V. Charpentier (Charpentier & Méry 2008; Lidour *et al.* 2020a). From 2006 until 2009, another critical clue was the excavation, at the request of the local authorities and under the responsibility of S. Méry, of the *Dugong Bone Mound* of Akab, to date, the most ancient

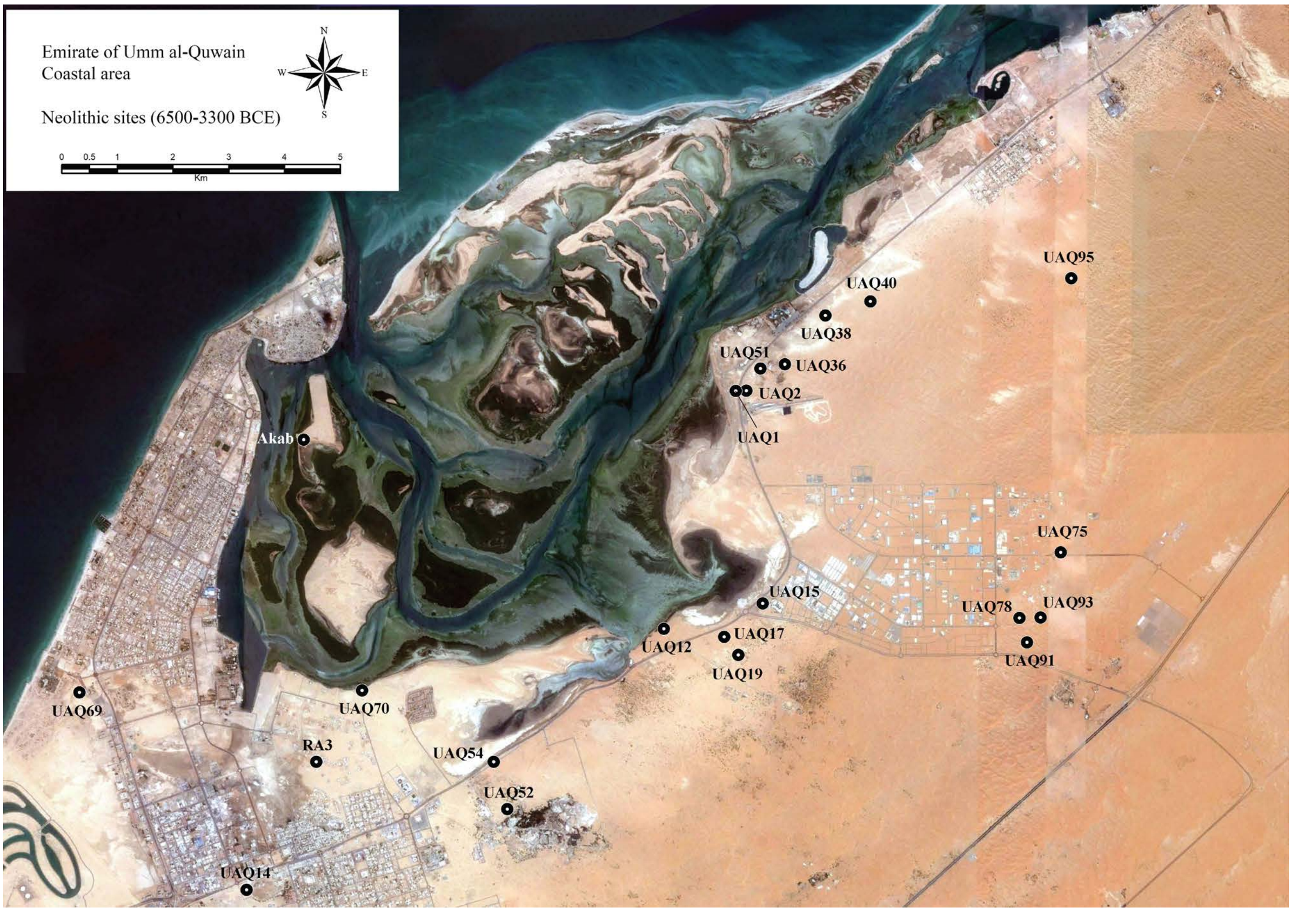


Figure 1.2. Map of the Umm al-Quwain coastal area with the location of the Neolithic sites.

ritual site known in Eastern Arabia (see, for example, Méry *et al.* 2009; Charpentier & Méry 2012).

After the first survey was undertaken in 2009, an excavation program was resumed at the site of UAQ2 (Méry 2015; Mashkour *et al.* 2016), and a multi-period survey began along the lagoon of Umm al-Quwain. It was discovered that the old coast of Umm al-Quwain was entirely travelled and occupied. An archaeological inventory consisted of a pedestrian exploration based on the results of a study of the Landsat archive and test-pit excavations. The topic was to archive the local archaeological and geomorphological heritage and to document the co-evolution of the local paleo-environment and the history of human occupation from the Middle Holocene (*c.* 6200-2200 BCE). For this reason, a geoarchaeological partnership was organised with Oxford Brookes University (UK), led by Adrian G. Parker. It soon became clear that the anthropogenic impact was recorded almost everywhere on the coastline of Umm al-Quwain, dated from the Pre- or Early Neolithic period (see Charpentier & Crassard 2013) until the Late Islamic Period – and the following periods. The new archaeological sites discovered, more than 100 of them, are exclusively shell middens, except a single pre-Islamic (PIR) tomb found near the roundabout of Umm al-Thuaub. To date, the sites of Tell Abraq for the Bronze and Iron Ages (Potts 1990; 1991; 2000) and of ed-Dur for the late pre-Islamic period (PIR) remain the only (published) Protohistoric sites with remains of architectural structures in the Emirate of Umm al-Quwain. Radiocarbon dating (processed in several laboratories) determined that the Umm al-Quwain coast was occupied during the Neolithic, from *c.* 5400/5200 BCE (Chapter 3).

So far, our team has identified 17 new Neolithic sites in the UAQ coastal area (Figure 1.2). Among them, several were tested, and two were excavated, UAQ36 and UAQ38, but to a smaller extent than at UAQ2 (Degli Esposti *et al.* 2019; Méry *et al.* 2019).

The coastal Neolithic sites of the Arabian Gulf are often considered surface sites (in contrast with the coastal sites of the Sultanate of Oman), but most of the shell middens have never been tested. Moreover, the test-pit excavations often concern only a few of the sites. The possibility cannot be excluded that stratified layers are present at other sites. The range and structure of the anthropogenic levels must be considered for the mobility of the Neolithic groups. In this sense, *c.* 2 m of accumulated Neolithic deposits characterise the sites of UAQ2, UAQ36, and UAQ38: they shed light on the diversity of settlement and mobility patterns among the coastal Neolithic groups, resulting in changes in the site's formation processes.

Today, UAQ2 represents a major settlement site in the UAE, based on the area excavated and the extent of the stratigraphy, as well as the oldest graveyard in the Arabian Peninsula. At UAQ2, one of the oldest residential and funerary levels (Levels 14 to 9) dates from this period and is associated with the Middle Neolithic (*c.* 6500-4500 BCE) in Eastern Arabia (Charpentier 2008). From the beginning of the occupation at UAQ2, it has demonstrated strong cultural bonds with the Sultanate of Oman and the other countries on the Arab shores of the Gulf. The links are not only evidenced by the presence of materials and objects circulating between these regions but also by the fact that part of the same material culture was shared in many ways.

In the UAE, UAQ2 is the site having delivered the highest number of Ubaid potsherds to date (nearly 400 potsherds plus over 250 smaller fragments, see Chapter 4), and one of the furthest south easterly sites 'connected' to the Middle and Late Chalcolithic Mesopotamian cultures of southern Iraq. The question of the connection with Lower Mesopotamia has to be clarified in the case of the UAE Neolithic sites. They are not 'Ubaid' nor even 'Ubaid-related' sites, because the pottery surely transited through numerous hands and Neolithic groups living for more than 2000 years along the Arabian side of the Gulf. It is certain that the UAE Neolithic groups were never in direct contact with Mesopotamian people. The northern part of the Arabian Gulf is the only region where a large set of cultural features shows that Mesopotamian and Gulf communities were interconnected, as shown by the discoveries at as-Sabiyah H3 and Bahra 1 in Kuwait (Carter & Crawford 2010; Bieliński 2018; 2020). In this context, there is a noticeable decrease in the presence of Mesopotamian-related artefacts as one moves southward, suggesting a significant exchange hub in Kuwait and, most likely, within the Central Gulf region, notably around Dosariyah (Carter 2020).

Interestingly, Mesopotamian potsherds are distributed in the whole stratigraphy of UAQ2, thus covering a *c.* 5400-3800 BCE time span, e.g. the Middle Neolithic and the first part of the Late Neolithic (*c.* 4500-3300 BCE) periods as they have been chronologically defined at the site (Charpentier 2008).

Stylistic comparison is possible with Ubaid wares, based on the cultural chronology of Oates (Oates 1960; Oates *et al.* 1977; Forest 1996; Carter & Philip 2010), and confirmed today with radiocarbon dating of Mesopotamian sites (Lidour 2014 for a review). Diagnostic sherds attributable to the 'Ancient Ubaid' or, more precisely, to the 'Ubaid 2' cultural phase as described by Oates (see above) come from Levels 14 to 9 at UAQ2, e.g. the second half of the 6th millennium BCE, according to the radiocarbon dates obtained in the same levels. It is also the case at MR11 (Area A) on Marawah Island (Beech *et al.* 2020), which confirms the age of the first exchanges by 5600-5500 BCE. Ubaid 2/3 and 3 types of vessels are numerous at Ain Qannas and Dosariyah in Saudi Arabia (Burkholder 1972; Masry 1974; Drechsler 2018), as at Bahra 1 (Smogorzewska 2020) and as-Sabiyah H3 in Kuwait, where radiocarbon dating points to the two last centuries of the 6th millennium BCE (Carter & Crawford 2010). So far, no Ubaid pottery earlier than the mid 6th millennium BCE has been identified in Gulf sites – the MR11 decorated pot probably consists of one of the earliest evidence of the diffusion of Mesopotamian pottery in the Arabian Gulf.

At UAQ2, the number of sherds significantly decreased after *c.* 5000 BCE. This phenomenon has already been observed and documented at other sites in the Upper Gulf, where identifiable Ubaid 4 pottery is limited to a smaller number of sites across the region, particularly in Saudi Arabia, but also at Akab. However, it remains impossible today to definitively associate this trend with either a genuine decline or a reorientation of Arabian Gulf trade activities. Alternatively, it could be a consequence of changes in the nature of occupation at coastal Arabian sites, possibly linked to shifts in climatic and environmental conditions (see below). It is also worth noting that Mesopotamian sherds found in contexts dating to the early 4th millennium BCE (Level 2) should chronologically correspond to southern Early Uruk productions. However, no clear typological comparisons have yet been established.

Thanks to other discoveries made during the UAQ2 excavations, further progress has been made regarding the knowledge of the Neolithic in Eastern Arabia. For example, fusiform points with a biconvex section and showing denticulations on their edges that are not identified, or in very few quantities, in Suwayh (Charpentier 2008) and other sites of the Sultanate of Oman have been already in use since *c.* 5400 at UAQ2. They are also known at Jazirat al-Hamra JH1 (Vogt 1996: 122) – a fusiform without denticulations is also documented at JH95 in the Wadi Misekhin area, farther inland (French Archaeological Mission in the UAE 2015). The same type of point, but more irregular in shape, has been associated with a stratified and dated context at Hayy al-Sarh in the Batinah region (Sultanate of Oman) (Bretzke *et al.* 2018: fig. 8). It thus seems that earlier industries of fusiform points occurred by the 6th millennium BCE in the north-western part of the Oman peninsula. Along the al-Hajar mountains, this region includes the UAE and the northwestern part of the Sultanate of Oman.

The chronological discrepancy between the northern UAE and the other regions of the Oman peninsula reflects that techno-typological change – and, therefore, use change – could take significant time to spread throughout Eastern Arabia. However, in the absence of charcoal at most sites, our hypotheses and reconstructions remain dependent on radiocarbon dating carried out on marine shell samples, so the differential 14C of marine organisms requires a correction of the reservoir effect and a calibration of the dates – the details of which are not yet fully agreed upon among archaeologists in Eastern Arabia.

Location and environmental setting

The site is located in an area called al-Shobekha, at the bottom of the lagoon of Umm al-Quwain, to the east of Road 11 (al-Ittihad road) to Jazirat al-Hamra and Ras al-Khaimah. It is *c.* 14 km north of the crossing of Roads E11 and E55 (al-Shuwaib–Umm al-Quwain road) at the entrance to the city of Umm al-Quwain. The archaeological site lies at the top of a 400-m long and 10-m high dune, oriented East-West. This non-mobile dune dates to the end of the Pleistocene, and its high position favoured the settlement of human Neolithic groups, as was the case for several sites in Umm al-Quwain, such as UAQ36, UAQ38, and UAQ69.

The Umm al-Quwain lagoon is locally known as Khor al-Beidah. Today, its maximum depth is only 10 m in dredged areas close to the old harbour, but depths do not exceed *c.* 3-4 m in the rest of the lagoon. Its formation dates to the Early Holocene (*c.* 9700-6200 BCE), when the marine transgression resulted in coves and smaller sheltered embayments through the pre-existing Pleistocene dunes that were aligned along the northern UAE coast at a SW-NE orientation (Sanlaville & Dalongeville 2005). At a later stage, the longshore drift transporting sediments established a sand barrier at the origin of the lagoon. The detailed shape of the lagoon is partly known, but only from 4000 BCE (Sanlaville & Dalongeville 2005: fig. 5). Sand bars were formed naturally by the longshore drift of sand. Striking promontories (e.g. the relicts of the high Pleistocene dunes) and extensive archipelagos formed according to an ever-changing evolution of the marine surface. The creation of a coastal barrier system formed a natural protection against erosion, thus creating favourable conditions for the development of mangrove stands and seagrass beds, as well as for active fish spawning.

Such a process also entailed that those sediments (including sand and other features, such as pollens, phytoliths, etc.) could, once integrated into the system, remain for a very long time within individual coves and smaller embayment. This is why a sediment core (with a percussion drilling set with a Cobra hammer) was sampled from the paleo-lagoon near UAQ2 to give information about the evolution of the local environment and its possible correlation with the evolution of the human group's settlement during the Holocene, considering that 8000-4000 BCE dates the optimal climatic phase in Eastern Arabia.

According to the archaeological data (presence of *Terebralia palustris* shells), mangrove stands already existed as early as *c.* 5400/5200 BCE in the lagoon of Umm al-Quwain. The brackish waters are due to the ongoing process of freshwater table ingress and its mixing with the sea waters. This is documented at the UAQ2 site by the presence in stratified and C14-dated contexts of the shells of two marine molluscs: *T. palustris*, a symbiotic mangrove gastropod of the west Indo-Pacific region, and *Saccostrea cuccullata*, whose shell often shows imprints of the aerial roots of the mangrove trees. At present day, the presence of pollens of *Avicennia marina* (grey mangrove) and *Rhizophora* cf. *mucronata* (red mangrove) is certified as early as the mid 5th millennium BCE in the sabkha located at the foot of the site of UAQ36, *c.* 2 km north of UAQ2 (Méry *et al.* 2019) – the palynological study is still ongoing by C. Leroyer and D. Aoustin for the more ancient sediments of the same drilled core.

Previous excavations at UAQ2 by C.S. Phillips (1992-1993)

UAQ2 was discovered by C.S. Phillips and P. Treveil in 1992 during a campaign of test pits carried out to identify shell middens in the Emirate of Umm al-Quwain.

Two 50-cm^2 squares separated by 5 m were first opened, then a 50-cm wide trench. Three levels rich in shells and separated by aeolian sand were distinguished. At the base of these deposits, an ashy level rich in terrestrial mammal and fish bones was found. It contained a human skull fragment and a few Mesopotamian pottery sherds associated with Ubaid wares. The trench was then enlarged, which led to the discovery of burials. A zone of 1 x 3 m was then excavated, revealing three partly articulated skeletons, proven in 1993 to represent the latest burials of a graveyard dated from the Neolithic. The excavation was resumed that year, with the help of a burial archaeologist, S. Strongman, and 50 m^2 opened. Only the ashy level at the shell layers' base contained human remains. In contrast, the upper layers were later than the burials and very poor in artefacts (they are not described in the article published by C.S. Phillips in 2002).

The ashy level contained hearths around a 2 x 4 m zone in which human bone remains were concentrated. C.S. Phillips did not interpret it as a residential area with a specialised funerary perimeter. Still, a graveyard associated with cooking hearths is understood as possibly related to preparing funeral feasts.

Figure 1.3. General view of UAQ2 in 2009 from the southern slope of the dune.

Figure 1.4. Natural section visible on the southern slope of the dune in 2009.

Figure 1.5. Dense layers of marine bivalves in the upper stratigraphy.

A group of 42 or 43 burials (MNI) was excavated (Chapter 2), including 18 males, 14 females – all adults – plus three sub-adults. Most of the bones were disarticulated or partially articulated. Only nine individuals were preserved in articulation, having been placed in a flexed position. According to the excavators, the deposits of these nine individuals corresponded to three main phases of burial. The excavators did not comment on the two pairs of skeletons (Phillips 2002: fig. 4) that corresponded to double simultaneous burials. It evokes the type of burials excavated later at the al-Buhais BHS18 graveyard (Kiesewetter 2006) and other sites in the Sultanate of Oman (Salvatori 2007; Munoz 2014). Interestingly, the excavators assigned the two double burials of UAQ2 to two different deposition phases: phases 1 and 3 (Phillips 2002: fig. 3).

The graveyard was supposedly dated to the 5th millennium BCE by C.S. Phillips, based on a stylistic comparison of the Ubaid pottery (with two sherds published in Phillips 2002: 175-176, fig. 5), and interpreted as the place of burial of a local population, with its own ritual practices and set of artefacts. Several bitumen beads (the bitumen originating from Mesopotamia (Hit-Abu Jir near Ramadi in Iraq, *cf.* Connan & Carter 2007) were recovered at the base of a skull (Phillips 2002: fig. 7), alongside a pearl (Charpentier *et al.* 2012a), and other artefacts (two points, including a fusiform type showing denticulations, a fragment of a shell bracelet, and an elongated stone pendant). Interestingly, a spatula with residues of ochre and a pellet of ochre were recovered in one of the inhumations (Phillips 2002: figs. 6-10). The latter could have been used as a cosmetic tool kit in everyday life or funerary rituals.

Studying the fish bones discovered during this first stage of excavations, Beech (2004) underlined the prevalence of fishing in the shallow waters of the Umm al-Quwain lagoon, based on the high frequency of seabreams (Sparidae – in particular belonging to the *Rhabdosargus* genus) and emperors (Lethrinidae – in particular the pink-ear emperor, *Lethrinus lentjan*) in the bone assemblage. He showed that fishing in the open sea was occasionally carried out at UAQ2, as tuna remains have been found, potentially in association with one of the burials. Beech identified two large vertebrae (14 mm in diameter) and a dentary from a large tuna (*c.* 120 cm in length), which probably belonged to the genus *Thunnus* rather than smaller scombrids like *Euthynnus affinis* (Beech 2004: 150). Finally, the study of emperor otoliths indicated that fishing was carried out mainly at the end of spring and the beginning of autumn (Beech 2004: 214), providing the first indication for the occupation season of the site. Remains of domesticated caprinids and cattle were also identified, along with those of wild ungulates, such as gazelle and oryx. It evidenced that both herding and hunting were practised during the 6th millennium BCE in the northern UAE and contributed to completing the nutrient requirements of people whose diet was based overall on seafood consumption.

The 2009 survey of the French Archaeological Mission in the UAE (with the contribution of V. Charpentier)

In 2009, V. Charpentier and S. Méry visited the site of UAQ2. They observed that the shell midden extended over several hundreds of metres (Figure 1.3). A natural section of more than 3 m, with anthropic stratified deposits *c.* 2 m deep, was visible in the collapsed area of the southern slope of the dune (Figure 1.4). Anthropogenic deposits covered a sterile dune formed during the Late Pleistocene (before *c.* 9700 BCE).

The site of UAQ2 was the first Neolithic coastal shell midden offering such an important accumulation of stratified deposits in the UAE (since then, further sites have such deep levels: UAQ36 and UAQ38). It also represented the most extended Neolithic shell midden known regarding surface area. Moreover, the deposits were sealed by compacted top layers, mainly of marine shells (Figure 1.5), protecting the site from erosion and deflation.

Figure 1.6. Ubaid sherd showing a painted herringbone pattern sticking out of the section.

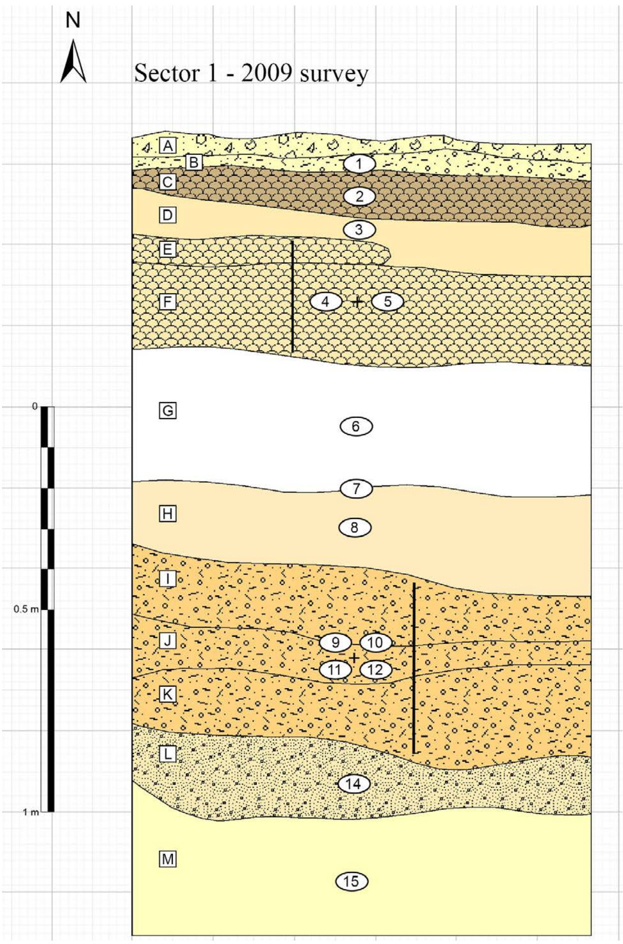


Figure 1.7. Drawing of the 2009 natural section.

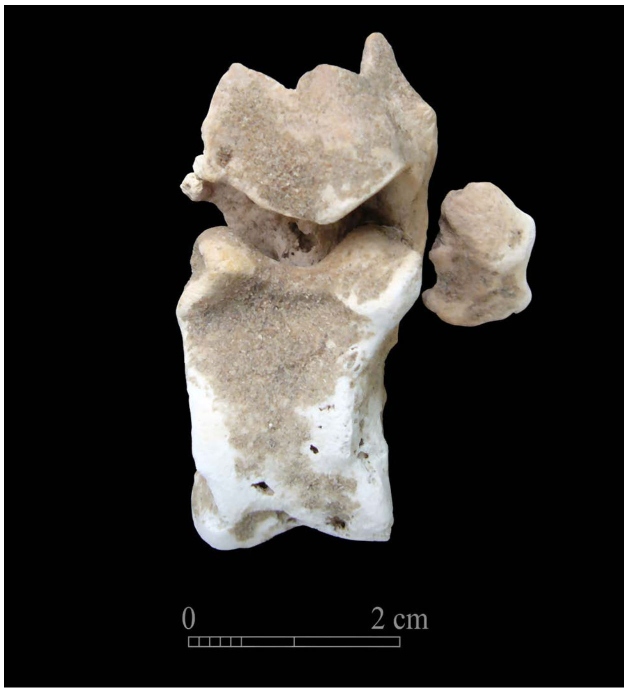


Figure 1.8. Talus of a large terrestrial mammal found at the surface of the site in 2009.

Figure 1.9. Sample of Ubaid pottery found at the surface of the site in 2009.

Figure 1.10. Crushing stone, tile knife, and some of the stone fishing sinkers found at the surface of the site in 2009.

Figure 1.11. Sample of lithic implements found at the surface of the site in 2009.

The majority of the material found at the site's surface in 2009 was dated from the Neolithic period, including shell tools (mostly made from valves of *Callista erycina* and *Callista umbonella*), stone fishing sinkers, lithic macro- and micro-debitage products, and tools. Several Ubaid sherds were recovered, including three from the same pot decorated with a painted herringbone pattern (Figure 1.6).

Part of the natural section was cleaned in 2009, studied and drawn by V. Charpentier (Figure 1.7). The strata can be described as follows (in brackets, the corresponding levels described during the extensive excavation of the site):

- Strata A (Level 1) is a sandy level comprising intact and fragmented bivalves (*Marcia* spp. and *S. cuccullata*) and gastropod (*Hexaplex kuesterianus*) shells
- Strata B (Level 2) contains few and very fragmented shells
- Strata C (Level 2) is dense in *Marcia* spp. and *T. palustris* shells
- Strata D (Level 2) is a lens of fragmented shells (*Marcia* spp., *S. cuccullata*). Some of them are burnt
- Strata E (Level 3) is an almost sterile sandy layer
- Strata F (Levels 4-5) is a bed of mostly intact *Marcia* spp. shells, associated with a few *H. kuesterianus* and *T. palustris* shells
- Strata G (Level 6) is almost sterile, with rare, burnt, and very fragmented shells.
- Strata H (Level 8) is also poor in biofacts, with rare, fragmented shells.
- Strata I (Levels 9-12) is dense in fragmented *Marcia* spp., plus very rare *T. palustris* and *H. kuesterianus* shells.
- Strata J (Levels 9-12) is grey and very dense in intact and fragmented shells, mainly *Marcia* spp., and contain artefacts
- Strata K (Levels 9-12) is brown and sandy, with rare fragmented shells (*S. cuccullata*, *H. kuesterianus*)
- Strata L (Level 14) is sandy and almost sterile. A talus of a large-sized terrestrial mammal was found (Figure 1.8)
- Strata M (Level 15) corresponds to aeolian sand that was accumulated on the dune before the occupational phase

As said before, several Ubaid sherds were recovered (Figure 1.9). All are relatively thick (7-9 mm), between 1 and 5 cm^2 on the surface, and mechanically resistant; their paste is beige to pale green and microporous, and their texture is sandy and slightly rugous. The temper belonged to sand fraction minerals (mainly quartz and feldspars between 200 and 400 µm) and was intentionally added by the potters. This fabric is very close, or similar to the 'standard Ubaid' ware, as described at as-Sabiyah

H3 (Crawford & Carter 2010), or the 'common ware' of Bahra 1 (Smogorzewska 2016). It is the best-represented type among the Ubaid pottery found at Neolithic sites along the coast of the UAE, for example, on the Delma and Marawah islands (Beech *et al.* 2000; Beech *et al.* 2005).

Most of the Ubaid sherds found in 2009 at UAQ2 are plain, but a few are decorated with thick, black, and often shiny paint. The most exciting piece is a bowl rim decorated with a herringbone pattern, a characteristic decoration of the Ubaid 2 or 2/3 stylistic phases based on the chronology of Forest (1996: 19, tab. 4). The first radiocarbon dating (Chapter 3), done at the LOCEAN Laboratory (Paris), assigned the basal anthropogenic deposits of the 2009 section to the last centuries of the 6th millennium BCE, which is consistent with the cultural dating of the Ubaid 2 and 2/3 styles. A rim found in Strata K is decorated with a black-painted horizontal line and an incomplete parallel band, a motif present across the Ubaid 2 to Ubaid 3/4 periods.

The surface material comprised a crushing stone, several stone fishing sinkers (Figure 1.10), and a point made from a long bone belonging to a terrestrial mammal – a sheep, presumably. Other artefacts include several elements of the Neolithic flint industry, including a tile knife made of a thin schistous rock (UAQ2.1225). A large sidescraper made of massive haematite was also found. The types of lithic resources are varied (flint, chert, radiolarite, chalcedonies, etc.) (Figure 1.11), and probably come from the Jebel al-Ma'taradh, about 30 km to the east (Charpentier *et al.* 2017). Among biofacts, apart from seashells and fish bones, which are sometimes burnt, several medium- and large-sized terrestrial mammal bones were recovered when cleaning the section, especially in strata K. It includes a talus of a large terrestrial mammal (Figure 1.8).

After the 2009 survey, the working hypothesis (V. Charpentier) was that the graveyard excavated in 1992-1993 was associated with or was part of an extensive settlement which broadly remained to be discovered and further documented. Moreover, from the late 1990s, industrial sand extractions have destabilised the dune in the middle of its southern slope. This is the reason why a rescue excavation had to be promptly organised. We were, therefore, requested by the authorities of the Museum of Umm al-Quwain to resume the excavation of UAQ2 with the permission of the discoverer and first excavator of the site, C.S. Phillips. In March 2010, the local authorities gave the excavation permit to S. Méry, and a first season was organised in February-March 2011 under her responsibility.

Surface material found since 2011

Pottery sherds and a few artefacts have been found at the site's surface, demonstrating widespread passage through, or occupations of the site after the Neolithic. However, we did not identify levels from these more recent periods, potentially because of taphonomic factors (the levels were perhaps not covered by a dense layer of shell) or the infrequency, sporadicity, fleeting nature, and lability of these occupations.

From the Early Bronze Age (Umm an-Nar period), a Mesopotamian pot body sherd and the base of a Fine Grey Ware pot originating from the Makran, possibly the Dasht, come from the site's surface. Two body sherds from Dilmun (Bahrain) are typical of the end of the Early Bronze Age or the Middle Bronze Age. Two sherds of semi-fine Wadi Suq ware from Shimal date from the Middle Bronze Age. One Iron Age II-III sherd of semi-fine ware and three sherds of coarse ware were also recovered – we refer here to the classification of the surface pottery from the Umm al-Quwain identification program made by S. Méry and A. Dupont-Delaleuf. Several body sherds of turquoise glazed ware, Ridged Grey Ware, and sandy beige Gulf wares represent pre-Islamic (PIR) pottery. All these types are well known at the ed-Dur site. Islamic pottery sherds are also numerous at the site's surface, and there are different types of pottery from the Julfar period.

A fragment of carnelian bead (UAQ2.60) was found but could not be positively dated from the Umm an-Nar period by O. Brunet (Chapter 4). Flint implements, including a few projectile points allegedly associated with the Neolithic occupation at the site, also come from the surface.

Narrative of the excavations (2011-2017)

Methods and terminology

The site was excavated during four seasons, each lasting a month, between 2011 and 2014, and another season lasting two weeks in 2017.

The site of UAQ2 was dug based on a 1 x 1 m² grid (Figure 1.12). Apart from the 2011 season, planimetric and altimetric coordinates of archaeological data were taken with a total station (SET) and re-elaborated using the ArcGIS software (by F. Borgi). Vertical pictures were taken with the help of a 2.50 m-high pole (Figure 1.13) and rectified using ArcGIS. Such a height is well suited to this site, allowing a complete photographic cover of the exposed floors and structures. All the collected sediments were dry sieved with a 3-4 mm (1/8 inch) mesh (Figure 1.14). In 2012, sediment samples from each excavated level were water sieved but yielded no conclusive results as no charcoal or other organic archaeological remains were identified. Therefore, due to time constraints, team size, and financial aspects, the water sieving was not continued after 2012.

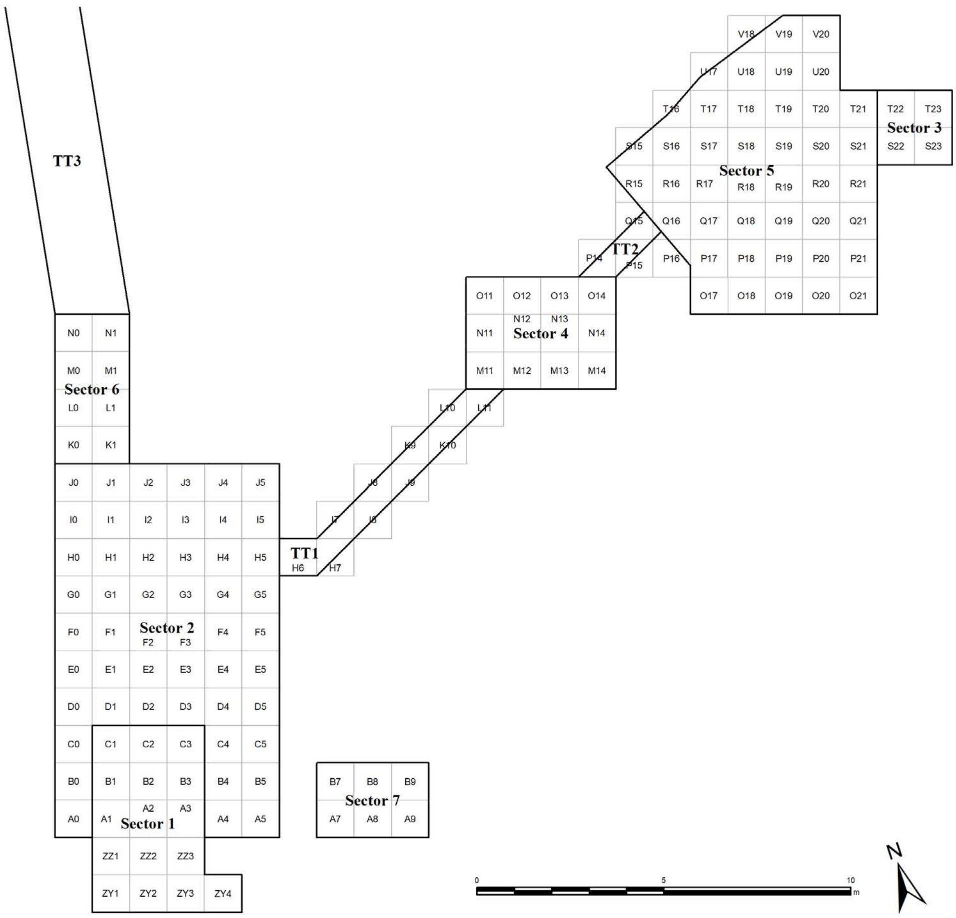


Figure 1.12. General plan of the sectors and test-trenches excavated at UAQ2.

Figure 1.13. F. Borgi using the 2.50 m high pole for vertical photos (2012).

Figure 1.14. O. Brunet and R. Hussein Kannouma using the sieve (2012).

Manual excavation is strongly recommended for the planimetric study of shell middens, and this is the methodology that has been applied at UAQ2, except in 2012 for Sector 2 of the site. During that year, the objective was to expose and excavate the oldest anthropogenic levels as we knew they were potentially rich in data of various types (structures, artefacts, and faunal remains). For this purpose, the upper and intermediate layers of Sector 2 (Levels 1-8), which were well identified and individualised during the first season of excavation, were removed with the help of a mechanical shovel and the entire sediment of the relevant levels was sieved. At UAQ2, at the end of Season 2017, the excavated surface achieved approximately 138 m^2.

The residential area of UAQ2 (Sectors 1-7) is characterised by an accumulation of various types of anthropogenic deposits that form layers, also named 'levels'. No completely sterile deposit was found before the pre-occupation substrate was reached (e.g. the Pleistocene dune). The layers consist of beige to grey-black (based on the Munsell Colour Chart) fine sand deposits. They are well organised and extend throughout the entire excavated area, as illustrated by the sections (Appendices 1-4). Part of the deposits is defined by many accumulations of shells that are organised in small and thin lenses up to extended and thick spreads of shells of Venus clams (*Marcia* spp.), murex (*Hexaplex kuesterianus*), mangrove oysters (*Saccostrea cuccullata*), and giant mangrove whelks (*Terebralia palustris*). Each mollusc taxa varies in proportion, degree of fragmentation, and wear depending on the level. The Persian stromb (*Conomurex persicus*) is present but few, as is the case for pearl oysters (*Pinctada radiata* and, more rarely, *Pinctada persica*). The layers are also characterised by the presence (or absence, depending on the layer) of concentrations of faunal remains (cooked or unintentionally burnt) – mainly shell, fish and terrestrial mammal remains are concerned. Most of them are isolated and fragmented but can be preserved well and sometimes articulated.

Most of the anthropogenic layers are well individualised in all the areas excavated. Regarding the vocabulary used in this book, a 'step' is defined as an artificial level of stripping. The identification letter of each step (from A to Z, thus AA to AZ) is related to the area excavated. A level may correspond to a single layer or a group of layers; it corresponds to a phase of occupation. A total of 17 anthropogenic levels have been distinguished so far, mainly based on the texture and colour of the floor (yellow or beige to grey) and the type, density, and fragmentation of the biofacts and artefacts. In the most densely occupied levels (Levels 9-14, in Sectors 1- 5), each occupation floor is covered by a level of occupation: an 'occupation floor' (also named 'floor' in this volume) is a surface defined by the presence of small concentrations of pottery sherds, objects (in bone, seashell or stone), or various biofacts (remains of unworked rocks or minerals, alimentary seashells, animal bones, etc.). Most of these items on the floors rest flat (i.e. almost horizontally).

The levels vary from thin to thick (*c.* 5 to 50 cm) (Table 1.1). The proportion of artefacts and biofacts is very variable in each of them. The biofacts include various marine shells, fragments of crab carapaces and claws, animal remains (from fish, terrestrial and marine mammals, and, less frequently, sea turtles and birds), and stones; the artefacts include pottery, tools (of mammal bone, marine shell or stone), weapons (in stone), and ornaments (in marine shells and stone).

Numerous vestiges of architectural structures are recognised at UAQ2. These structures are exclusively materialised by a series of post-holes (labelled TP#) showing nearly similar diameters and depths. A bone shaft (probably from a sheep) has been found in a post-hole from Sector 1 – likely to hold the post. Among other structures, fireplaces (labelled F#) and pits (labelled PIT#) are identified and show variable sizes. Well-designed fireplaces, or hearths, are difficult to discern at UAQ2 as they correspond to ashy, non-constructed, and flat zones, sometimes including concentrations of burnt material (principally bones and shells). The hearths are generally

Table 1.1. Thickness (range) of the UAQ2 levels.

	Thickness
Level 1	6-17 cm
Level 2	6-8 cm
Level 3	3-14 cm
Level 4	5-28 cm
Level 5	5-42 cm
Level 6	6-37 cm
Level 7	2-10 cm
Level 8	7-30 cm
Level 9	3-5 cm
Level 10	3-5 cm
Level 11	5-10 cm
Level 12	7-12 cm
Level 13	7-20 cm
Level 14	6-17 cm
Level 17	2-3 cm

small (20-40 cm in diameter), with only a single specimen measuring over 1 m (Sector 2, Level 8).

Numerous well-designed concentrations (labelled C#) of biofacts (shell, crab, and bone) correspond either to the preparation (cutting, crushing, etc.), cooking, and discarding of food or the emptying of fireplaces. Therefore, faunal remains consist of most of their filling. Concentrations may contain a few artefacts, including lithic implements and shell tools.

Some levels result from intensive activities related to food preparation and consumption of marine resources, as indicated by the numerous fireplaces and concentrations of their fragmented remains. Some are more related to housing than food preparation and consumption, as demonstrated by the abundance of post-holes and the scarcity or absence of fireplaces. Others still are the result of the discarding of vast quantities of edible and almost always eaten marine shells, creating multiple hard floors or natural paving that could have been, depending on the area, used for daily activities or the installation of architectural structures.

In Sector 5, several pit graves have been previously found and excavated by Phillips and Treveil. Altogether, the pits constitute a small sepulchral unit whose stratigraphy cannot be directly related to the results of our fieldwork as we have only little contextual information from the 1990s excavations (Phillips 2002). Two further tombs dating from the second half of the 6th millennium BCE have been found during the new excavations conducted at the site and under the contexts already investigated by the English team.

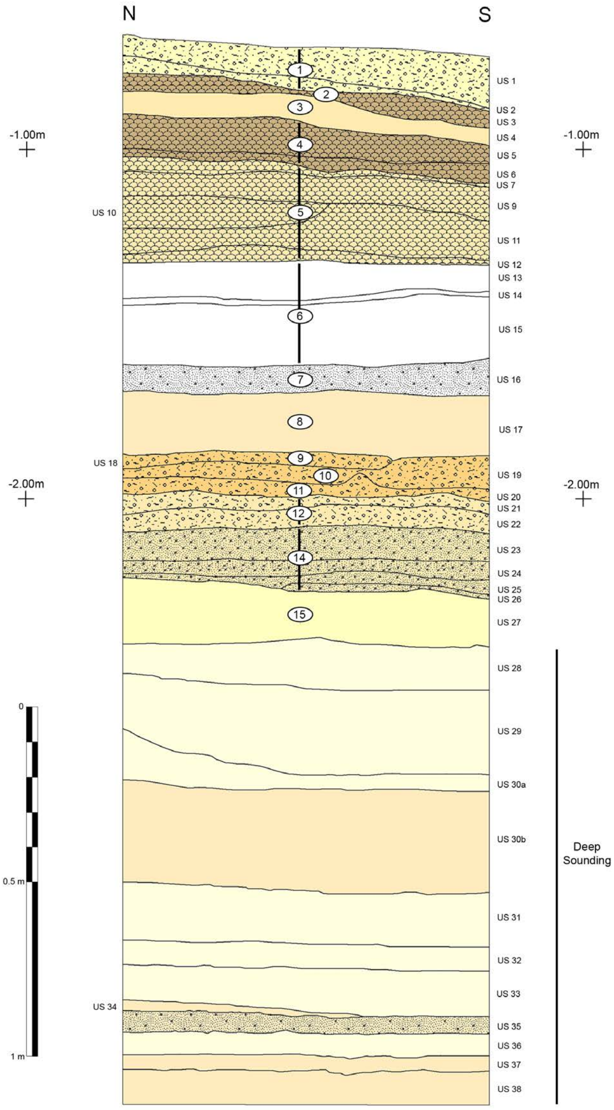


Figure 1.15. East section of Sector 1+2 in square B5 'Deep-sounding'.

The stratigraphy develops to a maximum thickness of 2.20 m, based on a deep trial trench (or 'deep sounding') dug in square B5 (Figure 1.15). The archaeological layers are overlying a *c.* 8.50 m-high and consolidated Pleistocene dune (forming aeolianite). In the 2012 section, 35 stratigraphic units were determined, representing 17 levels. Depending on the area, most of these levels were detected in all or part of the planimetric excavation. Regarding its dip, Level 1 was so eroded that it is impossible to evaluate its inclination value reliably. Noticeably, Levels 2 to 14 dip along the North-South direction, ranging between 0° and 1.5° either northwards or southwards. This means an overall variation so minimal that they can be considered flat along this direction. Regarding the East-West direction, a slight

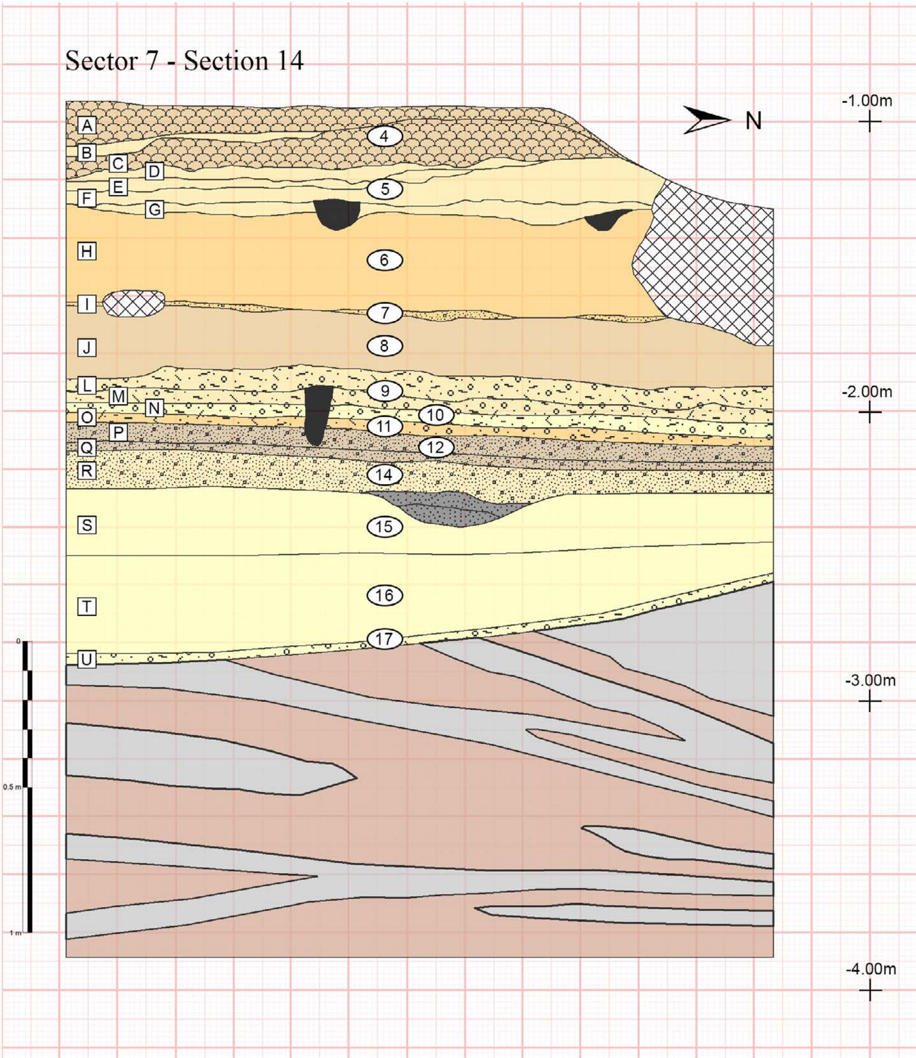


Figure 1.16. North section (Section 14) of Sector 7.

inclination of 3° eastwards is noticed for Levels 11 to 14, and the study of the northern section of Sector 7 (Section 14) shows a remarkable 6° inclination eastwards of Level 17 (Figure 1.16). There is thus a reversal of sedimentation orientation from Level 16, which is sterile.

Table 1.2. Estimated volume of excavated sediment by levels.

	Volumes of excavated sediment (in m³)
Sector 1+2	87
Sector 3	4
Sector 4	5
Sector 6	6
Sector 7	8
Total	110

The volume of each excavated level can be approximated (Table 1.2), except in Sector 5, because part of it was already excavated during the 1990s (Phillips 2002). The volume of removed sediment (*c.* 110 m^3) ensures good representativeness of the archaeological site and finds. Even though 80% of the removed sediment is related to Sector 1+2, other excavation sectors are also adequately represented.

Summary of the excavations

The 2011 season

When returning to the site in 2011, the section drawn two years before (Figure 1.7) collapsed, but the 'grey level' (Strata I-K) was still visible. It was decided to open Sector 1 of the excavation from the collapsed section (Figure 1.17). The aim was to reach Level 9 before the season's end to assess the potential of the site. Level 9 is the top

Figure 1.17. Excavation of Level 3 in Sector 1 (2011).

Figure 1.18. Excavation of Level 9 in Sector 1 (2011).

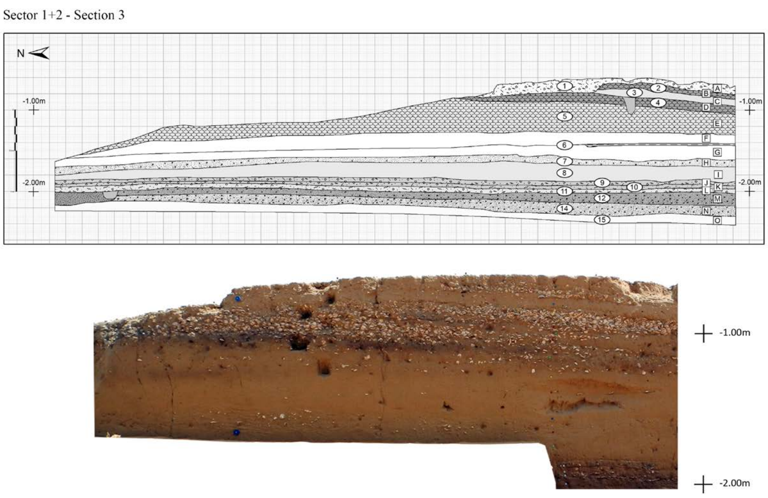


Figure 1.19. East section (Section 3) of Sector 1+2 (2012).

Figure 1.20. Three post-holes appearing along the East section of Sector 1, Level 9 (2011).

Figure 1.21. O. Brunet excavating one of the post-hole found in Level 9 (2011).

Figure 1.22. Mechanical shovel excavating the top layers of Sector 2 (2012).

layer of the 'grey level' and is rich in anthropogenic data. The excavation began by opening squares ZY1-ZY4, ZZ1-3, A1-3, B1-3, C1-C3 (Sector 1) (Figure 1.18, and see plan in Figure 1.12). The ZY and ZZ bands were located at the southern edge of the dune and thus irregular in shape. The excavated surface represented almost 15 m^2.

The three sections of Sector 1 (East, North, and West, plus the North section adjoining square ZY4) were studied and photographed. In the East section (redrawn in 2012, Figure 1.19), 21 stratigraphic units were distinguished and regrouped by levels. 14 anthropogenic levels were determined.

Fully excavated (hand-trowelled), Levels 1 to 8 were poor in artefacts and structures. No post-Neolithic artefacts were identified during their excavation. In contrast, the excavated portion of Levels 9 to 14 provided all the data typical of a settlement site (or residential site), such as post-holes, fireplaces, etc. Small concentrations of biofacts and raw materials were also recovered, which were associated with many artefacts found in situ. The artefactual assemblage was rich, and despite its closeness to those of the later levels, it partly differed in types of tools and ornaments. No material characteristic of the Late Neolithic was found in the latter levels.

Levels 9 to 14 slightly varied in thickness and composition, reaching a maximum thickness of 20 cm. Each level consisted of both a floor and the development of this floor, and the rhythmicity of the deposits was related to the same cycle of formation and taphonomic conditions, thus the same type of occupation. There was no sterile layer between the levels and no clear sign of an intermittent site occupation. Possible light dwellings (huts made with vegetal fibres or animal skins) or other types of architectural structures (such as windscreens and fences) may have existed on the UAQ2 site, the remains of which consisted of three post-holes forming an arc at the base of Level 9 (Figures 1.20, 1.21). However, it was impossible to complete this feature's extension, which continues through the East section in this sector.

Remains of this type of architecture were already known at other coastal Neolithic sites located in the UAE: at Delma (Emirate of Abu Dhabi), occupied during the 6th-5th millennia BCE (Beech & Elders 1999; Beech *et al.* 2016), and at the neighbouring site of Akab during the second half of the 5th millennium BCE (Charpentier & Méry 2008).

Older architectures, but in stone, are known on the islands of Marawah and Ghagha in the Emirate of Abu Dhabi (Beech et al. 2022; Al Hameli et al. 2023a) and are dated respectively from the beginning of the 6th and the mid 7th millennia BCE. The degree of technological development of these stone structures is outstanding in many aspects, such as the selection of stone blocks, the method for building a wall, construction elements, etc. Due to their architectures, MR11 and GHG14 are unique sites in the Lower Gulf – although the site of Shagra (South-East Qatar) (Inizan 1988) could correspond to a western extent of the same tradition. These sites are, however, not isolated culturally but belong to the same 'shared cultural background' as the one from UAQ2. For that reason, it seemed likely that other types of architecture would have existed in different areas of the Lower Gulf but related to the possibilities of construction materials in their environment. Parallelly, another tradition of stone architecture seems to have independently emerged later in Kuwait, from the end of 6th millennium BCE, as shown by the discoveries made at as-Sabiyah H3 and Bahra 1 (Carter & Crawford 2010; Bieliński 2018; 2020).

At the end of the 2011 season, it appeared that the potential of UAQ2 was so important that the Umm al-Quwain-French team programmed four other seasons of excavation. Based on the first radiocarbon dating, Level 9 was presumably dated to the last third of the 6th millennium BCE.

The 2012 season

In 2012, Sector 1 was enlarged, and three new excavation sectors were opened: sectors 3, 4, and 5.

Figure 1.23. Fusiform projectile point (UAQ2.556) in Level 12, Sector 1 (2012).

Sector 2 consists of an enlargement of Sector 1 (now 'Sector 1+2') – mainly to the North, thus perpendicular to the main axis of the dune. We intended to get a larger view of the settlement. The excavated surface reached 51 m^2 (extending to the squares A0-J0, D1-J1, D2-J2, D3-J3, A4-J4, and A5-J5). Levels 1 to 8 were excavated using a mechanical shovel (Figure 1.22) to reach rapidly the lower and densest levels observed in 2011. Levels 6 and 8 were removed in two artificial steps as they represented thick layers. The other levels were all excavated by hand: Levels 9 and 10 were fully excavated, but Levels 11 to 13 were only partially uncovered and documented during the season. The exceptional preservation of the site was first noticed during this season – Levels 9 to 14 were particularly rich in artefacts. Furthermore, a preferential association of the fusiform points (Figure 1.23) with the most ancient levels of the site (Levels 9-14) was observed – which was surprising to us in terms of the chronology of these points as known at that time and documented mainly from the Sultanate of Oman (see Charpentier 2008).

Sector 3 was opened to explore to the east of the burials excavated in 1992-1993 by C.S. Phillips. It measured 4 m^2 (comprising the squares T22-23 and S22-23) and was fully excavated by hand (Figure 1.24). A total of 11 stratigraphic steps were operated, corresponding to nine of the levels first identified in Sector 1+2 (Figure 1.25). The excavations were stopped in this trench, and a section was drawn. The levels were interpreted as remains of residential occupations but in an area less densely occupied than Sector 1+2. No human bone was recovered despite the proximity of the burials excavated in the 1990s, but many artefacts were present in all the layers.

Sector 4 is located on the top of the shell midden. It covered a surface of 12 m^2, corresponding to the squares M11-O11, M12-O12, M13-O13, and M14-O14 (Figure 1.26). Six thin steps were completed by hand. As documented in 2011, they correspond to Levels 2 and 3 identified in Sector 1+2. The excavation was stopped on Level 3 when half of a circular structure was found, measuring *c.* 2-4 m in diameter, and identified according to the alignment of 39 post-holes (Figure 1.27). Such a discovery documented that even the levels very dense in the shell could include dwellings at UAQ2 and did not function as dump areas only – which is potentially also the case at other sites from the Arabian Gulf. Sector 4 also provided several artefacts associated with the Late Neolithic: a mother-of-pearl fishhook (UAQ2.1549) and plain black softstone earrings (UAQ2.2022-3). The latter confirmed the later dating of the occupation documented in the upper stratigraphy of the site from the 5th millennium BCE and the first centuries of the 4th millennium BCE.

Sector 5 partly corresponds to the earlier excavation area opened by Phillips and Treveil in the 1990s (Phillips

Figure 1.24. Removal of the top layer by F. Borgi in Sector 3 (2012).

Figure 1.25. F. Borgi cleaning the North section (Section 13) of Sector 3 (2012).

Figure 1.26. Removal of the top layer by O. Brunet in Sector 4 (2012).

Figure 1.27. Aerial view of Sector 4 showing the numerous post-holes associated with Level 3 (2012).

Figure 1.28. J. Martin opening Sector 5 from the limits of the 1990s excavations – Sector 3 is visible on the right (2012).

Figure 1.29. Extension of Sector 5 when the first grave (Tomb 2) was discovered – visible in the corner to the right (2012).

Figure 1.30. D. Gasparini and K. Lidour excavating Level 12 in Sector 1+2 – dark patches visible on the ground correspond to the remains of hearths and post-holes (2013).

2002) (Figure 1.28). In 2012, the fieldwork consisted of establishing the stratigraphical link between the graveyard and the different sectors where settlement remains have been found. However, new burials were recovered when the former limit of the 1990s excavations was enlarged to the east (Figure 1.29) (Chapter 2).

The 2013 season

During the 2013 season, the excavations continued in Sector 1+2 of the site. Already reached in 2011 and 2012, Levels 11 and 12 have been entirely excavated by trowel, and Levels 13 and 14 have only been partly dug (Figure 1.30). At the end of the season, the top of Level 15 was reached. It consists of the bottom of the anthropogenic sequence at the site. In Sector 5, Tomb 1 – now identified as a multiple burial – has been further documented and fully excavated under the supervision of K. McSweeney (Figure 1.31, Chapter 2).

In the 2013 season, they allowed detailed documentation of a series of occupational layers corresponding to the continuous development of a vast residential area at the site by 5400/5200-5000 BCE through Levels 9 to 14. Many vestiges of architectural structures were observed during this season. These were materialised by a series of post-holes and surrounded by fireplaces, and well-designed concentrations of faunal remain wastes. Chronologically and culturally, the layers excavated correspond to the Middle Neolithic, as known along the southern coast of the Arabian Gulf (Méry 2015; Mashkour et al 2016; Drechsler 2018).

The 2014 season

The excavations have continued in Sector 1+2 in 2014. The fieldwork led to better documentation of the material culture of the Middle Neolithic occupation in Levels 13 and 14, in particular through the discovery of further vestiges of architectural remains (Figure 1.32). The excavation was fully completed on the entire surface of Sector 2 until it reached Level 15. The latter is sterile and corresponds to the top of the pre-occupational strata in stratigraphy by the mid 6th millennium BCE. The team began to draw and describe the sections from Sector 1+2 (Sections 1-3) and 5 (Sections 4-8) (see Appendices 1-4).

To further document and understand the stratigraphic connections between the different residential parts of the site and the graveyard, two test trenches were excavated in 2014: TT1 (connecting sectors 2 and 4) and TT2 (connecting sectors 4 and 5) (Figure 1.33). Their sections have also been documented (Sections 9-12). This allowed us to check the continuity of the levels identified in Sector 2 over the site, but Level 13 became thinner and disappeared in the other sectors.

Figure 1.31. Tomb 1 (multiple burial) revealed under the skeleton found in 2012 (Tomb 2) (2013).

Figure 1.32. View of Level 15 in Sector 1+2 showing several post-holes (2014).

The 2017 season

The last fieldwork campaign at UAQ2 was conducted in 2017. The main aim of the season was to document the connection between the archaeological stratigraphy and the natural stratification of the dune. The relation of the Pleistocene dune with the palaeo-lagoon (to the North) was also explored (Figure 1.34; Figure 1.35).

A long-stepped trench was dug along a North-South axis with the help of a mechanical shovel, starting from the northwest corner of Sector 2. For safety reasons, the test trench was subdivided into two parts (TT3 and TT4), with the same orientation downwards the dune's slope (Figure 1.36; Figure 1.37). Three additional trial trenches were excavated: two on the flat and lower part of the plain standing north of the site (TT5 and TT6) and the third one along the southern slope of the dune, east of the site (TT7).

Anthropic levels extended only 5 m from Sector 2. The remaining part of the TT3-TT4 trench provided no anthropic layers in the stratigraphy but a thick accumulation of sterile sand. Section 16 shows the collapse of Level 2 (dated *c.* 4000-3600 BCE) into the dune slope, directly overlying a sterile sandy layer – identified as equivalent to Level 15 (i.e. the pre-occupational layer) – and with only some very sporadic remnants of more

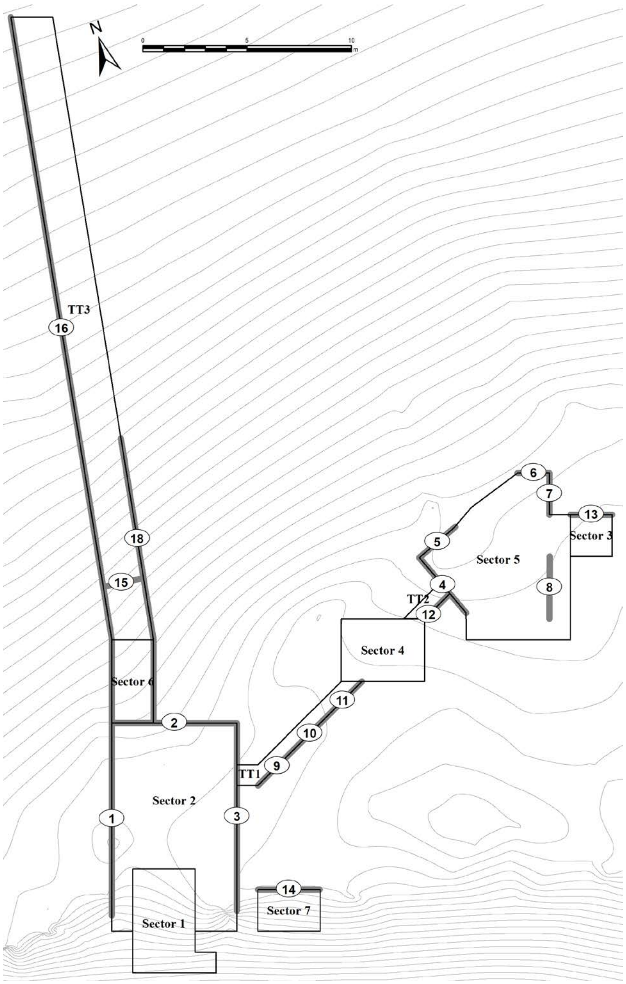


Figure 1.33. General plan of the sectors and test-trenches excavated at UAQ2 with the location of the sections documented.

Figure 1.34. Satellite view of the UAQ2 area and the sabkhah located further north with the location of the soundings excavated and the cores sampled.

recent levels. Given the overlapping of various levels, the stratigraphy is more difficult to interpret from Section 18 (Figure 1.38).

While starting the excavation of TT3 from the northern section of Sector 2, care was taken to preserve intact the northwards extension of Levels 14 and 15 over a small area (roughly 3.3 x 1.8 m) labelled as Sector 6. This extension allowed the identification and registration of a few new features (a fireplace and several post-holes) and a few artefacts, including a polished stone adze. A second area of excavation, labelled Sector 7, was located on a step (roughly 2.1 x 1.1 m) operated on the southern slope of the site (Figure 1.39) for documenting a new section (Section 14) close to Sector 1+2 – the southern section of the latter sector being continuously damaged over the years because of the destabilisation of the dune on its southern slope. There, the excavation continued as far down as the base of Level 17 (labelled SU 35 in the deep trial trench) (Figure 1.40).

Stratigraphy and chronology

General

The stratigraphy is similar or close in all sectors, and test trenches are excavated. Chronologically and culturally, the excavated levels correspond to two main phases:

- Levels 14-9 are dated *c.* 5400/5200-5000 BCE and correspond to a Middle Neolithic occupation. This phase is known from several coastal sites in the Arabian Gulf, i.e. as-Sabiyah H3, Dosariyah, and also on Delma and Marawah islands in the UAE.
- Levels 8-1 are associated with a Late Neolithic occupation that dates from the 5th millennium BCE and lasted for part of the first half of the 4th millennium BCE, a period better documented at the neighbouring site of Akab.

The levels have been gathered in several phases according to their absolute dates and to the nature of

Figure 1.35. M. Degli Esposti supervising the CL1 sounding (2017).

Figure 1.36. F. Borgi recording GIS points for the documentation of TT3 (2017).

Figure 1.37. View of Sector 6 and TT3 (2017).

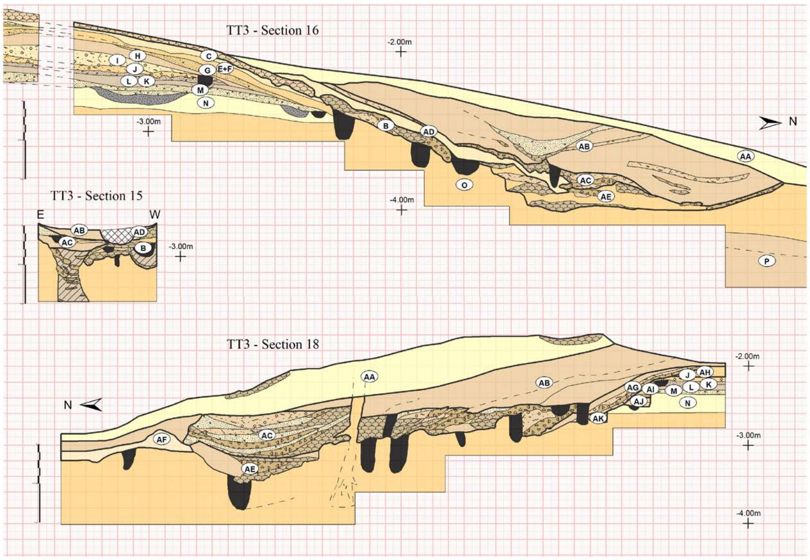


Figure 1.38. Sections 16-18 documenting the stratigraphy of TT3 on the northern slope of UAQ2.

Figure 1.39. View of Sector 7 located on the southern slope of the site – photo taken across Sector 1+2 (2017).

Figure 1.40. View of Section 14 in Sector 7 and of Level 17 showing a thin layer of bivalves (2017).

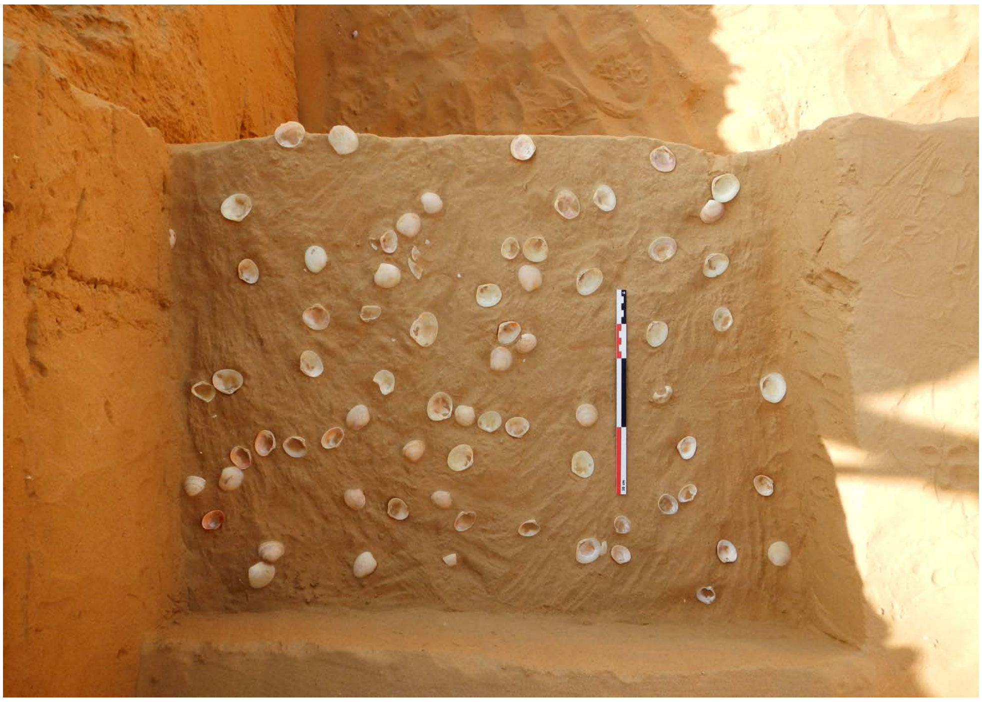


Figure 1.41. Detail of Level 17 as it has been exposed in Sector 7 (2017).

the sedimentological sequence studied by A.G. Parker (Chapter 3), which highlights co-related changes in the regional climate and the occupational pattern at the site through time. The chronological distinction between the Middle and Late Neolithic periods is based on the study of lithic traditions of Eastern Arabia conducted by Charpentier (2008).

Phase A (Level 17)

The first phase of deposits corresponds to a single and very thin layer (2-3 cm) of marine shell. It is located below thick, sandy strata and was first observed in 2012 (Section 3, square B5) in a deep trial trench at the northeast corner of Sector 5. In Sector 7, a thin layer showed the same features. This layer, labelled Level 17, represents the first but occasional (i.e. non-dense and ephemeral) human occupation at UAQ2. An anthropic occupation is thus certain, but no occupation level developed on the occupation floor, only characterised by intact valves of *Marcia* spp. and *Circe* sp. Shells (Figure 1.41). The shells are lying flat directly on the dune layer. There was no artefact associated. Level 17 (corresponding to SU 35 in the deep sounding) has been OSL dated from 6370-5510±430 BCE (OSL 5, Freiburg laboratory) (Chapter 3).

Interestingly, Level 17, the top of the natural dune, dips markedly from east to west, opposite the underlying sandy deposits (Figure 1.16). This indicates a notable erosive event that modified the natural dune morphology preceding the first episode of substantial human occupation at UAQ2. The lower geological sand layers display a banded layout, with reddish and more coarsely grained sand levels alternated with pale yellow ones, mirroring the succession of wind-blown accumulations.

Hiatus A-B (Level 15)

The thick, sandy strata covering Level 15 contain no charcoal or artefacts, but a very few tiny (below 1-2 mm) shell fragments. In this pale, yellow-beige sand layer, several sub-layers indicate the dynamics of the sand deposition. Exposed in Sector 1+2, the surface of Level 15 is compact, sandy, and yellowish brown – this level corresponds to SU 27 in the stratigraphic sequence of the deep trial trench (Figure 1.15). The sediment is aeolian sand, dense in tiny wind-blown shell fragments (below 500 µm) (25% of the visible surface in the deep trial trench). Level 15 was reached in all sectors and test trenches except Sector 4.

Phase B (Levels 14-9)

(General)

At UAQ2, the most informative anthropic layers from the site of UAQ2 correspond to Phase B. Several layers were regrouped because they show the same or close characteristics in terms of composition, density, and combination of features – e.g. structures (post-holes, firing place, pits), biofacts, and artefacts. At all levels, the findings document several well-organised and intense domestic activities inside the site's residential area, and the acquisition of marine resources appears central to

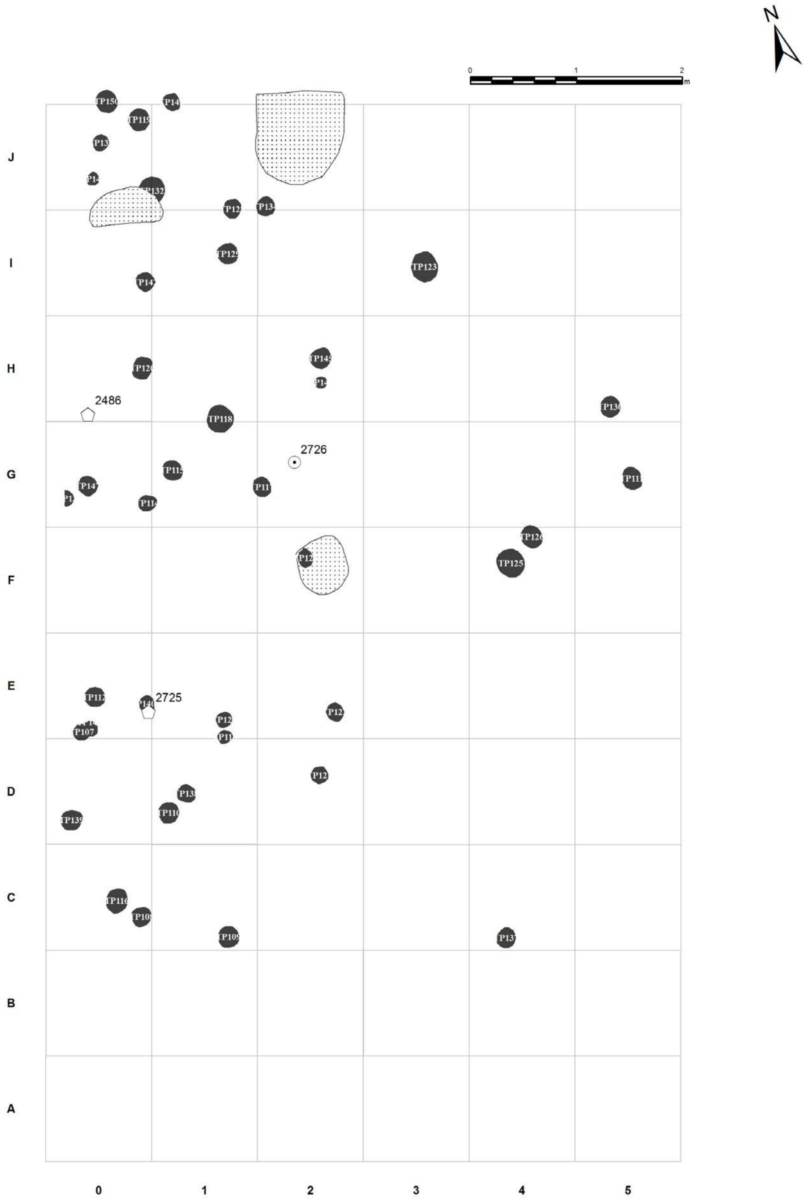


Figure 1.42. Plan of Level 14 (second occupation floor) in Sector 1+2.

the subsistence economy (Chapter 5). Many artefacts and biofacts were not of local origin, implying the mobility of all or part of the group or exchange practices with other Neolithic groups inhabiting the region.

Six levels were recorded in Sector 1+2: Levels 9 to 14. Except for Level 13, some of the other sectors were identified based on a systematic recording and analysis of cross-sections and planimetric excavations. It is worth noting that Level 13 is at the same altitude as Level 14 in Sector 2 and occupies the western part of Sector 1+2 only – it was not identified elsewhere. In other words, it is highly likely that Level 13 stratigraphically belongs to Level 14. The thickness of the accumulated levels of Phase B is *c.* 60 cm.

The two tombs found in 2013 are associated with the earliest occupation layer of Phase B: Level 14. According to the description given by C.S. Phillips (2002), some of the graves found in the 1990s located above may also have corresponded to Phase B (probably Levels 14 to 11).

Based on the data from the settlement, most of the activities at UAQ2 were related to the exploitation (fishing, hunting, gathering) of marine and terrestrial resources. For example, flint scrapers and shell tools

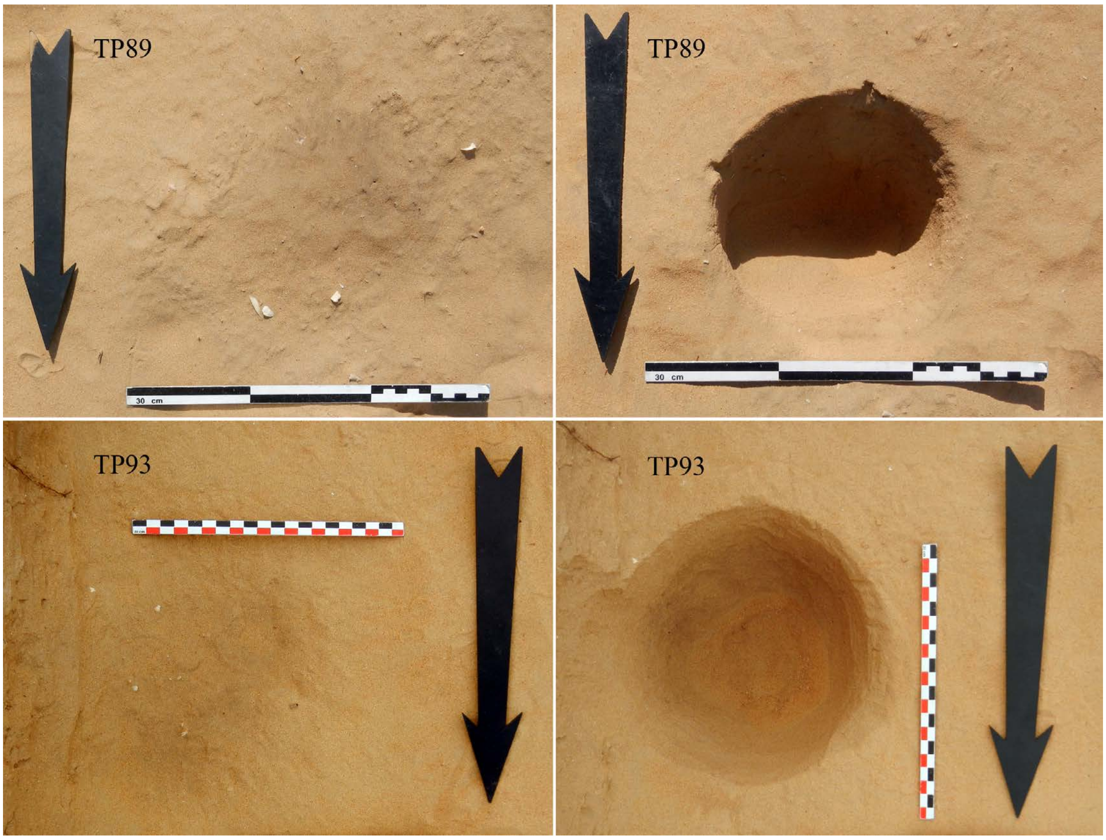


Figure 1.43. Examples of post-holes excavated in Level 14, Sector 1+2.

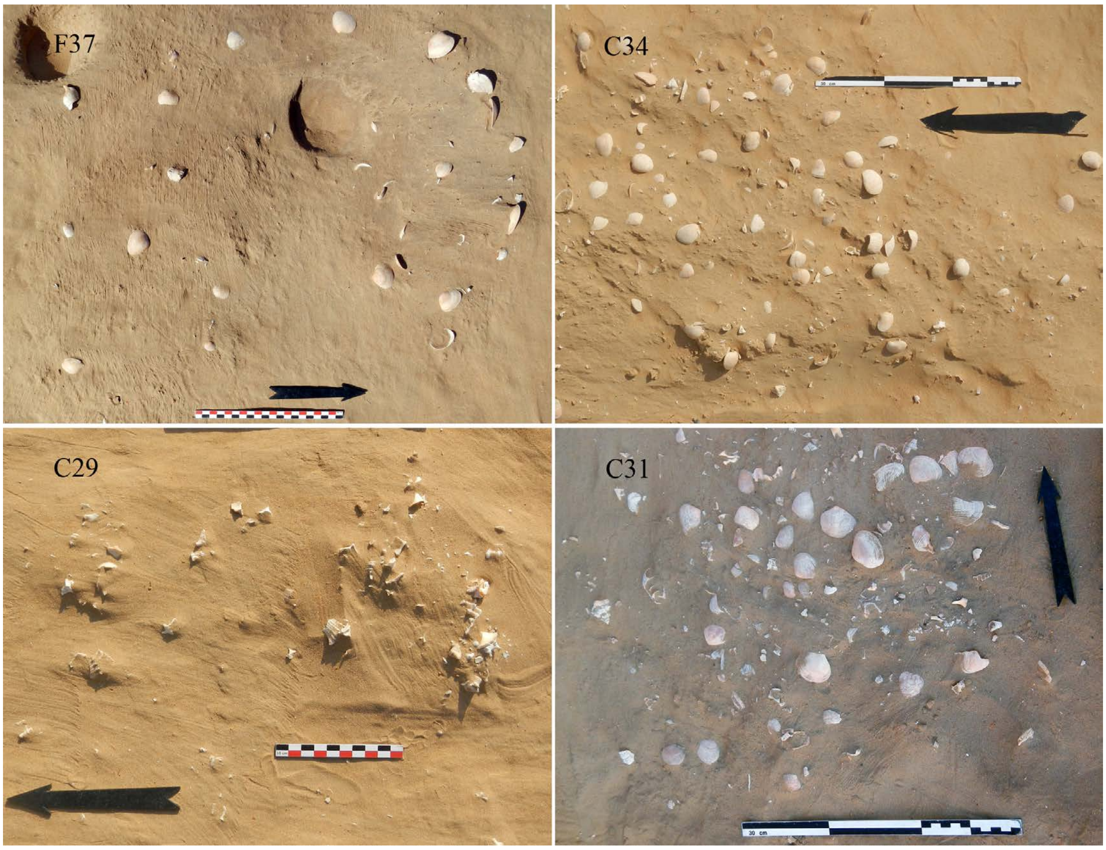


Figure 1.44. Examples of shell concentrations excavated in Level 14, Sector 1+2.

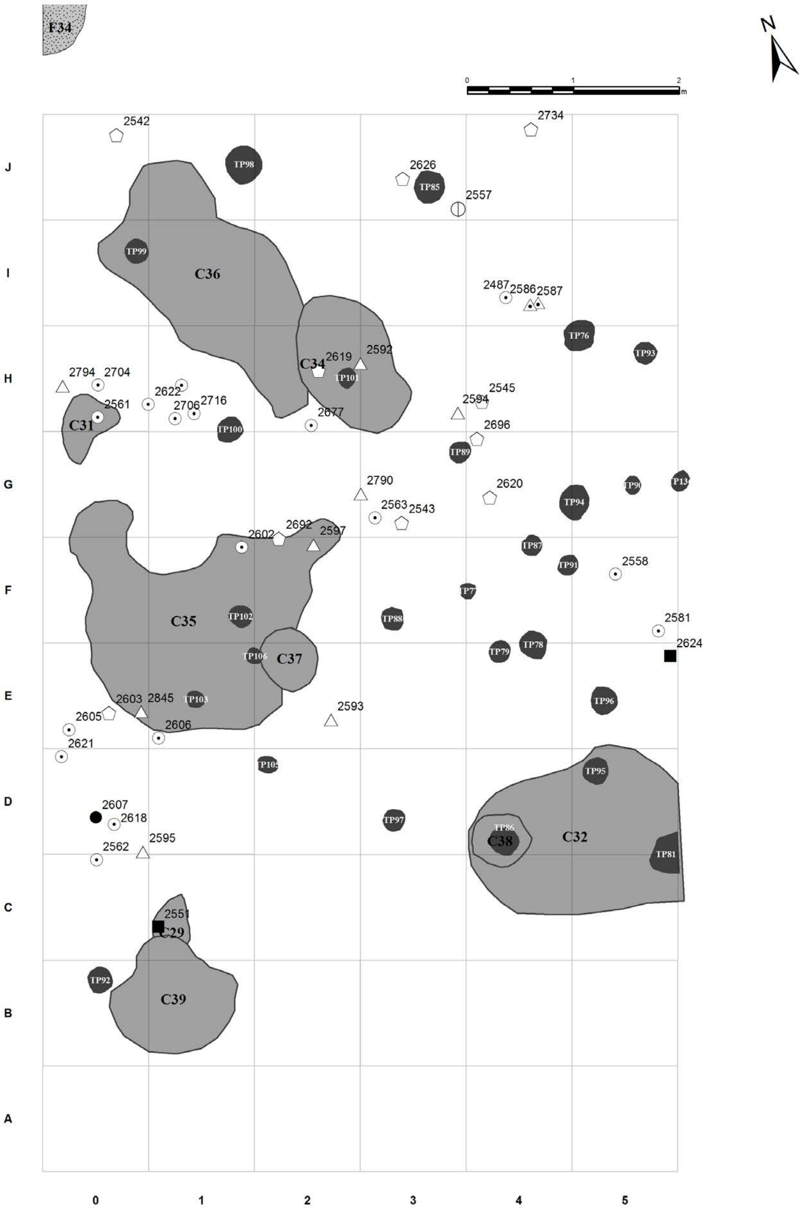


Figure 1.45. Plan of Level 14 (first occupation floor) in Sector 1+2.

(mainly in *Callista* spp.) were possibly used to process fish and mammal meat, for cutting, scraping, perforating, descaling, etc. According to use-wear analyses, shell tools were used for various tasks, principally for cutting vegetal fibres and for processing animal skins (Lidour *et al.* 2024). Possible containers or spoons (valves of *Vasticardium lacunosum* and ark shells, Arcidae), and points made of caprinid long bones are also attested. All these types of tools are present in practically all the stratigraphy. Other important activities are documented in all levels of Phase B, such as the knapping and retouching of lithics (flint, radiolarite, calcedony, quartz, and crystal rock). The production of *Spondylus spinosus* disc beads is attested in several levels, while unfinished *Pinctada* spp. Disc beads remain rare. Other craft types are more rarely documented.

Whether in the form of stone fragments (clastic, hard and softstone types, beach rock) or intact *Callista* spp. and *S. spinosus* valves, raw material is not abundant in the levels of Phase B, but again, attested in all its stratigraphy. An important discovery consists of nodules of ochre, few but recurrent in the stratigraphy. According to use-wear and residue analyses undertaken by K. Lidour on shell tools, ochre was, among others, used at UAQ2 for treating animal skins.

Figure 1.46. Aerial view of the burials (Tombs 1 and 2) excavated in the graveyard, Sector 5 (2013).

Despite their shared characteristics, each excavated level of Phase B is different and characterised by its combination of elements, hence an evolution in the use of the domestic space. For example, Level 13 results from intense activities related to food preparation and consumption, mainly from marine resources. The presence of numerous fireplaces and concentrations of fragmented shells indicates this. Level 14 is characterised instead by the presence of several shell concentrations resulting from food preparation and numerous post-holes.

(Level 14)

Level 14 is the oldest occupation of Phase B and corresponds to repeated occupations at the site. Its thickness is between 6 and 17 cm; its formation is brought by activities related to housing structures, as shown by the density of architectural remains and the scarcity of biofacts related to food preparation and consumption. It was excavated in all sectors and test trenches except in Sector 4.

In the stratigraphic sequence of the trial trench, it regroups four distinct stratigraphic units (Figure 1.15), described as follows:

- SU 26. Eolian sand, brown. Almost sterile. Some fragments of shell below 375 μm (5% of the visible surface in the deep trial trench). Rare valves of *Marcia* spp.
- SU 25. Eolian sand, brown. Relatively dense (10%) in centimetric shell fragments, including some *H. kuesterianus*.
- SU 24. Eolian sand, brown-grey. A few centimetric shell fragments (< 2%), including some *H. kuesterianus*.
- SU 23. Eolian sand is brown and black (heterogeneous colour within the layer). A few centimetric shell fragments (< 2%) also include some *H. kuesterianus* fragments.

In Sector 2, architectural remains are evidenced by post-holes perforating the top of Level 15 (Figure 1.42), indicating that temporary structures in perishable material were installed from Level 14. 39 post-holes were identified (TP107-147); their dimensions were small or medium, with a diameter between 15-20 cm and a depth from 8-15 cm. They are subcircular, conical in shape, with narrow and concave bases. Inside the post-holes, the sediment was sandy, soft and primarily brown or dark-yellowish brown (Figure 1.43). Small (centimetric) shell fragments (*H. kuesterianus*, *S. cuccullata*, and *Marcia* spp.),

Figure 1.47. Cluster of ten stone fishing sinkers (C13) found in the vicinity of the burials, in Sector 5 (2012).

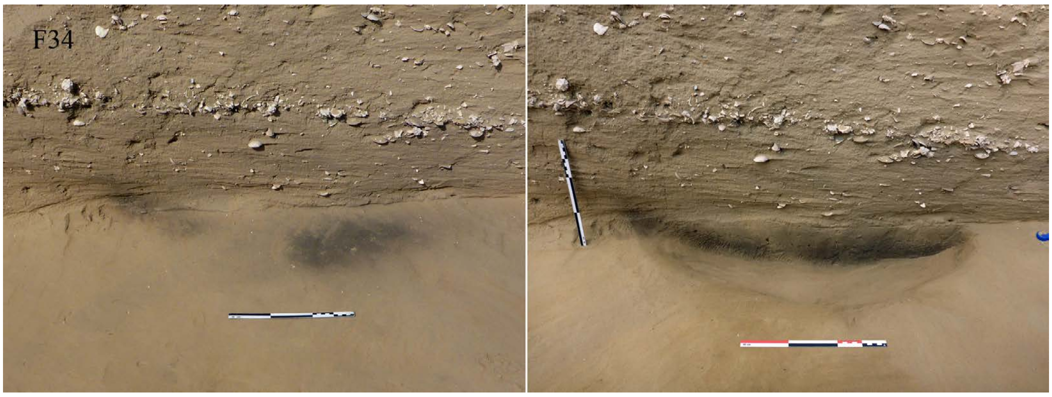


Figure 1.48. Fireplace F34 along the West section (Section 16) in Sector 6 (2017).

usually in a vertical position, and a few fish bones were frequently found. The post-holes were not organised. Thus, we cannot ascertain if they were associated with circular structures (dwellings), fences or shelters. However, we could hypothetically restitute several short alignments of post-holes. Other structural evidence has been found, including three pits with faunal remains. These were oval-shaped, measuring *c.* 50-90 cm long by 40-80 cm wide, and *c.* 20 cm deep. They were filled with dark-brown sandy sediment, the colour due to the mixing of sand and ashy material (Figure 1.44). Fragments of burnt fish bones and shells (*Marcia* spp., *H. kuesterianus*, *Circe* sp., *S. cuccullata* and a few fragments of *T. palustris*) were found within.

A second occupation floor was excavated within Level 14 (Figure 1.45), just above the one described. It provided 27 further post-holes (TP76-79, TP81, TP85-106) with the same characteristics of shape and depth. The remains of fragmented seashells and many fish bones were recovered inside and sometimes burnt. This second floor results from several activities related to food preparation and consumption, as shown by numerous concentrations of marine shells. It is also associated with housing structures, as demonstrated by the frequency of post-holes. Nine concentrations of marine shells (C29, C31-32, C34-39) were related to this occupation floor: C38 contained mostly *H. kuesterianus* shells, whereas *Marcia* spp. composed most of the shell assemblage in C34 and C36. Both *Marcia* spp. and *T. palustris* shells were present in quantities in C31, showing a more varied pattern of food consumption. In contrast, the concentration C32 contained very few fragments of seashells and fish remains, mostly filled with a dark, yellowish-brown sand matrix of soft compaction.

In Sector 3, Level 14 is 5-7 cm thick. Two large fireplaces (F19 and F20) have been identified (45-65 cm in length x 40-50 cm wide), filled by lenses of grey, loose soils full of ashes, rich in fragmented and burnt shells (mostly *Marcia* spp. and *H. kuesterianus*). No evidence of architectural structure was recovered in Sector 3.

Figure 1.49. Detail of Tomb 2, showing an array of shell beads close to the hips of the deceased (2012).

In Sector 5, the pit of Tomb 1 was dug in Level 15, and this consists of the oldest burial we know today at UAQ2 (Figure 1.46). The surface floor was also marked by a pile of ten stone fishing sinkers (C13) (Figure 1.47). The proximity of the burial represents an important discovery that may be interpreted as a possible ritual deposit. This deposit evokes another ritual practice attested at Akab, the deposits of unworked stone piles within and near the *Dugong Bone Mound* (Méry *et al.* 2009). Three post-holes were found near Tomb 1 (one visible in Figure 1.46). Were they part of an enclosure or simply isolated poles? This is impossible to ascertain, but they could be interpreted as land markers of the UAQ2 graveyard.

In Sector 6, a further fireplace (F34) (Figure 1.48) and three additional post-holes (TP148-150) were identified at the base of Level 14.

Only a few artefacts were discovered at the base of Level 14, in addition to the pile of stone fishing sinkers near Tomb 1 in Sector 5. Personal adornments include a single *Engina mendicaria* bead and several other specimens of *Polinices mammilla* from the settlement sectors. Ten further *P. mammilla* beads have been found in Tomb 2, arranged in a row close to the hip bones of the individual (Figure 1.49) – potentially the components of a belt. A pendant in mother-of-pearl (UAQ2.2362) was found close to the foot of Individual E of Tomb 1. Among the more remarkable finds were the discoveries of a pearl (UAQ2.2713) in the residential area, and seven others associated with Tomb 1 (UAQ2.2523-5) – the pearls being in association with two different individuals (A and B) from Tomb 1 (Figure 1.50). A magnificent fusiform point made of chalcedony (UAQ2.2526) was found in the same burial (Figure 1.51), showing that flint knappers had already mastered specific and standardised techniques for manufacturing this type of weaponry. Lithic resources, however, include flint and crystal rock principally. A splintered piece, a notch, and a scraper on the blade have been found among the tools. Tooling also comprised several scrapers or knives in *Callista* spp. valves, potential spoons or containers in ark shell (Arcidae) valves, and a bone point shaped in a caprinid long bone. The oldest stratified Ubaid pottery sherds from UAQ2 were found in the central residential area in this layer (in Sector 2).

The number of items is more important in association with the second occupation floor identified within Level 14. Another pearl was found in Sector 2 (UAQ2.2711). The lithic industry is still not very abundant. Nevertheless, the diversity of lithic resources is highly significant: flint (half of the industry) and chalcedonies and, less well represented, chrysoprase, radiolarite, chert, agate, and quartz. This diversity is a good indicator for the mobility and regional exchange during the Neolithic, as the sources of these lithic resources have been located farther inland, at least 30 km away to the south-east of UAQ2, i.e. on the Jebel al-Ma'taradh (Charpentier *et al.* 2017). Crystal rock is also knapped at the site, despite no tools being associated with this industry, apart from a single splinter.

Figure 1.50. Detail of two pearls found in association with one of the Tomb 1 individuals (2013).

Figure 1.51. Location of the chalcedony point UAQ2.2526 found in association with Individual D in Tomb 1 (2013).

Figure 1.52. Elliptical scraper on blade, found in Level 14 (Sector 1+2) (2014).

Figure 1.53. Detail of the two polished stone adzes found in the same shallow pit in Level 14 – the cutting edges point upwards. On the left, UAQ2.2587; on the right, UAQ2.2586 (2014).

Further projectile points have been found in Sector 5, a few metres from Tomb 1. One is a short fusiform point of black flint, showing denticulations along its edges (UAQ2.1324). Among several other types, an elliptical scraper on the blade has been found (UAQ2.1592) (Figure 1.52), showing a less standardised knapping technique. Among the lithic tooling, several splintered pieces have also been identified, using the latter as cutting tools linked with the production of shell beads.

The most remarkable findings of this layer consist of two complete polished adzes (UAQ2.2586-7), found together and with their cutting edges pointing upwards, in the filling of a small shallow pit located in Sector 2 (Figure 1.53). Groundstone implements also include stone fishing sinkers and a hammerstone. Fragments of beach rock could have been used as abrading tools, such as for making stone and shell beads. The presence of ochre nodules is also worth mentioning – their uses as cosmetics and for treating animal skins have been previously suggested. Tooling is also represented by several specimens of shell tools, including from *Callista* spp. valves but also made from a valve of *Asaphis violascens*. Seashells are also exploited for making personal adornments: more than 50 shell beads are registered. These consist mainly of *P. mammilla* beads (*c.* 60%), followed by disc beads in *S. spinosus*, some rare segments of *Dentalium octangulatum*, and annular beads made from the apex of *C. persicus* shells. An annular bead made of stone completes the personal adornment assemblage. Ubaid sherds remain rare, but a single painted sherd has to be mentioned (UAQ2.2784).

(Level 13)

Level 13 was identified only in the western part of Sector 1+2 (Figure 1.54). It has been fully excavated during the 2012 and 2013 seasons. Following the stratigraphic sequence obtained in the deep trial trench operated in square B3, it gathers two different layers:

- SU 22. Aeolian sand, greyish beige. Few fragments of shells (< 2%), mainly *Marcia* spp.
- SU 21. Aeolian sand, greyish beige. Few (< 2%) valves and small fragments of various seashell species.

Loose, sandy deposits and dark grey characterise Level 13. The faunal assemblage includes many fragmented seashells, mostly belonging to *H. kuesterianus*, *T. palustris*, *Marcia* spp, *Circe* sp., and *S. cuccullata*. Fragments of fish bone (Figure 1.55) and crab exoskeletons (belonging to *Portunus segnis* and *Scylla serrata*, according to Lidour *et al.* 2023a) are also abundant. Two small clusters of marine shells (C30 and C33) have been found, mainly composed of *Marcia* spp. and *S. cuccullata* valves. Several fireplaces are also present at this level: non-lined shallow oval pits, *c.* 6-14 cm deep, and usually filled with dark brown and compacted ashy sediment. Two different fillings have been identified for F28: the top was a compacted dark sand showing numerous fragments of seashells and burnt fish bones; the base was a loose sand, including lesser quantities of faunal remains.

Architectural structures are evidenced by nine post-holes with no perceptible organisation (TP3, TP73-75, TP80, TP82-83, TP156-157). They are comparable to those found within Level 14. Interestingly, a cluster of fragments of *S. spinosus* shell fragments (C28) was found (Figure 1.56), including several rough-outs of the disc bead manufacturing sequence: fragments showing cut

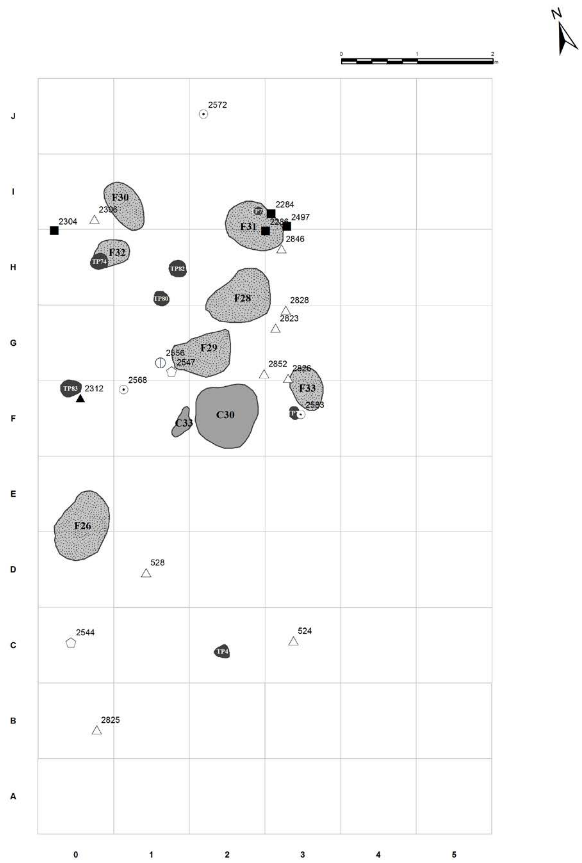


Figure 1.54. Plan of Level 13 in Sector 1+2.

Figure 1.55. Detail of fish backbone from Level 13, Sector 1+2 (2013).

Figure 1.56. Detail of a small cluster of disc bead rough-outs made of *Spondylus spinosus* shell (C28) (2014).

Figure 1.57. Small cluster of a fragment of *Pinna bicolor* valve with a scraper on blade underneath, plus two valves of *Marcia* sp. and *Circe* sp. (square C3 in Level 13 – Sector 1+2) (2012).

edges (n = 10), others are showing a central perforation but have not yet been abraded and polished (n = 2). This vestige of a small workshop confirms the existence of a local manufacture of shell ornaments as early as *c.* 5400/5200 BCE in the residential area of UAQ2. Another specialised craft area was identified in Level 13 as an accumulation of crushed rock crystal fragments resulting from knapping activities.

The artefactual assemblage is relatively close to what was found in the previous level but significantly more abundant compared to the excavated surface and the volume of sediment. The variety of artefacts is also greater. Among salient discoveries of Level 13, new types of personal adornments have been recovered. These include a hardstone pendant (UAQ2.381) and a polished black-grey stone sphere (UAQ2.380) found in Sector 1. A shell button (UAQ2.491) was found in Sector 2. In contrast to Level 14, disc beads in *S. spinosus* are more numerous than *P. mammilla* beads – specimens made of perforated shells of *E. mendicaria* are few. Other specimens include beads made from perforated shells of *Nassarius* spp. and polished segments of *D. octangulatum* – the latter sometimes described as 'barrel shaped'. However, it remains to specify if polishing was

Figure 1.58. Short fusiform point (UAQ2.2312) found in Level 13, Sector 1+2 (2013).

deliberately done or if it is the result of their prolonged rubbing on skin or clothes. Three fragments of the same *Pinna bicolor* valve (Figure 1.57) have been found and can consist of raw material used to produce mother-of-pearl adornments alongside *Pinctada* spp. shells. In this sense, a manufactured fragment of *P. persica* was found in Sector 1. The number of Ubaid potsherds increases; only a few are painted (showing black painted bands) (UAQ2.233; UAQ2.508; UAQ2.2281).

The lithic industry is less rich than at the previous level. Still, the diversity and percentages of exploited resources are not significantly different – with most flint products followed by chalcedony. Other types of clastic rocks remain rare. A short fusiform point (UAQ2.2312) (Figure 1.58) shows great similarities in its production technique with a comparable specimen found in Level 14 (UAQ2.1324 see above). Other remarkable lithic products include several elliptical scrapers made on the blade. It is worth mentioning the presence of a fragment of a hardstone vessel (UAQ2.505). A notched fishing sinker is also present. One ochre nodule and several pieces of beach rock complete the assemblage.

(Level 12)

Level 12 has been identified and excavated in Sector 1+2 (Figure 1.59). It measures 7-12 cm thick and gathers two layers corresponding to the SU 21 and 22 in the deep-sounding sequence. The latter is described as follows:

- SU 22. Aeolian sand, greyish beige. Few fragments of shells (< 2%), mainly *Marcia* spp.
- SU 21. Aeolian sand, greyish beige. Few (< 2%) valves and small fragments of various shell species.

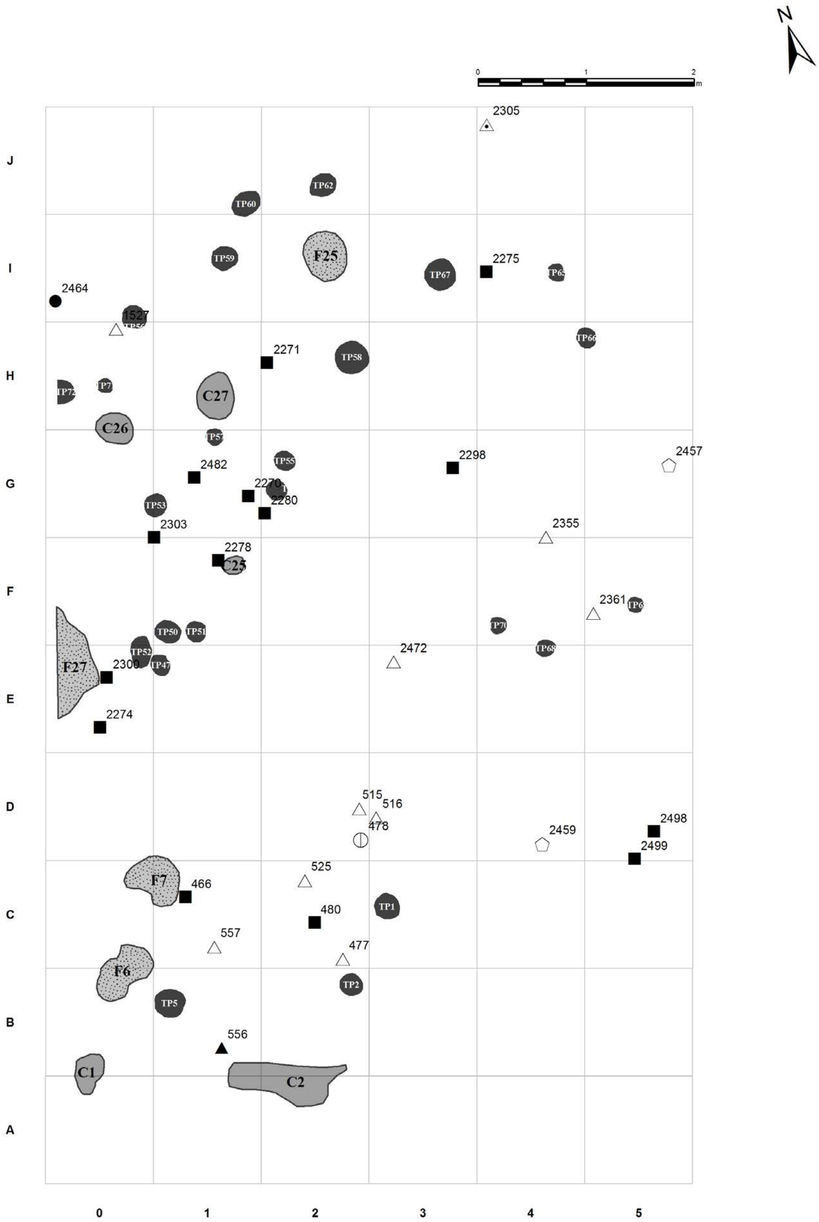


Figure 1.59. Plan of Level 12 in Sector 1+2.

The surface of Level 12 is a light yellowish-brown compacted sand. Its development corresponds to repeated occupations in Sector 1+2, but its function is different from that of Level 13. It is characterised by many post-holes, which were most probably repositioned several times. 24 post-holes (TP1-2, TP5, TP47, TP50-TP62, TP65-TP72) have been identified, evidencing the presence of several and varied types of installations. Other structures include fireplaces and concentrations of seashells. Still, they are not as frequent as was the case in Level 13 – resulting from a less intense activity of food preparation and consumption. Most fireplaces only contain brown to grey filling, with a few faunal remains. They measured 50-115 cm in length by 20-40 cm wide – with a depth of *c.* 15 cm. Two small concentrations of seashells are registered (C26 and C27) – mainly containing *Marcia* spp. valves (Figure 1.60). A concentration of small fish remains (C25) was also found in square F1 (Figure 1.61).

The number of artefacts is much more important than in the older levels. It includes a significant amount of shell beads, mainly disc beads in *S. spinosus* with some rough-outs, followed by perforated shells of *P. mammilla*, annular beads made from the apex of *C. persicus* shells, and segments of *D. octangulatum*. Disc beads made in the mother-of-pearl of *Pinctada* spp. valves are rare at UAQ2

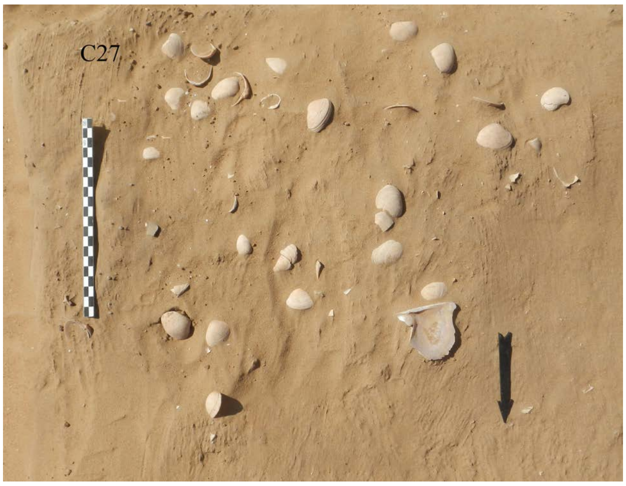


Figure 1.60. Shell concentration C27 in Level 12, Sector 1+2 (2013).

Figure 1.61. Detail of fish backbone (*Euthynnus affinis*) in the concentration C25, Level 12, Sector 1+2 (2013).

Figure 1.62. Example of Ubaid sherd found associated with Level 12 (left: UAQ2.466; right: UAQ2.148) (2012).

Figure 1.63. Elliptical scraper on blade UAQ2.1527 found in Level 12, Sector 1+2 (2012).

compared to other sites such as Akab, but a few specimens have been found in Level 12, thus confirming their local manufacture. A mother-of-pearl button (UAQ2.126) must also be mentioned among the other personal adornments made of seashells. Scrapers or knives made from the valves of *Callista* spp. consist of the only shell tools represented in this level.

Ubaid sherds are numerous at this level, including many painted potsherds, although they are poorly preserved and only show remaining traces of pigment most of the time. One rim sherd (UAQ2.466) (Figure 1.62 left) of a thin open bowl is decorated (on its external surface) with a herringbone pattern, which shows parallels with 'Ancient Ubaid' pottery styles (in particular to the Ubaid 2 stylistic phase). Another painted sherd (UAQ2.148) is decorated with a hatched band and a lozenge (Figure 1.62 right). It

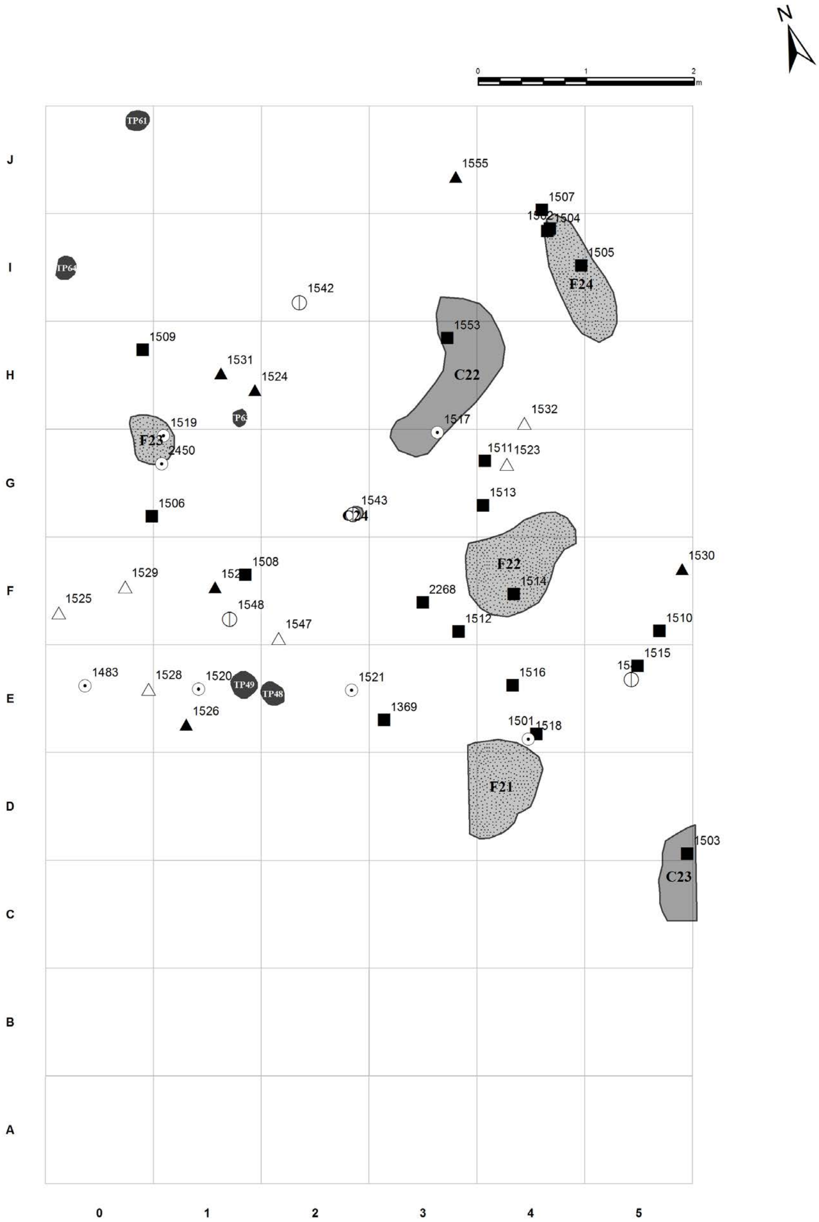


Figure 1.64. Plan of Level 11 in Sector 1+2.

can be compared to sherds that have been found at the neighbouring site of al-Hamriyah – another Neolithic shell midden which is located near Sharjah (UAE) (Jasim 1996: fig. 6). It is worth mentioning that UAQ2.148 seems to belong to the same decorated pot that other sherds that have been previously found in the section studied in 2009.

The lithic industry is well documented in Level 12. It is based on exploiting various lithic resources, including flint, chalcedony, and rock crystal. A large fusiform point made of chalcedony (UAQ2.556) has been found in this layer. Another broken specimen from Level 12 (UAQ2.2314) shows denticulations along its edges but could belong to a trihedral point. Many scrapers are attested among the other products composing the lithic assemblage: they slightly differ from specimens discovered in Levels 13 and 14 – as they are made on thinner blades and show shorter retouches (UAQ2.1527) (Figure 1.63). Several splintered pieces and borers are also present, and the latter are considered to have been used for producing shell beads during the Neolithic era. This specific use has been suggested, particularly at Akab, for producing disc beads made from mother-of-pearl and the valves of *S. spinosus* (Charpentier & Méry 2008).

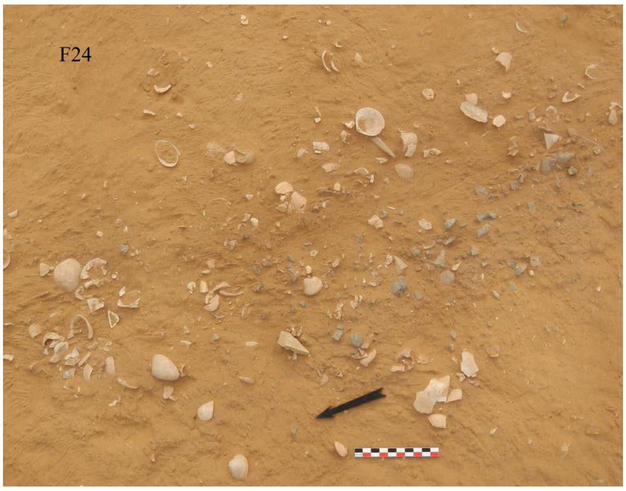


Figure 1.65. Hearth F24 in Level 11, Sector 1+2 (2012).

Figure 1.66. Bead made from a perforated *Polinices mammilla* shell (UAQ2.654) found in Level 11, Sector 1+2 (2012).

Figure 1.67. Potential remains of a shell bead bracelet found in square A2 in Level 11, Sector 1+2 (2012).

Among the groundstone tooling, several grinding stones (in beach rock and hardstone) sometimes show traces potentially caused by their use for the manufacture of shell beads (UAQ2.3073-4), a few fishing sinkers, a hammerstone, and a potential preform of stone adze (UAQ2.2305) have been found. It is also worth mentioning the presence of a softstone file (UAQ2.427) showing many traces of use. It is the first time such a tool has been found in the UAE – usually documented from later contexts in the Sultanate of Oman.

(Level 11)

Level 11 (Figure 1.64) was first identified in the deep-sounding section as a thin layer of greyish beige sand, a little dense in shell fragments (10% of the volume) with many *Marcia* spp. valves are lying flat. Remarkable quantities of *H. kuesterianus* shells have also been recovered at this level. The sand matrix appeared dark greyish brown during the extensive excavations and showed friable compaction. It contained numerous fragments of shells, including *T. palustris* and *Circe* sp., as well as many fragments of crab (carapaces and fingers) and fish remains.

The presence of architectural structures is tenuous compared to the previous levels (particularly Levels 12 and 13). A total of 5 post-holes (TP48-49, TP61, TP63-64) are registered and did not show any specific organisation. Human activities are evidenced by the presence of several hearths: two in Sector 3 (F16-17) and four in Sector 1+2 (F21-24) – they highlight the preparation and consumption of food (mainly seafood) during the occupation of Level 11. They measured from 50 to 125 cm in length and 40-80 cm wide. F21-23 were particularly rich in fragments of *Marcia* spp. and *H. kuesterianus* shells, while F24 contained several complete valves of *P. radiata* (Figure 1.65). The latter could have been collected for food and pearl fishing – since two pearls have been found in this level. Furthermore, concentrations of shells have been identified (C16 in Sector 3; C22-23 in Sector 1+2) – their direct exposure to fire is sometimes visible on charred bits. C22 seems directly associated with the use of F24, which consists of numerous fragments of burnt *Marcia* spp. shells lying flat in its close vicinity. Other domestic activities include evidence (rough-outs) of the manufacture of disc beads made from the shell of *S. spinosus*.

Most artefacts associated with Level 11 (nearly 800) have been found in Sector 1+2. They represent roughly twice the number found in Level 12. Several of the most diagnostic or unique ornaments found at UAQ2 come from Level 11. These include a black hardstone earring (UAQ2.2450), roughly flat, and which, as far as we know, has no comparable parallel in the whole Arabian Peninsula – being very different from the usual types recovered from

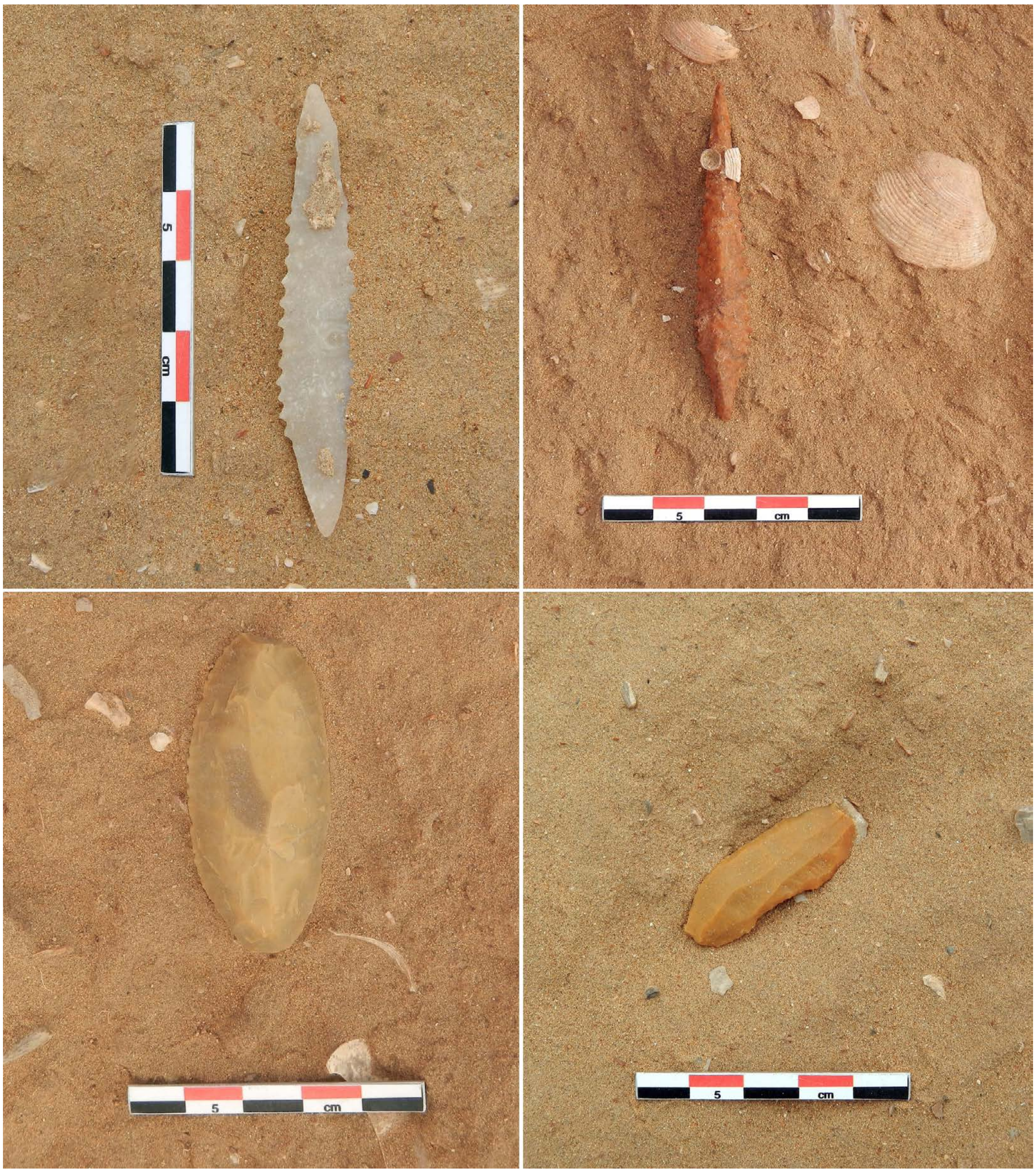


Figure 1.68. Examples of projectile points and scrapers on blade found in Level 11, Sector 1+2 (2012).

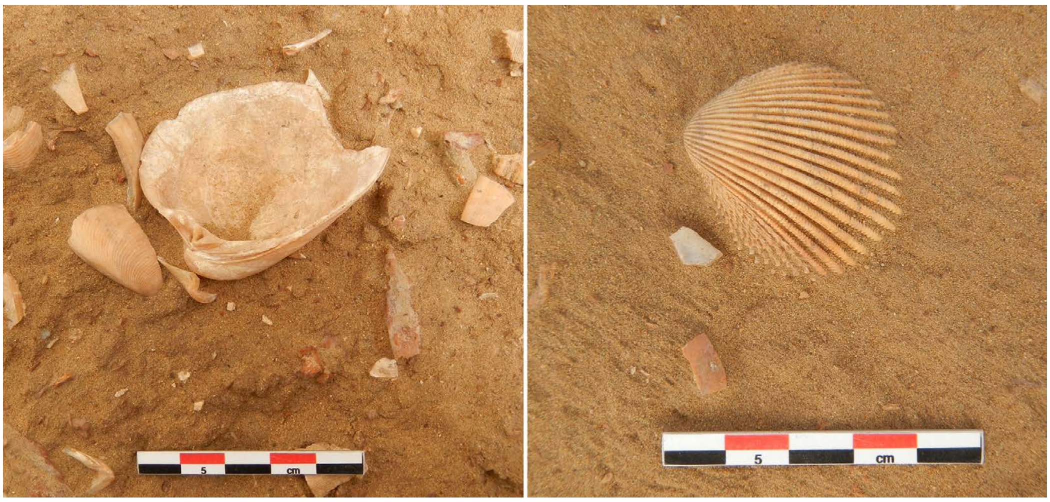


Figure 1.69. Examples of shell tools found in Level 11, Sector 1+2 (2012).

Figure 1.70. Cluster of stone fishing sinkers (C24) found in square G2 in Level 11, Sector 1+2 (2012).

Late Neolithic contexts in the Sultanate of Oman (during the 5th and 4th millennia BCE). A long tubular bead in softstone (UAQ2.441) was also recovered from this level – its morphotype has been documented at al-Buhais BHS18 (5th millennium BCE) (de Beauclair 2008a: fig. 8), but it is unique at UAQ2. Level 11 contained other unique items: a small haematite pendant (UAQ2.2451) and a bright red carnelian sphere (UAQ2.171), which has been perfectly polished – the latter are exceptional pieces discussed in more detail in Chapter 4. Another specimen made from a black stone (UAQ2.2037) has been found at the same level. Other adornments include a softstone disc bead and two pearls (UAQ2.1664; UAQ2.2728). The quantity of shell beads is remarkably high in Level 11 compared to the levels previously described. A difference in the shell taxa distribution can be observed: the *P. mammilla* beads are predominant (Figure 1.66), followed by the *C. persicus* apex beads and the *S. spinosus* disc beads. A cluster of 34 *C. persicus* apex beads (UAQ2.175-208), plus a *P. mammilla* (UAQ2.209) and a *Nerita* sp. (UAQ2.210) beads – potentially corresponding to the remains of a necklace or bracelet – has been found in square A2 (Figure 1.67). Other types include *E. mendicaria* and *D. octangulatum* beads – the disc beads made from the mother-of-pearl of *Pinctada* spp. valves are even fewer. Rare beads made from perforated shells of *Ancilla* sp., *Nerita* sp., and a *Naria turdus* (a cowrie shell) (UAQ2.1718) are also present.

The lithic assemblage is mainly composed of flint and rock crystal implements and debitage products, followed by chalcedony and chrysoprase. The other lithic resources are slightly better represented in Level 11 than in the older levels. We have chert, agate, radiolarite, and quartz – quartzite is also now attested. A few fragments of hardstone, schist, and an unworked nodule of massive haematite (UAQ2.2452) have been found – probably consisting of raw material exploited for producing stone adornments (UAQ2.2451 see above). Large quantities of crystal rock fragments have been found in squares B2 and ZZ1-2 in Sector 1, indicating their local transformation and use, although no finished products have been found at the site, but a flake. The knapping of rock crystal is challenging due to its very particular crystalline structure, and thus very few splinters are found. Projectile points are more numerous than in the previous levels. Most are elongated fusiform

Figure 1.71. Detail of the surface of Level 10, showing scarce seashell fragments but no archaeological structures, Sector 1 (2011).

types, showing denticulations along their edges, except for one (UAQ2.1522; UAQ2.1526) (Figure 1.68). Both types, however, belong to the same standardised production module of large fusiform points. The numerous scrapers in this level consist of various kinds, whose shapes appear more or less standardised. However, elliptical scrapers on blade are still present (UAQ2.1523; UAQ2.1528) (Figure 1.68). Tooling also includes borers and splintered pieces. Shell tools include many scrapers or knives in *Callista* spp. and *A. violascens* valves, as well as *V. lacunosum* and ark shell (Arcidae) valves (Figure 1.69), which could have been used either as spoons or small containers – their potential use as scraping tools has been suspected but this assertion remains to be confirmed through use-wear analyses. Two milling stones have been found among the groundstone material, plus a crushing stone, which is another type of rare item at UAQ2, but recurring within Neolithic contexts in Eastern Arabia, where it has been sometimes associated with the crushing of marine mollusc shells to access their meat, in particular for *T. palustris*. The tool kit includes grinding stones, a cluster of stone fishing sinkers (C24 in square G2) (Figure 1.70), and bone points. The potential presence of stone vessel fragments from this level is also worth mentioning.

Regarding pottery finds, Ubaid sherds are numerous, with several specimens being painted. Three potsherds of the same vessel are decorated with a single horizontal band. A ledged rim is decorated with an undulated line between two horizontal lines (UAQ2.1515), which could correspond to a Ubaid 3 pattern (see Chapter 4 for more detail). Other distinctive patterns include a 'double ladder' or a 'zigzag ladder' decoration (UAQ2.2508) – standard among the Ubaid 3 as well – and a dense grid (UAQ2.1604) which is more characteristic of the Ubaid 2 style.

(Level 10)

Level 10 has been excavated in all the sectors and test trenches except Sector 4 – it corresponds to SU 19 in the deep-sounding section. It consists of a thin layer (3-5 cm thick) of greyish beige sand with a few (*c.* 2%) small *Marcia* spp. and *H. kuesterianus* shell fragments. No post-holes, fireplaces, or concentrations of shells have been identified despite the significant number of artefacts collected (*c.* 500) (Figure 1.71).

Personal adornments include numerous perforated shells of *P. mammilla* used as beads, followed by *S. spinosus* disc beads, plus several rough-outs indicating their local production. Other types include tusk shell beads (*D. octangulatum*), sometimes with polished sides (the 'barrel shaped' beads), and a few perforated *E. mendicaria*, *Nassarius* sp. and *Nerita* sp. shells. A pearl was also discovered in this level (UAQ2.1663). Adornments in stone include several disc beads and three polished black stone spheres (UAQ2.2038-40) comparable to the specimens found in Level 11 (UAQ2.171, UAQ2.2037, see above). Interestingly, this level has found a tiger shark (Galeocerdo cuvier) tooth (UAQ2.648). However, the latter does not clearly show modification traces (particularly abrading and drilling traces). It is thus quite unlikely that the latter has been used as a personal adornment (see for comparison the specimen from MR11 published in Lidour 2023: fig. 4 n°3) – although it could have been collected and kept to be worked later. Nevertheless, it confirms that fishing sometimes allowed the capture of huge sharks during the Neolithic (on that particular issue, see Lidour & Beech 2019).

Rock crystal knapping is evidenced in several areas of the site but mainly concentrated in a single square of Sector 1 (ZZ3) – close to ZZ1-2, where a concentration of rock crystal fragments has been already identified in Level 11, thus probably consisting of the same event. The lithic resources are found in the same proportions as for Level 11, although we observed a diminution of the chalcedony. Other lithic resources consist of hardstone fragments, including haematite. The tool kit includes a single broken projectile point (UAQ2.2160) belonging to a fusiform type showing denticulations. The other lithic implements are less standardised than the previous levels – a single elliptical scraper on blade has been found (UAQ2.2198), which marks a variation with Level 12. Many splintered pieces have been found as well. Groundstone implements comprise many grinding stones, a few stone fishing sinkers, and a hammerstone. Tooling also consists of shell tools – as usual, they include scrapers or knives made from the valves of *Callista* spp., as well as *V. lacunosum* and ark shell valves, potentially used either as scrapers or as small containers (possibly spoons). The number of Ubaid sherds is much lower than in the previous level, but they are present in all the sectors. No painted sherd was uncovered, except for one with traces of a black paint band.

(Level 9)

Level 9 was excavated only in Sector 1+2. It corresponds to SU 18 in the deep-sounding sequence. It is *c.* 3-5 cm thick and composed of a thin layer of greyish-beige sand. It is relatively dense in small shell fragments (10% of the volume), belonging mainly to *Marcia* spp. and *S. cuccullata* (Figure 1.72). This layer did not contain vestiges of architectural installations – no post-holes, fireplaces, or concentrations of shells or other contents. No proper occupation floor was identified. However, rough-outs of disc beads made from mother-of-pearl and the valves of *S. spinosus* point to the presence of bead-making industries at this level.

Beads made from perforated shells of *P. mammilla* are more numerous than *S. spinosus* disc beads. Personal

Figure 1.72. Detail of the surface of Level 9, showing denser deposits of shell valves lying flat, Sector 1 (2011).

Figure 1.73. Removal of Level 8 in Sector 1 – the dense accumulation of sand visible in the section (2011).

adornments include several beads made from perforated shells of *E. mendicaria*, from the apex of *C. persicus* shells, and segments of *D. octangulatum* shells. A softstone disc bead completes the personal adornment assemblage. A pearl was also found in Level 9 (UAQ2.1311). Other finds include shell tools (*Callista* spp., *V. lacunosum*, and Arcidae shells). Several fishing sinkers have also been found. This layer also attests to grinding stones and fragments of beach rocks that could have been used as abrading tools in the manufacture of shell beads. The number of Ubaid sherds greatly falls in level 9. Among them, one rim sherd is painted; it belongs to an open bowl showing a herringbone pattern decoration on its external side (UAQ2.554).

The lithic industry is less represented than in Level 10, with the same variety of resources – but the chalcedony is less represented. Among tool types, the quantity of splintered pieces is noticeable. The rarity of the projectile points is outstanding: a single fusiform (UAQ2.1550) is shorter than most points coming from levels 10 to 12. The presence of a single elliptical scraper on the blade (UAQ2.109) must also be mentioned.

(Synthesis)

In all aspects, Levels 14 to 9 are similar and nearly homogeneous in terms of their contents. They correspond to the same kind of domestic and residential occupations and activities. The production of shell disc beads and the lithic industry, including the exploitation of rock crystal, are identified in almost all levels. It, however, excludes the projectile points and the elliptical scrapers on the blade, whose productions do not seem to have taken place on-site. It is not possible to distinguish the levels based on their types of artefact and on the nature of lithic resources that have been exploited. Regarding the shell beads, the taxonomic distribution is relatively stable or statistically insignificant, suggesting their manufacture did not change through time. Rare and probably more prestigious items unique to UAQ2 cannot be considered evidence of cultural change as they appear in the most quantitatively rich levels. One can thus assume that no apparent evolution occurs within the material culture in Levels 14 to 9 – allowing us to define a Phase B associated with a repeated occupation of the same area of the site over several seasons, years or, potentially, generations (although it remains impossible to be precise about the duration of each occupational event).

Mobility – either residential or logistical – is suggested by the diversity of lithic resources obtained, which cannot be exploited locally. We hypothesise a catchment distance of no more than 50-60 km, based on surveys made by Charpentier *et al.* (2017) farther inland, particularly on and around the Jebel al-Ma'taradh. The *E. mendicaria* shell beads also provide a good indicator of mobility or contacts with Neolithic groups inhabiting other areas of Eastern Arabia, as this marine gastropod is not locally available in Umm al-Quwain but only encountered along the Sultanate of Oman, according to its current distribution (Bosch *et al.* 1995: 128, n°522). If the hypothesis of contacts with the Sultanate of Oman is confirmed, then it does not help explain why Ubaid pottery was not exchanged with populations living on the other side of the al-Hajar mountains, but only diffused among groups living in the Arabian Gulf. Further research is thus necessary to solve regional mobility and exchange network issues during the Neolithic.

Radiocarbon dating on marine shell samples (calibrated using a reservoir effect correction) suggests that Phase B is chronologically between *c.* 5400/5200 and 5000 BCE. This is supported by the results of the pottery analysis, including the decoration of several painted potsherds that match the Ubaid 2 and 2/3 stylistic phases.

Phase C (Level 8)

Following the well-defined residential floors associated with Phase B, Level 8, which consists of the unique layer of Phase C, presents a distinct aspect. This difference may be attributed to one or more settlement floors that were likely disturbed during the reactivation of the dune under an aridification phase.

Level 8 is a thick layer (up to 30 cm) of yellow sand (Figure 1.73). It corresponds to SU 17 in the stratigraphic sequence obtained in the deep trial trench. This layer is homogeneous in its composition. It seems to have rapidly developed and might correspond to a phase of aridification associated with strong wind-blowing events and leading to significant changes in the local environmental conditions. A comparable accumulation of sand was detected at UAQ38 (SU 22) in 2018 (Degli Esposti *et al.* 2019), showing that such a phenomenon might have impacted all of the northern UAE (see Chapter 3).

There was no detailed planimetric excavation of this level, but all the material was sieved at 2 mm. No post-holes were found, only a single large fireplace in the form of a large ash patch. Disc bead manufacture and lithic knapping industries have continued during Phase C.

Level 8 provides *c.* 700 items. It consists of the richest level of UAQ2 after Level 11. It includes many personal adornments, with a distribution quite similar to Phase B: *P. mammilla* beads are twice as numerous as disc beads made of *S. spinosus* shells. Other shell beads include perforated shells of *E. mendicaria*, *Conus ebraeus*, *Ancilla* sp., *Nassarius* sp., Columbellidae, annular beads made from the apex of *C. persicus*, and segments of *D. octangulatum*. Adornments also consist of beads and pendants in both softstone and hardstone – including a few potential rough-outs (UAQ2.827). Shell tools are numerous in this level: mostly made from *Callista* spp. Valves, plus some *V. lacunosum* and ark shells (Arcidae). A remarkable perforated disc made in camel bone (UAQ2.555) has been found – it constitutes a unique piece at UAQ2 and has been hypothetically interpreted as a spindle whorl.

The number of pottery sherds remains high: it includes two specimens that have been painted on their external surface. UAQ2.965 has a motif composed of two parallel bands (one is larger) and the beginning of two triangles. Comparison is possible with Ubaid 2/3 and 3 patterns from Mesopotamian sites: at Tell el-Oueili (Lebeau 1991: pl. 5 n. 13, pl. 10 n. 14), Level 10 of Eridu (Safar *et al.* 1981: fig. 86.9), and Level 2 of Tell Abada (Jasim 1985: fig. 127g). The second sherd is very small, showing a painted black band (UAQ2.873).

The lithic industry is mainly based on the exploitation of flint, followed by substantial quantities of chalcedony and chert that are better represented than in level 9. Other types of lithic resources are rare. Splintered pieces consist of almost half of the lithic tool kit. Borers and scrapers are also identified.

Figure 1.74. View of Level 7 in Sector 1 with the location of C3 and C4 (clusters of burnt stones) (2011).

Figure 1.75. View of the South section of Sector 1 prior to the removal of Level 6 – a dense accumulation of sand which is visible in the upper half of the section (2011).

Level 8 is associated with the reactivation of the dune activity and the likely erosion of late Phase B levels.

Phase D (Level 7)

Phase D corresponds to a single occupation but well-defined layer. Level 7 is a very thin (up to 10 cm) layer of light grey sand. It provided quantities of *H. kuesterianus* and *S. cuccullata* shells, while those of *Marcia* spp. and *T. palustris* are relatively scarce. Two concentrations (C3 and C4) of burnt stones were located in Sector 1+2 (Figure 1.74). No fireplaces or postholes have been identified.

The quantity of objects is relatively moderate in this level, consisting of less than 200 artefacts. The most remarkable find is a shellfish hook (UAQ2.1012) made from a *P. persica* valve. Shellfish hooks are considered an excellent chronological marker for the Late Neolithic in Southeast Arabia, especially in the Ja'alan region, where they have been abundantly documented over the last decades. The latter are more rarely found in the Arabian Gulf, being only restricted to the northern UAE sites between Umm al-Quwain and Ras al-Khaimah, including at Akab, where their manufacture took place during the second half of the 5th and the 4th millennia BCE (Charpentier and Méry 1997; Méry *et al.* 2008; Lidour *et al.* 2020a).

Marine shells have also been exploited to produce personal adornments, as shown by the discovery of several perforated shells of *P. mammilla*, *Ancilla* sp., and *E. mendicaria*, as a small specimen of *Conus* sp. Other adornments in seashells include disc beads made from the valves of *S. spinosus* (including some rough-outs) and, less frequently, of *Pinctada* spp. Some 'barrel-shaped' beads, identified as polished segments of *D. octangulatum* shells, are also counted among the finds. In contrast to the other Phases B and C levels, stone beads are slightly better represented in level 7. Ubaid sherds are still present in this level, including a painted body sherd showing a painted decoration of two black bands (UAQ2.1144).

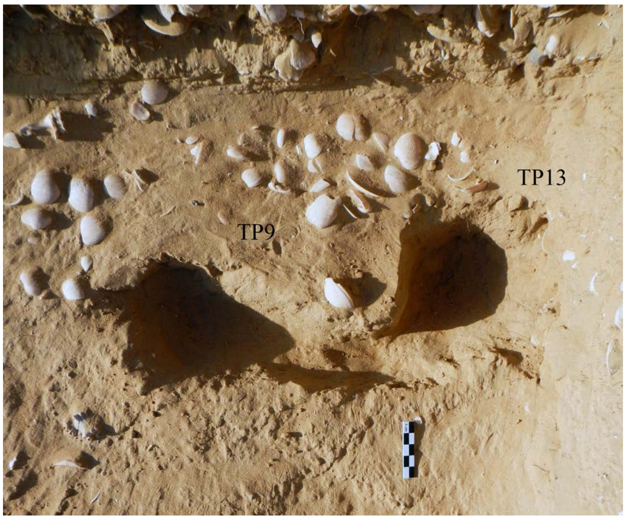


Figure 1.76. Post-holes TP9 and TP13 associated with Level 6 in Sector 3 (2012).

Figure 1.77. Short fusiform point (UAQ2.906) found in Level 6, Sector 3 (2012).

The two bands are very close, one larger than the other, recalling some Ubaid 3 and 4 patterns. There is a similar distribution of the lithic resources – waste products associated with the knapping of rock crystal are still present but scarcer than in the earlier levels. A scraper on blade merits notice (UAQ2.2742). Two hammerstones and a single fishing sinker must be mentioned among the groundstone tooling. The remaining material comprises the usual grinding stones and shell tools (*Callista* spp. scrapers, knives, and potential spoons in *V. lacunosum* valves).

Phase E (Level 6)

This phase is constituted of a single level. Level 6 is a thick accumulation (up to 30 cm) of yellowish-brown sand, distributed into two main layers separated by a thin lens of *Marcia* spp. valves lying flat (Figure 1.75). The whole level seems to have developed fast, as has been suggested for level 8.

Two post-holes (TP9 and TP13) are reported from Sector 3 (Figure 1.76), evidencing the presence of structures but not allowing us to interpret them as the remains of a residential occupation at the site. For this reason, there was no detailed planimetric excavation of this level in Sector 1+2, but all the material was sieved using a 2 mm mesh.

Despite the thinness of the layer and the volume of sediment excavated, a small amount of artefacts have been registered: *c.* 200. Shell beads are particularly abundant in this assemblage, which consists mainly of perforated shells of *P. mammilla*. Strikingly, only one complete disc bead in the *S. spinosus* shell was found despite many rough-outs, blanks, and waste products, evidencing that different stages of the manufacturing process have occurred in level 6. Other beads include perforated shells of *E. mendicaria*, *Ancilla* sp., and segments of *D. octangulatum*. Ubaid pottery includes two painted sherds with no identifiable pattern. Shell tooling consists of *Callista* spp. valves used as scrapers or knives, and *V. lacunosum* or ark shells (Arcidae) valves are potentially used as small containers (e.g. spoons). Among the lithic industry, radiolarite is now the most represented resource used after flint – it consists of a significant change in the raw material procurement strategy. The other types of lithic resources attested in the older levels are present, but now in very small amounts; moreover, quartz and quartzite are absent. Regarding the lithic tooling, splintered pieces constitute the most significant part of the assemblage. Only one scraper on the blade and one projectile point have been found – the latter is a rare short fusiform point with no denticulations (UAQ2.906) (Figure 1.77).

Phase F (Levels 5-1)

(General)

The following levels (5 to 1) are characterised by huge accumulations of shells separated by sandy but thin layers or lenses. This new configuration, which is more in line with what we classically imagine to be a 'shell midden', can be interpreted as a new model of occupation of the site.

The subsistence economy seems further based on exploiting inshore waters obtained from the inner lagoon and the mangrove; there is evidence of domestic and residential occupation, but few – concentrated in Level 3 of Sector 4. The levels consist of numerous layers resulting from a continuous build-up of waste from shellfish preparation and consumption. The layers and lenses are associated with many different occupations of the site, including brief events, more than likely. After their deposit, they were naturally compacted due to taphonomic processes (in particular, the deflation of the sand matrix). According to the smaller quantities of fish and terrestrial mammal remains (Chapter 5), each seasonal occupation's duration seems shorter compared to the levels associated with Phase B.

In addition to the object categories and manufacturing techniques that existed in the most ancient levels at UAQ2, we observe the appearance of new types of artefacts, including softstone earrings of a new morphotype (cf. UAQ2.2022-3). We also observe a change in lithic resource procurement and use (see Chapter 4).

(Level 5)

Level 5 is a thick layer (up to 40 cm) of a yellowish-brown, fine sand matrix. Compared to level 6, the density of discarded shells is slightly more important (usually between 2% and 5%, but occasionally up to 50%). Valves of *Marcia* spp. represent two-thirds of the shell waste, followed by *T. palustris* and *H. kuesterianus* shells in the taxonomic distribution. A single hearth has been identified (F12) in Sector 3 (Figure 1.78). It measured *c.* 70 cm in length by 60 cm wide and contained no remarkable find, only a few burnt shells in a thin layer of ash.

Ubaid pottery is rare in Level 5 and does not include decorated sherds. Other finds include lithic implements, mostly made from radiolarite, chert, flint, and, more rarely, from chalcedony. Splintered pieces are few within the assemblage of this level, and the discovery of a micro-borer is sufficiently rare during Phase F to be mentioned. Several shell beads have been found, mostly made from *P. mammilla* and *S. spinosus* shells – a single *E. mendicaria* shell bead is also mentioned. Other artefacts include several specimens of shell tools in *Callista* spp. valves.

(Level 4)

Level 4 is a thick layer that reaches up to 50 cm at the top of the site. It is composed of a yellow-brown, fine sand matrix associated with dense deposits of seashells (up to 50% of the volume) (Figure 1.79). It is composed of several sub-layers and lenses of seashells, frequently burnt. The shell assemblage is composed mainly of *Marcia* spp. valves (*c.* 70%), followed by *T. palustris* and *H. kuesterianus* shells. Two concentrations of shells have been identified (C11 and C20).

Artefacts mainly consist of lithic debitage in radiolarite and, less frequently, of flint. A splintered piece, another retouched flake, and a single projectile point belonging to the type 3 defined at UAQ2 (UAQ2.1223) (see Chapter 4) have been found in Sector 1. Ubaid sherds are very rare (a single body sherd identified). Among the most remarkable findings, we can mention the presence of two shell beads (a perforated shell of *P. mammilla* and a segment of *D. octangulatum*). Other finds include several specimens of shell tools in *Callista* spp. valves, and some grinding stones.

(Level 3)

Level 3 is a thin (*c.* 3 cm) and almost sterile layer in Sector 1 – it is composed of a few valves of *Marcia* spp. in a fine, yellowish-brown sand matrix (Figure 1.80). It is, however, measuring up to 14 cm thick in Sector 4 – farther on the top of the shell midden – where more remarkable finds have to be mentioned. They include a shellfish hook (UAQ2.1549) made from a *P. persica* valve and two fragments of softstone earrings (UAQ2.2022-3). Both shellfish hooks and softstone earrings are good indicators of the Late Neolithic cultural period as documented in the Oman Peninsula from the 5th millennium BCE onwards.

These finds are associated with a layer where remains of dwellings constituted of almost 40 post-holes found arranged in a bow (Figure 1.81) – thus probably resulting from multiple adjustments or repairs of the same housing structure over time (over several months, years?). It constitutes better evidence of a residential occupation at UAQ2 during the second half of the 5th millennium and the first centuries of the 4th millennium BCE. Concentrations of shells have also been reported from Sector 4, including C10, which has provided both *Marcia* spp. valves and a few mammal bones. Several fireplaces were also associated with level 3: F11 and F18 measured *c.* 70 cm in length by 45-60 cm wide and are relatively shallow (10 cm deep). They contained ashes and burnt *Marcia* spp. shells. F10 is a smaller fireplace, *c.* 30 cm x 30 cm, but includes only a few terrestrial mammal bones.

Among the other finds associated with level 3, the lithic is composed mainly of radiolarite and a few chert, flint, and chalcedony flakes and fragments – with a single splintered piece as a tool. We can, however, mention the discovery of a remarkable, partially polished adze in haematite (UAQ2.770) in Sector 1. The tooling also includes shell specimens (*Callista* spp. and *V. lacunosum*). A few shell beads are also present: a single perforated shell of *E. mendicaria* and another specimen of Columbellidae.

(Level 2)

Level 2 comprises several sub-layers and lenses of shells, sometimes heavily crushed and burnt (Figure 1.82). The sand matrix is a yellowish-brown, fine sand associated

Figure 1.78. Hearth F12 in Level 5, Sector 3 (2012).

Figure 1.79. Level 4 in Sector 1, showing dense deposits of seashells (2011).

Figure 1.80. Level 3 in Sector 1, showing lesser dense deposits of seashells in a fine yellowish brown sand matrix (2011).

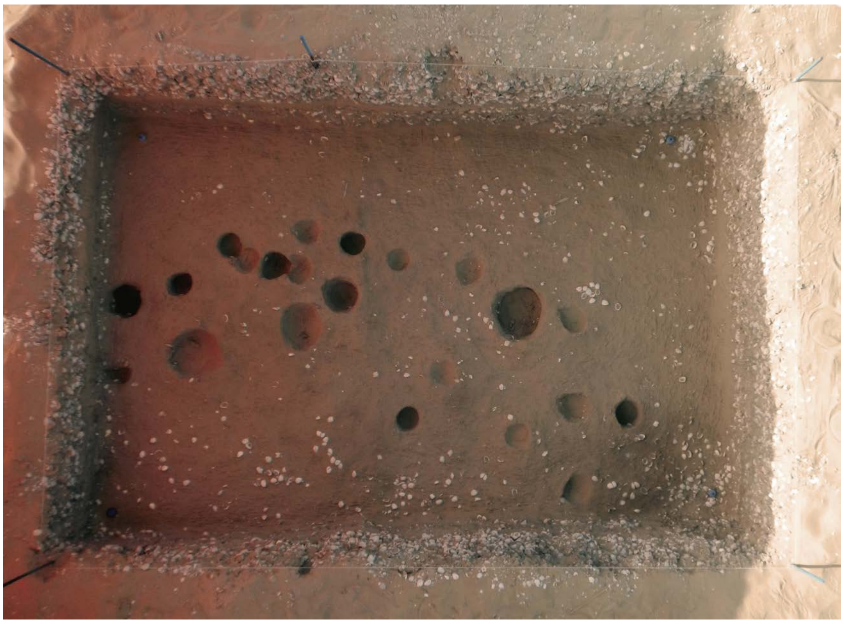


Figure 1.81. Aerial view of Level 3 in Sector 4 with the remains of rounded dwellings evidenced by the presence of numerous post-holes (2012).

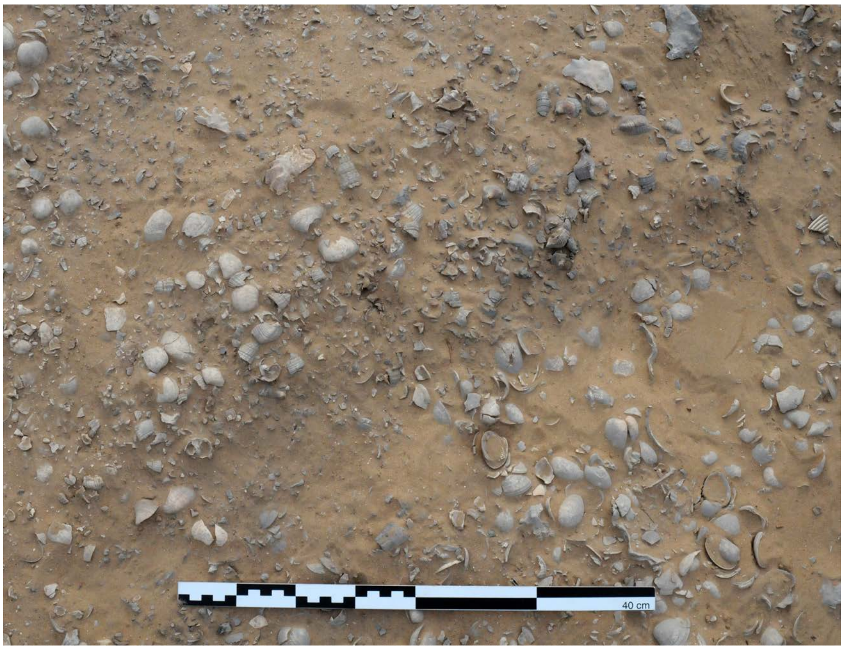


Figure 1.82. Level 2 in Sector 1, showing dense deposits of burnt and crushed seashells (2011).

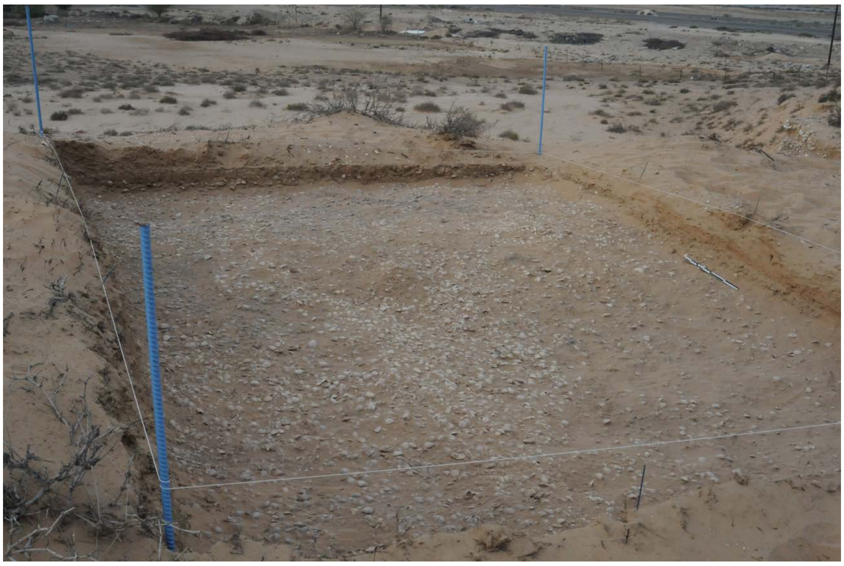


Figure 1.83. Detail of Level 2 in Sector 1 (2011).

Figure 1.84. Shell concentration C5 in Level 2, Sector 3 (2011).

with dense deposits of seashells (up to 25% of the volume) (Figure 1.83). The level is up to 20 cm thick and consists of the latest well-defined anthropic layer of the site. Venus clams (*Marcia* spp. mainly) shells dominate the malacological assemblage (*c.* 95%). The other main taxa include *S. cuccullata*, *H. kuesterianus*, and *T. palustris* – each consisting of *c.* 2% of the corpus. This composition differs significantly from what can be observed in Levels 4 and 5. The human occupation is exclusively related to the processing and consumption of seafood, principally marine molluscs, with no architectural remains found. A concentration of mostly intact *T. palustris* shells (C5) has been observed in Sector 3 (Figure 1.84).

Similarly, the artefacts, mainly lithic debitage and tools, are scarce. It includes a flint sidescraper, a splintered piece, and many flakes and chunks of radiolarite. A few grinding stones and a unique stone fishing sinker in beach rock are also reported. Other finds include several Ubaid sherds, including a painted specimen showing a narrow black band just below its rim (UAQ2.716+718). The presence of a pearl (UAQ2.687) and some shell beads (perforated shells of *P. mammilla* and polished segments of *D. octangulatum*) is also worth mentioning.

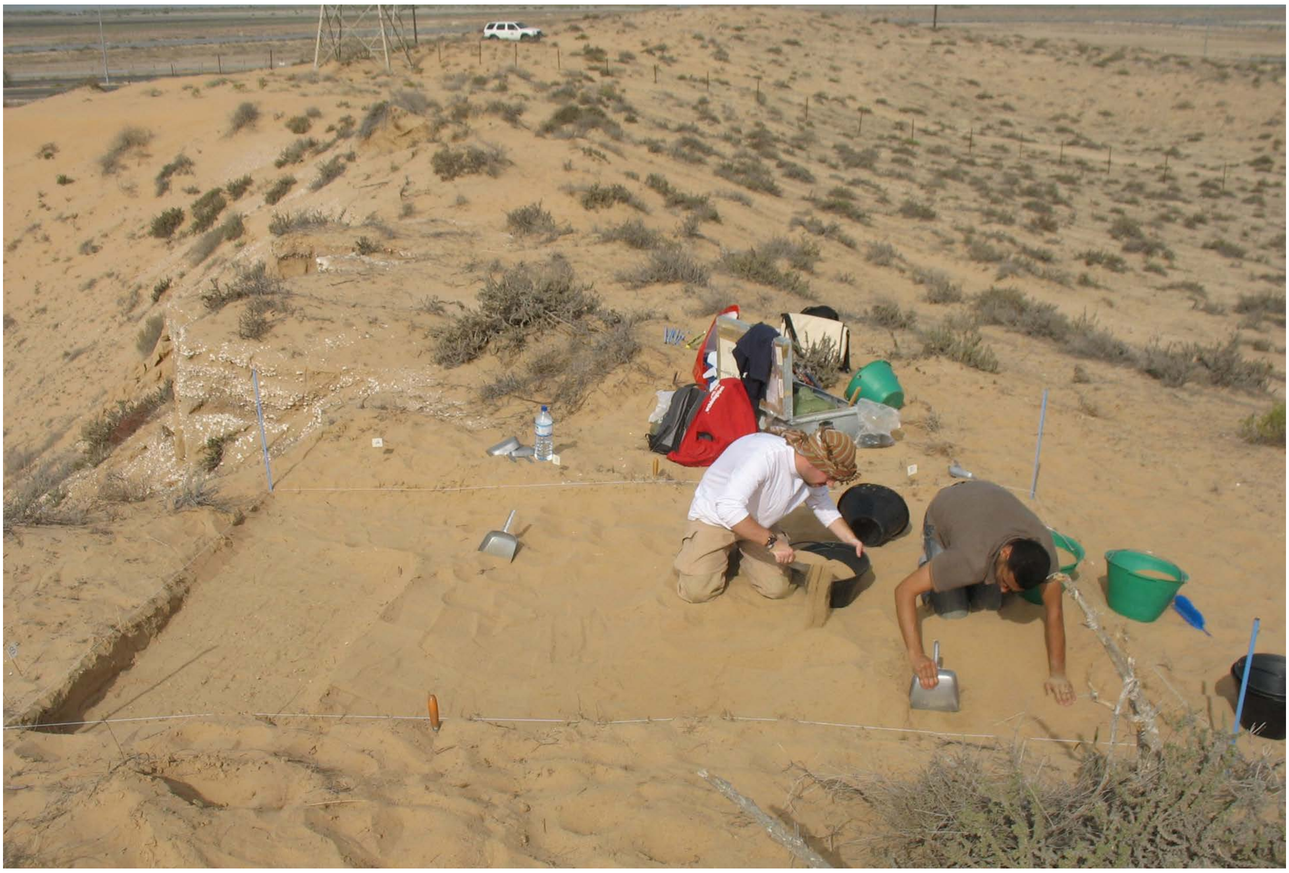


Figure 1.85. O. Brunet and H. Attia Edris excavating Level 1 (top layer of the site) in Sector 1 (2011).

(Level 1)

The sub-surface level is entirely eroded in most of the upper parts of the site. It has been identified in Sector 1 and on parts of Sectors 2, 3, and 5, with a maximum thickness of 20 cm – it was entirely eroded in Sector 4. The level is composed of an aeolian, medium-coarse sand layer showing very loose compactness (Figure 1.85). It has a yellowish-brown colour. It is almost sterile in archaeological material. This level contains very few artefacts: some *Callista* spp. shell tools – plus a specimen made from a *Mimachlamys* sp. valve – a single *P. mammilla* bead, as well as some rare vestiges of lithic debitage.

(Synthesis)

Levels 5 to 1 consist of dense layers of marine shell deposits associated with relatively little evidence of architectural structures and material culture compared to the older phases. It highlights an essential change in the occupation mode at UAQ2 and, probably, in the mobility patterns and the associated subsistence strategies regarding herding and exploiting marine resources. The main activity documented is the intensive preparation and consumption of marine molluscs – in particular of small bivalves such as *Marcia* spp., evidencing that most shell gatherings have been carried out in intertidal flats located in the lagoon. According to the lesser quantity of fish and terrestrial mammal remains recovered in these levels, the duration of each occupation is likely shorter compared to the levels associated with Phase B. There is a substantial increase in the proportion of *Marcia* spp. shells between Levels 8-7 and 5, possibly reflecting a change in the environmental conditions (associated with greater aridity) or the subsistence strategies at site scale. Multiple episodes of reoccupation of the site are suggested but cannot be properly distinguished or numbered without a very detailed and long excavation, impossible to do because of the small size of our team and time constraints. Moreover, except for food preparation, the domestic activities are less documented and diversified than during Phase B. The anthropic occupation is presumably related to a different mobility cycle of the human groups, based on briefer installations on the site. This does not contradict the architectural presence of the structure, as shown by the 39 post-holes organised in a semi-circle and associated with Level 3 in Sector 4. The organisation of the post-holes indicates repair work or reinstallation of a probable dwelling on the same site area during a 'relatively' prolonged duration – such structures are not documented in the other levels of Phase F.

Radiocarbon dating on marine shell samples indicates that the latest phase of occupation at UAQ2 occurred between the second half of the 5th and the first centuries of the 4th millennium BCE – excluding Level 1 which is Early Bronze Age (see Chapter 3). It is supported by diagnostic artefacts for the Late Neolithic, such as softstone earrings and shellfish hooks that only appeared during the 5th millennium BCE, according to published information from the Sultanate of Oman.

The UAQ2 Graveyard – Biological anthropology and funerary practices

S. Méry, K. Lidour, K. McSweeney

Introduction

The site of UAQ2 was discovered in 1992 during test pits performed on shell middens in the Umm al-Quwain coastal area. The first seasons of excavations were undertaken in 1992 and 1993 by C.S. Phillips and P. Treveil (Phillips 2002). Over 40 Neolithic buried individuals were recorded and excavated, plus faunal remains and artefacts, which provided a preliminary site dating to the regional Neolithic period. The chronological attribution was based on Mesopotamian pottery sherds found during the excavations – identified as belonging to the Ubaid tradition and indicating a late 6th-4th millennia BCE occupation at the site according to Oates' (1960) chronology. Radiocarbon dating could not be obtained at the time because of the absence of archaeological charcoal.

When resuming the UAQ2 excavations in 2012-2013, our team found further human skeletons below the level previously reached by Phillips and Treveil. Some of the bodies seemed to have been buried together in a single event. This discovery led us to question the meaning of multiple graves in the Eastern Arabian Peninsula during the Neolithic and, more broadly, the use of certain terms in funerary archaeology.

Defining certain terms used in funerary archaeology in the Arabian Peninsula is essential. The interpretation of burials of the Bronze Age and Iron Age as collective burials is not in doubt, but the presence of collective burials in the Neolithic remains to be demonstrated. For this period, all that has been witnessed is the use of individual graves, double graves (two deceased interred simultaneously) and multiple graves (more than two interred simultaneously). Such cases are known at al-Buhais BHS18 (Emirate of Sharjah, UAE), Ras al-Hamra RH5, Wadi Shab GAS1, and, possibly, Suwayh SWY1 (Sultanate of Oman) (Charpentier *et al.* 2003; Gaultier *et al.* 2005; Kiesewetter 2006; Salvatori 2007; Munoz & Usai 2020). However, Area 43 at RH5 remains too poorly documented in the literature (Santini 2002) for a definitive interpretation, and the same applies to the excavations conducted in the early 1990s at UAQ2 (Phillips 2002).

Therefore, we propose distinguishing the term *collective burial*, associated with funerary practice (i.e. a succession of gestures), from the *collective tomb*, which is a structure (constructed or not constructed). The *necropolis* – according to its usual definition in European Protohistory – is a suitable term for the context of the Neolithic and Bronze Age in Eastern Arabia. Anthropological field methods on collective graves were developed in France in the 1970s by Duday (1995; 2005), Leclerc (1990; 1999), Chambon and Masset (e.g. Leclerc & Chambon 2003; Leclerc & Masset 1980), but have only been used recently in Arabia at Hili North (Emirate of Abu Dhabi, UAE) from 1998 to 2006 (Méry *et al.* 2001; McSweeney *et al.* 2008). In the early 2000s, the same method was applied at Ras al-Jinz RJ1 (Sultanate of Oman) (Munoz & Cleuziou 2008).

In the UAE and the Sultanate of Oman, the confirmation of Protohistoric collective burials has been easy to ascertain for periods following the Late Neolithic, from 3300/3200 to 3100/3000 BCE (depending on the conditions of preservation of the graves and their contents, as well as the methods of excavation, sampling, storage, and dating, cf. Munoz 2019). They date from the Early Bronze Age (Hafit, *c.* 3100/3000-2700/2600 BCE; and Umm an-Nar, *c.* 2700/2600-2000 BCE), Middle Bronze Age (Wadi Suq, *c.* 2000-1700/1600 BCE), Late Bronze Age (*c.* 1700/1600-1300 BCE), and Iron Age (*c.* 1300-1000 BCE). Our evidence comes from the fact that most of the collective tombs of these periods were stone-built and constructed above ground, or partially above ground. Therefore families, or whoever, had to reopen closed features, possibly hundreds of occasions, to enter the tombs and deposit new bodies. Within these structures there were accumulations of bones, some relatively disturbed, some very, perhaps representing hundreds of groups of articulated bones (we can exclude that they were mummified, because of the climate-related conditions of decomposition); occasionally large parts of skeletons, or even entire ones, might be preserved, such as at Tell Abraq (Emirate of Sharjah, UAE) and Tomb A at Hili North (Potts 2000; McSweeney *et al.* 2008).

The second type of collective burial tomb known from the Early Bronze Age is the lined pit. This tomb type was identified following the resumption of excavations at a large, Early Bronze Age pit (Hili North) dated to *c.* 2200-2000 BCE, i.e. the end of the Umm an-Nar Period (Méry *et al.* 2001). Another lined pit with collective burials was found at Mowaihat (Emirate of Ajman, UAE) (Haerinck 1991b).

Neolithic tombs in Eastern Arabia are differentiated from those of the Early Bronze Age by their architecture, methods of deposition of the bodies, and the methods used to recover them.

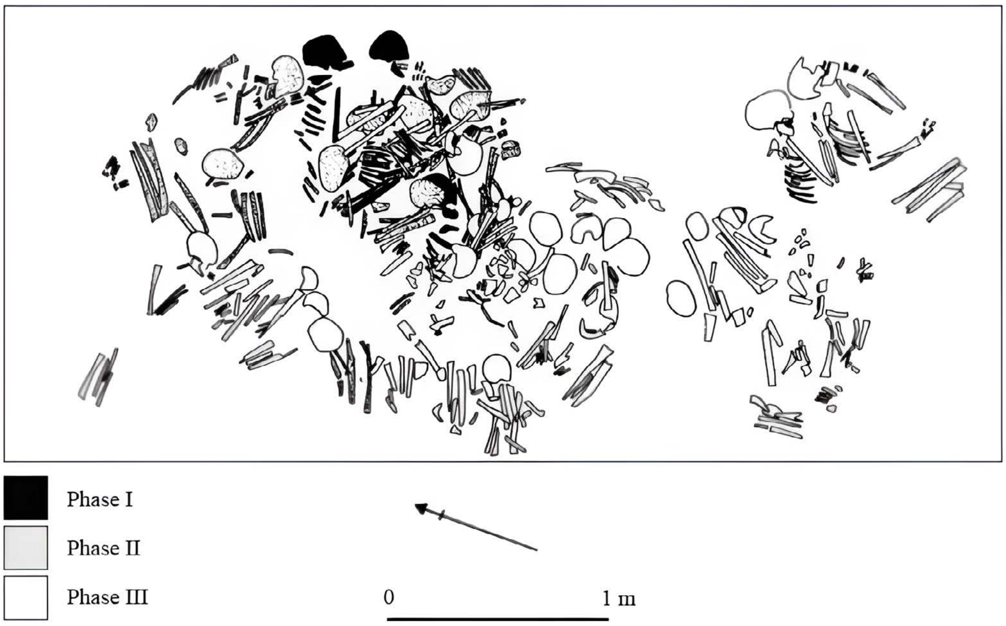


Figure 2.1. Plan of the UAQ2 graveyard excavated in the early 1990s. Credit: C.S. Phillips.

- These are structures in non-lined pits dug into various types of natural sediment soils – sandy/shelly anthropic sediments of shell middens along the coasts (Emirates of Ras al-Khaimah and Umm al-Quwain in the UAE; regions of Muscat, and the Ja'alan in the Sultanate of Oman); sandy-clay and rocky soils of the interior (only one known case, at BHS18).
- The bodies are then covered with sand or other materials, such as plants and animal deposits, by the burial attendants.
- The tombs are sometimes sealed with stones, i.e. at SWY1 and RH5.

We propose reserving the term *collective burial* for deposits that represent *the final act of burial in a designated place* (such as a stone-lined feature, i.e. at Hili N) closed after each deposit, but not filled with sand, and having to be reopened each time to incorporate new burials. These collective graves must include primary burials but can also include secondary burials. Such is the case with the Early Bronze Age (end of the Umm an-Nar period) Hili North tomb, which contained mainly, if not exclusively, primary burials, and Tomb B at Mowaihat, which contained primary burials.

The term *tomb emptying* will be reserved for *graves that contain only secondary burials*, where it can be shown that the bones they contained had been redeposited from elsewhere. Such tombs are known from the Umm an-Nar period, at least during the last two-thirds of this period, at al-Sufouh (Emirate of Dubai, UAE) and RJ1 (Benton 1996; Munoz *et al.* 2012).

Previous works

S. Méry, K. Lidour

Soon after the discovery of the site in 1992, Phillips and Treveil opened a long trench (5 m x 0.50 m) at the top of the sand dune. It revealed a 60-80 cm-thick deposit containing large quantities of marine shells. An ashy layer has been identified at the base of the trench – it has provided quantities of faunal remains (mainly shells, fish, and terrestrial mammals). It also contained a human skull and a few Mesopotamian potsherds attributed to the Ubaid culture. A 1 m x 3 m extended trench has revealed the presence of three articulated human skeletons.

This trench was further enlarged (2 m x 4 m) in 1993, providing more information on funeral activities at the site. Several bodies have been recorded and excavated, in collaboration with the physical anthropologist, S. Strongman. The second campaign of excavations confirmed that the graves were concentrated in the ashy level (at or near the base of the stratigraphy). The upper layers provided only a few artefacts.

Most of the human bones were found disarticulated, or only partly articulated. Only nine individuals were well preserved; they had been placed in flexed or contracted positions, on their left side; the deposits being organised

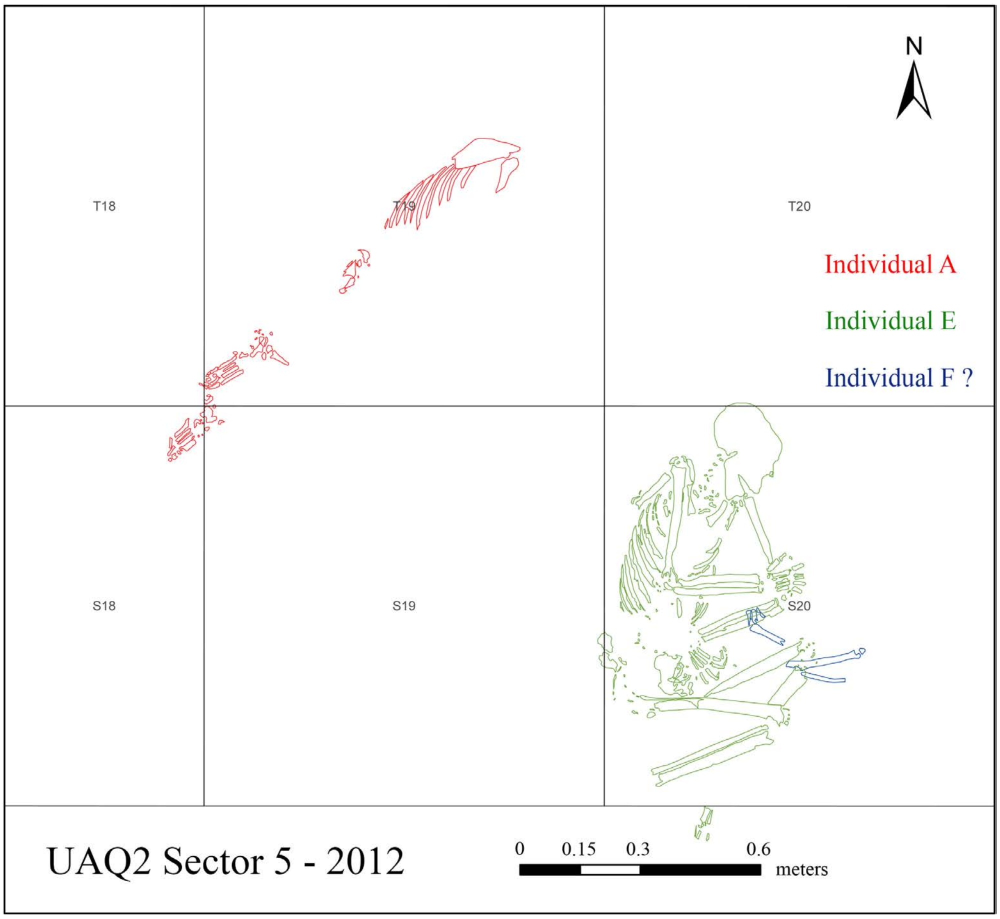


Figure 2.2. Plan showing the location of the skeletons identified in 2012: Individual A from Tomb 1; Individual E from Tomb 2.; The remains of a potential Individual F have been identified – probably belonging to a skeleton that has been disturbed.

Figure 2.3. Detail of the Individual F remains.

in three principal phases (Figure 2.1). Some bones had been disturbed or moved as new burials took place; in particular, several skulls and long bones had been moved to the side. According to the plans published by Phillips (2002: figs 2 and 4), two double burials can be identified. Strongman found a minimum number of individuals (MNI) of 42 or 43, consisting of 18 adult males, 14 adult females, and 3 sub-adults. The oldest individual was *c.* 35 years old.

The material associated with the settlement comprised a small number of artefacts and biofacts. Numerous burnt animal bones were found in hearths or at the edge of hearths, allowing the excavators to interpret them as possible remains of funerary meals. A preliminary analysis by K. Dobney (Phillips 2002: fn. 8) indicates that they included the remains of both domesticated (goat, sheep, cattle) and wild terrestrial mammals (gazelle, oryx).

The most remarkable find was a well-preserved pearl (Charpentier *et al.* 2012a). Pearls were of particular importance in Neolithic funerary rites in the UAE and in the Sultanate of Oman (at BHS18, some were placed on the upper lip of some of the deceased). At the latter site, the pearls were semi-perforated in the case of males and non-perforated in the case of females (de Beauclair 2008b). It is also worth noting that a carnelian sphere fragment was found in the same level as the pearl (comm. pers. C.S. Phillips). Like the pearls, stone spheres can be found unperforated, semi-perforated, or perforated, and seem to have played a significant role in Neolithic funerary practices.

In addition, there were other elements of Neolithic personal adornments, such as various shell beads, a softstone disc bead, several beads made of Mesopotamian bitumen, plus an elongated stone pendant. A perforated bangle plaque made from a bivalve shell compares well with ornaments taken from RH5 and other sites from the Sultanate of Oman (Méry & Charpentier 2013). Interestingly, the UAQ2 bangle was not made from a large gastropod shell (i.e. *Pleuroploca trapezium* (Linnaeus 1758)), as is usually the case in the Sultanate of Oman.

A few Mesopotamian pottery sherds, sometimes painted, have also been discovered. Ubaid-style-associated pottery was first identified on the coast of the emirates of Sharjah and Ras al-Khaimah during the mid 1980s (Boucharlat *et al.* 1991a; Haerinck 1991a).

Two flint projectile points were also found. Their style (technological, morphological, and dimensional) proved to be very typical of coastal Neolithic sites between Sharjah and Ras al-Khaimah. Many comparable points have been found during the new excavation campaigns at UAQ2 since 2011.

Other finds of great interest have to be mentioned: a nodule of ochre (*c.* 4 cm in diameter) near the skull of one of the individuals, as well as a bone spatula bearing traces of this colourant. Such an object is, to date, unique in the region for the Neolithic. These finds show the importance of ochre in the rituals, as has been confirmed in other Neolithic contexts, notably during the 4th millennium BCE at Akab, where ochre was used for various ritual purposes associated with the ceremonial structure built from dugong bones (Méry *et al.* 2009).

Resuming excavations of the UAQ2 graveyard

S. Méry, K. Lidour

In resuming the excavations of UAQ2, our first intention was not to continue the search for new burials in the graveyard but to explore the residential area of the Neolithic inhabitants. In November 2012, the East section of Sector 1 had to be pushed further eastwards. In doing so, J. Martin, who was also a member of Phillips' team, suggested investigating the limits of the 1993 trench. This led to the discovery and partial excavation of two new skeletons, plus the partial articulation (arm and hand) of another body found in an overlying level, i.e. over Individual E (Figures 2.2, 2.3). Individual 1 (later called Individual A) was lying 113 cm below the surface. Individual 2 (later called Individual E) was 74 cm below the surface (Figure 2.4). Both were found slightly below the level of the burials excavated in the 1990s.

The excavations of the human burials continued in November 2013 in collaboration with K. McSweeney. Our initial plan was to fully excavate and carry out osteological analyses of the two skeletons identified, but not retrieved, during the previous season.

As the excavations progressed, three new skeletons (Individuals B, C, D) were discovered between the first two (Individuals A and E) (Figure 2.5). McSweeney conducted brief assessments of sex and age at death as the remains were uncovered. As the condition of the bones was poor, some measurements were taken in the field before the remains were retrieved. A thorough osteological examination was done after that to give more complete details. The partial articulation overlying Individual E was counted as a supplementary individual, although the MNI was based on the number of crania at the time Strongman studied the human bones of the 1990s excavations. Thus, when considering the excavations of the 1990s, the MNI of buried individuals is now 47 or 48 in terms of the UAQ2 necropolis. The new excavation campaigns also provided better documentation of the burial type: the bodies were deposited in shallow pits dug in pure sand. The skeletons were distributed as follows: individuals A, B, C, and D in a multiple burial labelled Tomb 1; Individual E (Ind. E) was

Figure 2.4. Individual E from Tomb 2.

Figure 2.5. Tombs 1 and 2 during their excavation in 2013.

Figure 2.6. General view of Tombs 1 and 2.

placed in a pit, slightly above the multiple burial, labelled as Tomb 2 (Figure 2.6).

The 2013 campaign also allowed us to understand better the relationship between the graveyard and the newly found settlement area. The burials are located within and at the base of the occupational layers. This observation was strongly confirmed in 2014 by the excavation of a transect between the two areas and encompassing Sectors 2, 4, and 5.

Description of the tombs

S. Méry, K. Lidour

Tomb 1 was dug into Level 15, a yellow-beige sandy stratum containing fragments of the same shell type as the overlying levels, but less numerous and smaller. This tomb is the most ancient tomb known so far at UAQ2, being below the strata excavated by Phillips in the early 1990s. Four burials lie in a shallow, low pit dug into the sand.

The four individuals (Ind. A, B, C, and D) had been neatly laid out and were situated close together, all lying on their left side, with their heads to the north, facing east. All had their right arms flexed and placed over the next skeleton, with their legs also flexed, and, in some cases, their feet intertwined. These details confirm two things – that the four deceased were buried at the same time; and that their positions were intentionally and very carefully arranged.

From examining the position of the four skeletons, it can be confirmed that the first skeleton to be buried was Ind. D, followed by Ind. C, Ind. B, and then Ind. A; at some point afterwards Ind. E was deposited.

This fifth individual, buried in front of the others and partly on top of Ind. D, was separated from the Ind. A-D group by a thin layer of sand – we thus refer to another burial: Tomb 2. This male skeleton was flexed on the left side with the pelvis tilted forward. His right arm was flexed at the elbow, the right hand resting just above the left elbow. The head was oriented to the northeast and was resting on his left shoulder, with the left arm bent outwards at the elbow. The legs were tightly flexed, more so than the individuals in Tomb 1, possibly indicating binding.

It is not possible to know whether the burial of this individual was carried out immediately after the inhumation of the four first bodies, or whether or not this act had any direct relationship to the previous burials. In other words, are we dealing with one multiple grave of five individuals, or, rather, one grave with four individuals plus a single inhumation? Despite the second scenario being more likely, the first option should not be excluded. This adult male was found with personal ornamentation in the form of a belt of beads made from marine gastropod shells.

Grave goods

S. Méry, K. Lidour

During the excavation of the graves, we found several items, including pearls and adornments made from marine shells. Shell accessories were exclusively associated with Ind. E from Tomb 2, i.e. an alignment of marine shell beads was found along his right hip (Figure 2.7), composed of ten *Polinices mammilla* perforated shells and two *Conomurex persicus* apex beads. This cluster of beads is interpreted as the possible remains of a belt tied to the waist of Ind. E. Two *Engina mendicaria* perforated shells were found close to each extremity of the left humerus, thus suggesting that they could have been sewn onto a piece of cloth or hide (Figure 2.8). Of note is the broken mother-of-pearl pendant (UAQ2.2362) found close to one of his feet.

The pearls were exclusively found associated with Tomb 1: Ind. A with two, and Ind. B with five (Figure 2.9). Varying in shape and size, they are, unfortunately, heavily encrusted. Once again, however, the finds highlight the importance of pearls within funeral practices, and, more than likely, their great symbolic and aesthetic value for Neolithic people. The pearls were systematically

Figure 2.7. Detail of the Individual A skull.

Figure 2.8. Detail of the Individual B skull.

Figure 2.9. Detail of the Individual C skull.

Figure 2.10. Detail of the Individual D skull.

Figure 2.11. Detail of the Individual E skull.

found near the hips of the deceased, suggesting they were contained in a small bag or pocket. This discovery suggests that they were probably pearl fishers.

It is also worth singling out the assemblage of ten stone net sinkers discovered in a shallow pit (C13) west of Ind. A. Although the direct connection to funerary rites of this feature remains doubtful, it is reminiscent of comparable concentrations of (unworked) pebbles found in the ceremonial structure at Akab (Méry *et al.* 2009).

Two post-holes were found to the east and north of the tomb, suggesting the presence of a light structure or 'marking' of the graveyard.

Osteological examination of the human remains

K. McSweeney

The author's participation in the excavation of the human remains from UAQ2 took place from 16 November 2013 to 1 December 2013. The full osteological analysis was carried out in Umm al-Quwain from 5 to 19 December 2014, beginning with Ind. A.

Methodology

Unless otherwise stated, the remains were analysed in accordance with the methods outlined in Bass 2005, Buikstra and Ubelaker 1998, Schaefer *et al.* 2009, Van Beek 1983, and White and Folkens 2005. Stature estimates were based on Trotter and Gleser's methods for white males (1958).

The results of the skeletal analysis were recorded on an Excel spreadsheet, with separate worksheets for each skeleton. A description of each bone or fragment of bone was recorded, as well as evidence for sex, age at death, measurements, non-metric traits, and any evidence of disease and trauma associated with that bone. Because of the poor condition of the remains, as many measurements as possible were taken while the skeletons were still in the ground, i.e. before they were lifted.

Condition of the remains

All the individuals were lying on their left sides with their legs flexed to the right. The left sides of all the skeletons were in poorer condition than the right, and the skulls all flattened mediolaterally. Most bone surfaces were very eroded, the majority with postmortem concretion adhering; in some cases, this had caused some bone fragments to stick to others. Most long bones, apart from some phalanges, had lost their epiphyseal ends.

Some bones, because they were only held together by the surrounding sand matrix, had been packaged with as much of the encompassing sand as possible, wrapped in tissue paper and then foil until their osteological examination.

In the light of poor preservation, and to aid identification during osteological analysis, as far as possible, individual bones were identified from their anatomical position while still in the ground and packaged and labelled separately. This included individual ribs and hand bones, some of which can be difficult to precisely identify once lifted. Unfortunately, the poor condition of the skeletal remains meant that only limited osteological findings could be elicited.

Individual A

Ind. A was lying on his right side with the top of his skull close to the occipital bone of Ind. B, and with his right arm over Ind. B.

(Completeness and condition of the remains)

Although most of the skeleton of Ind. A was present, much of it was in poor condition. The skull had flattened mediolaterally due to soil pressure and was completely fragmented (Figure **2**.10). In many cases both the internal table and the cancellous bone of the diploë between the external and internal tables had disintegrated, with only the external surface remaining. Of the long bones, even though the shafts had largely survived, their external surfaces were eroded, and none of the articular ends had survived. The vertebrae had only the spinous processes and laminae remaining, and even these were fragmenting into tiny pieces, while the cancellous bodies had completely disintegrated. Ribs were also very poorly preserved and reduced to small fragments. The mandible, normally a fairly sturdy bone that survives well, and the maxillae, were also fragmented, and the teeth were friable. To preserve form as much as possible, very little cleaning was carried out.

(Sex)

The morphology of the skull and mandible, specifically, the size of the mastoid processes and shape of the mandible, both scored a 4 (out of a possible 5) on Walker's system of sexing the skull (as cited by Buikstra and Ubelaker 1994), indicating a probable male. General robustness of the postcranial skeleton tended to support the assessment of male sex; in particular, that of femoral shaft circumference (85 mm). Black (1978) in a study of 114 individuals from the site at Libben (Ohio), which had been sexed by other means, found (with 85% accuracy) that circumferences > 81 mm were male, and < 81 mm were female. A test of this method by Di Bennardo and Taylor (1979) generally supported Black's findings.

(Age at death)

The third molars had erupted, and full epiphyseal fusion appeared to have occurred, indicating an age of at least 21 years. The degree of dental attrition gave an age of 20-24 according to Lovejoy 1985 (Stage D), and 17-25 using Brothwell 1983. Age at death was probably therefore in the range 21-25 years.

(Stature)

The estimations of stature were based on the measurements of limb bones taken while the remains were still in situ. These measurements, normally taken in the lab with specialised measuring equipment, gave varying results for estimates of stature. In the case of Ind. A, stature is estimated at 169.60 ± 3.29 cm on the basis of the length of the fibula; this bone was chosen in preference to other limb bones as it was easier to take a simple length measurement in the ground and thus provide a more accurate measurement. Considering the standard deviation, stature is estimated to be in the range of 166.31 cm - 172.89 cm.

(Pathological lesions)

Other than a bony lesion in the form of an exostosis on the medial midshaft of the right proximal phalanx of the index finger which could be indicative of a localised trauma, no other pathological lesions were identified.

Individual B

(Completeness and condition of the remains)

The mandible was resting against and just under the skull of Ind. C (Figure **2**.11). There were no traces of the cervical spine. The right arm was flexed and lying over the ribcage and right humerus of Ind. C. The right hand was hyper-flexed, with the dorsal aspect resting against the ribcage of Ind. D. The legs were flexed at *c.* 90°. Both femurs were almost in alignment, with the right knee touching the back of the left femur. The right lower leg was under the distal lower leg of Ind. A. The right foot was flexed normally, with the right ankle under the lower right tibia of Ind. A. The left foot was very poorly preserved and underlying the distal end of the left lower leg of Ind. A. Four beads were found on the right femur.

Ind. B was very poorly preserved. The skull was in very poor condition and flattened mediolaterally. Most of what had survived was held together by the soil matrix. Only the outer table of the cranium remained, and much of that was eroded. The maxilla was represented by only a few fragments, although some loose upper teeth were present. In the mandible, part of the left side had survived, with sockets for the three left lower molars (although these teeth were not found). Part of the right side of the mandible was visible and appeared edentulous. The rib cage was very fragmentary and very little remained of the pelvis. None of the long bones were complete, nor any of the hand and foot bones.

(Sex)

A few surviving features of the skull, especially a pronounced glabella (Stage 4 on Walker's system, cited by Buikstra and Ubelaker 1994), a very robust zygomatic bone and ascending ramus of the mandible, and very robust ulnae, all suggested that this individual was male.

(Age at death)

Indicators of age were limited. Epiphyseal fusion could only be established on some hand and foot phalanges and metacarpals; full fusion of these bones gave a minimum age at death of 16 years (Schafaer *et al.* 2009). Age at death based on dental attrition of the upper dentition is 20-24 (Stage D) on Lovejoy's system, and 17-25 on Brothwell's. Age at death, therefore, was probably within the range of 17 - 25 years.

(Stature)

The estimation of stature based on the length of the left fibula (34 cm) was 162.9 ± 3.29 cm, which gave a range of 159.61 cm - 166.19 cm.

(Pathological lesions)

The only pathological lesion noted was a misshapen shaft of the right fifth metacarpal, which signified a healed fracture that had occurred at some point during his life.

Individual C

(Completeness and condition of the remains)

The occipital and nose of Ind. C was lying between the mandible of Ind. B and the occipital of Ind. D (Figure **2**.12). The knees were lying over one another. The right femur was missing both ends. The right lower leg was in normal articulation. The right ankle was lying over the left foot. In the left lower leg, the fibula had rotated into an empty space. The right foot was almost complete and was mostly in articulation, but the foot bones were splayed and had possibly rolled. The left foot was in normal flexion and complete, although poorly preserved. The left femur was lying partly under the proximal end of the right. The left femur had rolled, presenting by its posterior face. The humerus was in articulation with the ulna. There was no hand at the extremity of the ulna.

The skull was flattened mediolaterally and in very poor condition, with only the outer surface surviving. Only a small part of the right mastoid process was present and

Figure 2.12. General view of Tomb 2 showing the row of shell beads along the hip of Individual E.

Figure 2.13. Location of the two *Engina mendicaria* shell beads along the Individual E left humerus (the skull has been already removed at this point).

there was no left. Most of the dentition was present. The vertebrae and rib cage had survived, but only in small fragments. None of the limb bones were complete, most were represented by the shafts only. There was only one hand bone identified – a proximal phalanx, and although there were several foot bones, none were complete.

(Sex)

A very broad ascending ramus of the mandible (40.2 mm) and robust femoral circumference (88 mm) pointed to male sex (Black 1978).

(Age at death)

The upper left third molar was in the process of erupting and the root apices had not closed. The lower left 3rd molar was almost in full occlusion but there was almost no wear on the cusps, implying that this had only recently erupted. The other two third molars could not be observed. Van Beek (1983) gives the time of the eruption of third molars as 17-21 years, and completion of their roots as 18-25 years. Epiphyseal fusion had occurred in some hand and foot bones and in the distal right humerus. The age of fusion of these epiphyses is 14-18 years. In the pelvis a small part of the coxal bone had the iliac crest fused. The age of complete fusion of this epiphysis in males, according to Shaefer *et al.* 2009, is 20-23 years. Skeletal and dental ageing give similar ranges, and so age at death is probably between 18 and 21 years.

(Stature)

The only limb bone suitable for obtaining a maximum length on which to estimate stature was the left humerus

Figure 2.14. Detail of two small clusters of two pearls each (note the association of a big and a small pearl in both cases) close to the pelvis of Individual B.

Figure 2.15. Detail of the chalcedony fusiform point found in the ribcage of Individual D.

(32 cm). This resulted in an estimated height of 169.01±4.05 cm, providing a range of 164.96 cm - 173.06 cm.

Individual D

(Completeness and condition of the remains)

As with the other individuals, the skull was flattened mediolaterally, although it was in better condition, with the maxilla and mandible attached and all dentition in situ (Figure 2.13). All areas of the spine were present, although fragmented, as were the ribs. The rest of the postcranial skeleton was well represented, although there were few complete bones, and in most cases the long bones were represented by shafts only.

The left arm of Ind. D was under Ind. E (from the second grave-pit). The left forearm of Ind. D was on a slope, with the distal extremity higher than the proximal one. The right hand was flexed under the right radius and ulna. A projectile point was found in the area of the pelvis. Several ribs and scapula were out of articulation, and although it was not embedded in any bones, this was an indication that the point had penetrated the rib cage.

(Sex)

General robustness of most of the skeleton, for example, flaring gonial angles, a clavicle with a midshaft circumference of 39 mm, very robust right radius and ulna, and a pronounced mastoid process (Stage 4), are all indicative of male sex.

(Age at death)

There were very few epiphyses to assess age at death based on the degree of their fusion. However, a fused distal epiphysis of the right humerus and some of foot bones, and fusion of the iliac crest in the right coxal bone, pointed to an age of at least 17 years. Age at death based on dental attrition gave similar ranges, employing the systems of both the Brothwell 1983 and Lovejoy 1985. Brothwell produced a range of 25-35 years, whereas Lovejoy indicated (Stage E/F) 24-30/30-35, i.e. both very similar. Taking both results into account, age at death was between 24 - 35 years.

(Stature)

The estimation of stature was 167.47±4.05, based on the estimated length of the humeri, both of which measured 31.5 cm, giving a range of 163.42 cm - 171.52 cm.

(Pathological lesions)

As indicated above, a projectile point was found in the sandy filling around the area between the lower (broken) ribs and the pelvis of the individual (Figure **2**.14). Although this was not embedded in the pelvic bone, several ribs and a scapula were out of articulation and the ribs were very fragmented.

Once excavated, the lower part of the ribcage was found to be damaged, but the pieces of ribs were still in place in the bone, indicating that the damage had occurred perimortem; had this occurred when the bones were 'dry' the pieces would have detached (White and Folkens 2005). The projectile point was located in between the fragments of the ribs but there was no trace of any secondary disturbance of the bones above (the ulna and radius) or around (the coxal bone). When the soft tissues decomposed, the ribcage would have been filled with sand during natural taphonomic processes. For this reason, it can be concluded that the point was most probably embedded inside the body and was not a ritual artefactual offering placed at the time of the deposition of the body. It seems likely that the projectile had smashed the ribcage and rested in the soft tissue surrounding the pelvic cavity. Such a trauma is likely to have resulted in death.

Individual E

(Completeness and condition of the remains)

Ind. E was separate from the others. He was lying on his left side with his legs tightly flexed at the hip and knees. The right arm was bent *c.* 45° at the elbow, in front, while the left shoulder was under the skull, and the arm rather awkwardly held straight, with the lower arm bent 90° at the elbow and the hand twisted backwards.

The skull was very fragile but presented with the right mastoid process of the temporal (Figure **2**.15). The atlas and axis were in articulation with the skull. Many teeth in both the upper and lower jaw were in occlusion, but some were loose. In total, 25 teeth were present. Those missing were the upper right and left second and third molars, the lower left second and third molars and the right first premolar. Like the other individuals, most of the postcranial skeleton was present but very fragmentary. The coxal bones in particular were reduced to tiny fragments. Most long bones consisted of shafts only, the epiphyseal ends having perished. Several hand bones were present, but very few foot bones.

(Sex)

A pronounced mastoid process (Stage 4) and nuchal crest (Stage 4) indicated that sex was very probably male. Such an assessment is supported by very robust femoral bones; the left had a midshaft circumference of 90 mm (Black 1978). The clavicle, too, was very robust, with a midshaft circumference of 40 mm. It is therefore very likely that Ind. E was male.

(Age at death)

The absence of epiphyseal ends in most bones means that they could not be used for assessing age at death. The fusion of the medial epiphysis in a right clavicle, which is a late-fusing epiphysis, indicated an age of at least 21 years. The upper and lower dentition were heavily worn and scored 40-45 years (Stage H) on Lovejoy's system and 35-45 years on Brothwell's. Taking account of both methods, age at death was within the range 35 - 45 years.

(Stature)

There were no complete long bones on which stature could be calculated. The shaft of the right fibula was otherwise in good condition (remaining length 29.0 cm), and it was possible to estimate the full length at 32.0 cm. This gave an estimate of 157.54±3.29, a range of 154.25 cm - 160.83 cm.

Summary

(Completeness and condition of the remains)

The burials at UAQ2 were of four individuals in one grave and a further individual in another nearby. It is clear that the four individuals were buried at the same time, their bodies all being flexed on their left sides and intertwined, i.e. the top of the skull of Ind. A was close to the occipital of Ind. B, the mandible of Ind. B was resting on the skull of Ind. C, and the nose of Ind. C was touching the occipital of Ind. D. The right arm of Ind. A was lying over Ind. B, the flexed right arm of Ind. B was over the right humerus of Ind. C, and his right hand was resting against the ribcage of Ind. D. The left hand of Ind. B was under the skull of Ind. D, and the left arm of Ind. B was under the neck and skulls of Ind. C and Ind. D. The legs were all flexed and in alignment of each other, with the knees lying over the next individual and with some intertwining of feet (the right lower leg of Ind. B was lying under the distal end of the left lower leg of Ind. A).

It seems quite clear that individuals A, B, C, and D were buried at the same time and that their bodies were deliberately staged. From the way the bodies were placed, it is clear that Ind. D was buried first, followed by Ind. C, Ind. B, and finally Ind. A. When the stage of *rigor mortis* is considered, it is clear that the depositing of the skeletons must have occurred either very soon after death or relatively later. According to Pokines and Symes (2014) *rigor mortis* (or postmortem rigidity), which causes stiffening of the limbs, can occur as soon as two to six hours after death and can last for one to two days. Clark *et al.* (1997) state that the first stage, tightening of the muscles of the face, can start at 2-3 hours postmortem, followed by the whole body being in a rigor state at 12-24 hours. Stiffness starts to relax after *c.* 36-48 hours. However, these stages can be accelerated by heat (Gill-King 1997).

Ind. E was probably buried at a later stage. Although he was also flexed, and on his left side, he was more tightly flexed than the others. The orientation is also slightly different. Ind. A to Ind. D were orientated E-W, with heads to the east, whereas E was orientated more NE-SW. The left arm of D was under the skull of E, not touching, but separated by a thin layer of sand. Indicating some lapse of time between the burials of A - D, and E.

(Sex)

Although the condition of the remains was poor there were sufficient morphological traits surviving to state that all five were probably male.

(Age at death)

Individuals A-D were similar in age, three being young adults, and D slightly older, whereas E was the oldest at 35-45 (Table 2.1).

(Stature)

The accuracy of estimations of stature, normally considered to be only a rough guide, were further hampered by the poor conditions of the remains. To go some way to addressing this situation, measurements of limb bones were taken before the remains were recovered.

Table 2.1. Estimations of the age at death for the different individuals.

Individual	Age at Death
A	21-25
B	17-25
C	18-21
D	25-35
E	35-45

Table 2.2. Estimation of stature for the different individuals.

Individual	Stature (cm)
A	169.6±3.29
B	162.9±3.29
C	169.01±4.05
D	167.5±4.05
E	157.5±3.29

Ind. E appears to be the smallest of the five (Table 2.2). However, in his case the stature estimation was based on an incomplete fibula, which may have introduced an additional inaccuracy, and so the apparent disparity may not be significant.

(Pathological lesions)

Other than a healed metacarpal in Ind. B, some minor trauma to a finger of Ind. A, and the traumatic weapon injury to Ind. D, no indicators of disease were identified. However, poor bone preservation meant that any traces of disease processes present could have been destroyed. While that injury to Ind. D would have been fatal, there is no indication of the cause of death to the other four.

Discussion

S. Méry, K. Lidour

The five individuals discovered during the 2012-2013 excavations at UAQ2 were all adult males. Four were young adults; the last was an older male. One of the individuals probably died from a projectile injury. A, B, C, and D seem to have been buried simultaneously, and their bodies were carefully arranged. From examining the position of the five skeletons, it can be confirmed that the first skeleton to be buried was Ind. D, followed by Ind. C, Ind. B, and then Ind. A. At some point after this first burial, Ind. E was added.

The oldest male, Ind. B, was accompanied by five pearls, and Ind. A by two. This gives us *prima facie* evidence of the status of pearl fishing during the Neolithic in Arabia, and the symbolic value of pearls in funeral rites.

The first four men died and were interred almost simultaneously. Careful observations have revealed the relative positions of each body: Ind. D must have been the first of the four to be placed in the grave.

A further point to consider is the physiochemical process of *rigor mortis*, or the stiffening of the body after death. While *rigor mortis* is present, the body would be difficult to manipulate and would have kept its position after stiffening had set in. This means that the circumstances of death would have had a bearing on how the corpses were arranged in the way they were found (Ind. A to D, and indeed the flexed position of Ind. E). For example, if death occurred some distance from the settlement, the men must have either been buried immediately after death, probably unlikely, or after 36 hours. It is impossible, however, to estimate how much time passed between the inhumation of the first four individuals and that of Ind. E. At most, we can say that the interment of the latter did not disturb the individuals in the grave below.

How can we interpret the deceased men in the first tomb? Why are they all grouped into the same tomb, with one of them having a projectile wound? Although one of these individuals was likely to have died as a result of his projectile-related wound, we have no sign of the cause of death of the other three. According to statistical studies (Chambon & Leclerc 2007), the probability of four simultaneous, natural deaths of young adults is almost negligible, even if we assume a small living population size and seasonal variations in mortality.

Ethnographic parallels show that, in traditional societies, combinations of bodies in the same grave are rare except for burials due to disaster (conflict, epidemic, famine, massacre). Graves are known of individuals, men and women, who were killed following the death of another – referred to as the 'main subject' by Testart (2004). According to the same author, companion burials relate to individuals who previously 'belonged' to the main subject, their relationship continuing after death.

What reasons could there be for the simultaneous or successive deaths of these four men found at UAQ2? It seems less likely that the four died at the same time while hunting, considering the type of environment and the prey available to them (gazelles and small rodents). Had an accident occurred at sea, they would never have been found. It logically leads us to put forth the hypothesis of a provoked death, perhaps a violent one, because even though the cause of death of the other three individuals of Tomb 1 is unclear, the specific placement of the fifth body (Ind. E) is intentional. The staging of the bodies in this spectacular grave from UAQ2 symbolises union in death.

What about the signs of violence in Eastern Arabia during the Neolithic? Two types of violence are visible in the funeral context: wounds from blows or projectiles, and projectile points. In the 1980s, a projectile point made of a modified shark tooth was found embedded in a lumbar vertebra of an individual from Area 43 at RH5 (Santini 2002). It is the only direct proof of injury by a projectile point among the nearly 350 primary burials from the Neolithic period excavated in Arabia. However, according to K. McSweeney, in many cases, this type of injury may not have left marks on bones but may have been embedded in soft tissue. On the other hand, violent blows to the head and forearms – called defensive or parade fractures – have often been attested at BHS18 (Kiesewetter 2006)

Accidental cranial traumas caused lesions of variable size and shape distributed over the whole surface of many of the skulls. By contrast, the depressed fractures observed by H. Kiesewetter at BHS18 have the typical pattern of intentional injuries predominantly located on the parietal bones above the level of the brim of the head. The author argued that from their shape and distribution, most, if not all of them, were probably not accidental injuries. Instead, they appear to have been produced by intended blows to the head. The small punctures observed on a number of skulls are concentrated on the forehead and are predominantly circular or ellipsoidal in outline. Their consistent size, shape, and localisation imply that they were caused by the systematic use of a weapon, most likely by using a slingshot. Furthermore, they have found several chop wounds, which undoubtedly result from a sharp-edged weapon, thus corroborating the violent character of skull injuries discovered at BHS18.

It has also been shown that examining minor injuries in the form of defensive fractures provides insights into the susceptibility to aggressive incidents. Several metacarpals also reveal fractures, which are most likely punch-related hand injuries. Accordingly, when involvement of the post-cranium is considered, it appears that hands and arms were implicated in interpersonal violence. From paleotrauma analyses, it was possible to conclude that interpersonal violence was common at BHS18, especially in the frequency of cranial fractures, which are regarded as reliable indicators of aggressive behaviour (14% of the skulls excavated). Twice as many men as women were affected by this type of injury.

Interpersonal violence was frequent, often fatal and deliberate in the BHS18 population, and the evidence from osseous remains almost certainly underestimates the rate of actual trauma, as no doubt a high proportion of wounds affected only soft tissue. Many fractures were identified on the bones found in the Neolithic graves at

GAS1, including a defensive fracture found in a multiple grave (pers. comm, O. Munoz).

The presence of projectile points in the graves may indirectly highlight violence. In the Sultanate of Oman, large shark teeth can be used as pendants or projectile points. As Fortini (2012) showed through experimentation, shark teeth are quite efficient as projectile points. Such artefacts have been found in several graves at RH5, GAS1 and Ras al-Khabbah KHB1 (Munoz *et al.* 2010). At RH5, in Grave 329 (Santini 2002), which included five individuals, a shark tooth was found near the ischium of the pelvis of Ind. D (they are not direct evidence that it was impaled in the body of this individual, or that such a trauma had caused its death). Shark teeth, including two with perforated roots, were found associated with two other graves from RH5, including five examples in Grave 68 inf. (Salvatori 2007: 130, fig. 105).

This body of evidence demonstrates a degree of violence during the Neolithic period in Eastern Arabia and the UAE, between the mid 6th and end of the 4th millennium BCE.

Are the multiple graves a significant cultural marker of the Neolithic in Eastern Arabia? The UAQ2 Tomb 1 is not unique in the region; other multiple graves are known. These inhumations include between two and five individuals. We know about ten of them at BHS18, one at RH4 (Tomb 10), at least 21 at RH5, one or two at RH6 (Grave 1986/1, Graves 2012/1-2), five at RH10 (including one triple and four double graves), one at GAS1, and perhaps one at SWY1 (Durante & Tosi 1977; Biagi 1987; Santini 1987; Gaultier *et al.* 2005; Charpentier *et al.* 2003; Salvatori 2007; Marcucci *et al.* 2014).

At first observation, the number of multiple graves – about 40 – is high in the UAE and the Sultanate of Oman. However, based on the known number of individual primary burials (nearly 250), they are far from being the exception, representing nearly a quarter of the known graves. Thus, the multiple grave is among the most significant of cultural markers for the Neolithic in Eastern Arabia. These multiple graves are in alignment with what we consider as being the 'standard' regional grave type of the period in terms of structure (a pit whose size corresponds to an individual or according to the number of individuals buried – once in flexed posture), orientation and arrangement of the bodies (deposited on one side, legs bent, arms flexed, one or both hands near the face). Furthermore, the composition of artefacts and associated biofacts are the same as in individual graves.

Finally, the ages and sexes of the individuals in the multiple graves are varied: men and women could be buried together, but also children – generally with one adult or more. The BHS18 excavations revealed six multiple burials, all containing only adults, but none of the latter contained four men, as at UAQ2 – only double or triple inhumations.

In summary, the significant proportion of multiple graves, the fact that the norms of funerary rituals are respected, the composition (individuals of both sexes and all ages), combined with the fact that the traces of violence (direct or indirect) are evenly distributed for individual inhumations as well as multiple burials shows that these multiple burials were not exceptional, nor were they necessarily linked to a deadly conflict. The proportion of head injuries in individual and multiple graves from BHS18 is similar, *c.* 10%, based on the 350 skulls studied. At this site, half of the multiple graves discovered contained an individual with one or more peri-mortem cranial trauma.

May we speak about 'war' in Arabia during the Neolithic? As said before, many graves contain evidence that could testify to the occurrence of a violent or deadly conflict, particularly in the form of injuries that can leave marks on bones or the presence of projectile points. We will not go into the details of BHS18, widely published (Kiesewetter 2006; Kutterer 2010; Kutterer & Uerpmann 2012), and where H.-P. Uerpmann and his team have hypothesised rivalries between population groups. We hypothesise that this is also the case at UAQ2. Indeed, on the coast along the Arabian Gulf, the search for good places to install a settlement and stay either occurred seasonally or even only yearly, and was crucial. In the northern UAE, establishing a settlement on high dunes allowed for efficient monitoring of the area and the exploitation of the resources provided by lagoons and mangroves. Fish, shellfish, and crabs were present in quantity on those sites, as well as mangrove wood that could be used in the construction of huts, boats, and as livestock feed.

The arrangement of the bodies at UAQ2 shows the close relationship of the individuals concerned. This particular layout, although, rare, is already documented in Eastern Arabia, such as at BHS18 and RH5. It occurs in many double graves, though not exclusively, and the placement of the bodies in several burials from BHS18 is similar to UAQ2. One contained the skeletons of three men and two women (i.e. four adults and one adolescent, *c.* 14-16 years old). The probability to us that all died during a violent episode seems high.

The same positioning of intertwined bodies exists elsewhere in other periods, including two famous examples, both of which are confirmed war graves, i.e. the Gallic tomb of the Gondole oppidum (Puy-de-Dôme, France) (Cabezuelo *et al.* 2007), with eight riders entwined, accompanied by their horses; and the tomb of the 10th Lincolnshire Battalion, containing 20 young men who died in combat in April 1917 at the Battle of

Arras (Pas-de-Calais, France), buried simultaneously, lying on their backs, heads to the north, forearms folded and arranged horizontally, joined hands resting on their abdomens (Desfossés *et al.* 2003). The inhumation of the bodies was east-facing, with exacting detail, as the right elbow of each man rests atop the left elbow of the body to the right, and forming a chain – the so-called 'Grimsby Chums', named after the small port in the north-east of England from where this group of WWI combatants originated.

If the qualification 'war grave' is possible in the case of the UAQ2 Tomb 1, it remains impossible to prove. The precise arrangement of the deceased appears to be a symbol of the relationship of the group in death, but also, most likely, in life: social relationships, potentially familial, given the assumed small size of the group. The willingness of the individuals who conducted the inhumation to have arranged the bodies in this way, with such detail and care, allows us to posit that the burial was performed by people from the same group or community as the deceased. It is also clear that they wanted to give them a burial worthy of the relationships to which they belonged during their lifetimes.

Nothing differentiates any individual over another in the UAQ2 burials – neither in the disposition of the bodies, nor in the very meagre associated grave goods, and nothing, therefore, indicates the presence of the dead accompanying a main inhumation.

Conclusion

S. Méry, K. Lidour

Although not initially planned, the new excavation of the UAQ2 graveyard allowed us to refine its previous dating and put it in connection with the oldest anthropic occupations at the site.

Unfortunately, it is impossible to precisely locate the burials excavated in the 1990s within the general stratigraphy of the site. However, we could demonstrate that the UAQ2 graveyard was in use during the first main phase of the settlement occupation at the site: the oldest part corresponding to Levels 14 to 9, dated to the second half of the 6th millennium BCE. It allows us to rule out that the graveyard was still in use during the most recent settlement occupation, i.e. Levels 8 to 1, which correspond to the 5th millennium BCE. The stratigraphic analysis and the correlation of the strata layers observed in both the trenches and the transect dug across the site allow us to exclude that the same graveyard was still in use during the most recent settlement occupation, i.e. Levels 6 to 1, which correspond to a Late Neolithic culture dating from the end of the 5th and first centuries of the 4th millennium BCE.

UAQ2 was the first Neolithic graveyard discovered in the UAE, and its discovery had a significant impact in the early 1990s. However, the interpretation of this confined funerary space remained problematic: was it a collective grave or a cemetery? The findings presented here show that the reality is both simpler (as we have Neolithic tombs of standard type corresponding to single, double, and multiple graves) and more complex, as the small size of the graveyard, and the remarkably high density of burials found, remains unparalleled to date in the Arabian Gulf region.

Chronology, Geoarchaeology and Palaeoenvironments

A. Parker, G. Preston, A. Goudie, F. Borgi, M. Degli Esposti, J.-F. Berger, S. Méry, K. Lidour, S. Lindauer, F. Preusser

Introduction

Extensive linear sand dunes characterise the southeastern Arabian coastal desert landscape. These SW-NE trending dunes reach up to 80 m in height and stretch *c.* 80 km in length between Dubai and Ras al-Khaimah. The landforms have undergone multiple phases of emplacement and accumulation dating back to the Late Pleistocene and earliest Holocene periods. Subsequent reactivation and accumulation during the Middle to Late Holocene primarily involve the reworking of material from these mega linear ridges, resulting in the formation of smaller linear dunes, typically *c.* 6 m high, trending from southwest to northeast (Goudie *et al.* 2000; Parker and Goudie 2008; Leighton *et al.* 2013; Farrant *et al.* 2015). Situated within the interdunal areas, former small lake basins and wetlands provide proxy records of past climatic change. These basins indicate periods of increased rainfall, such as the Early Holocene humid period (EHHP) between *c.* 6500 and 2000 BCE (8500 and 4000 years ago), characterised by the development of savannah grasslands with woody elements (Parker *et al.* 2004; 2006; Preston *et al.* 2012; 2015). Speleothem records from the Hajar Mountains in Oman further corroborate increased rainfall during the period from 8300-3500 BCE, associated with the northerly migration of the Indian Ocean Monsoon (Neff *et al.* 2001; Fleitmann *et al.* 2007). However, environmental records also reveal intermittent dry events punctuating the EHHP (Fleitmann *et al.* 2007; Preston *et al.* 2013; Parker *et al.* 2016). The EHHP corresponds with Neolithic occupation in the Gulf region.

This chapter provides an overview of the geomorphological and geoarchaeological investigations conducted to support excavations at UAQ2. Overall, this research aims to contribute to delineating the landscape of the Gulf coast and its hinterland, providing a comprehensive framework of climate, landscape, and environmental changes against which archaeological findings can be contextualised. Along the coastal desert region of the eastern (lower) Arabian Gulf, extensive shell-midden sites provide detailed records of Neolithic occupation (6500-3300 BCE), resource exploitation, and trade. While a few sites have been dated in the western and central regions of the Gulf in Kuwait, Saudi Arabia, and Qatar inland sites have been scarce and mainly limited to hunting campsites with ephemeral occupation, with the exception of Jebel Buhais (Uerpmann *et al.* 2008). Several surveys and excavations have been conducted from coastal midden sites, revealing a rich assemblage of marine resources and evidence of a nomadic population, along with indications of animal herding in the surrounding areas (Boucharlat *et al.* 1991b; Vogt 1994; Uerpmann and Uerpmann 1996; Phillips 2002). Trade relations between the lower Gulf region and Mesopotamia are evidenced by the presence of Ubaid pottery from lower Mesopotamia and chert lithics sourced from the Oman Mountains (Phillips 2002; Boucharlat *et al.* 1991b; Haerinck 1991a; Beech *et al.* 2005). Many sites exhibit stratification with multiple phases of occupation, yet establishing a firm chronology for these shell middens and phases of human occupation along the eastern Gulf coast remains challenging due to the limited availability of radiocarbon dates (Boucharlat *et al.* 1991b; Uerpmann and Uerpmann 1996; Vogt 1994).

Methods

Sediment sections from several excavation trenches at UAQ2 underwent thorough cleaning and detailed description. Samples, 2 cm in thickness and weighing *c.* 100 g, were systematically collected from cleaned open trench sections for geoarchaeological investigation and sealed in double zip-lock bags (see sections below). Samples from the sections were also taken for chronological control.

Sediment properties

Various laboratory methods were employed to characterise the nature of the sediments. Dry bulk density (BD) was calculated as the ratio between sediment mass and volume (g cm^{-3}) (Tranter *et al.* 2007). Low BD values indicate higher organic content, while high values suggest increasing minerogenic material. An increase in minerogenic material, such as sand, within the sediments can be associated with greater detrital input, as noted by Parker *et al.* (2004) and Tranter *et al.* (2007). Measurements were conducted on each sample using calibrated brass pots following the standard procedure described by Parker (1995).

Sediment organic and inorganic content was determined using the loss on ignition method at 550°C and 950°C, as described by Heiri *et al.* (2001). This method involves the substantial oxidation of organic and inorganic carbonates into carbon dioxide and ash through combustion using a muffle furnace.

Magnetic susceptibility was used to evaluate the nature and probable sources of the sediments. Mass specific, low frequency mineral magnetic susceptibility measurements (χlf) were conducted following the procedure outlined in Dearing (1999), using a Bartington MS2 meter with a MS2B sensor at 0.1 SI sensitivity. Samples were oven dried at 40°C to remove moisture, packed in Perspex pots and weighted to two decimal places (subtracting the weight of the pot), and measured in replicate before being averaged. Results are expressed as the mass specific susceptibility (χlf) measured as $10^{-6}m^3kg^{-1}$.

Grain size analysis provides important insights into sediment provenance, transport history and depositional conditions. Particle size data are grouped in Sand (2 mm – 63 µm), Silt (63 – 2 µm) and Clay (<2 µm) fractions using a modified Udden–Wentworth grade scale (Udden 1914; Wentworth 1922). Sorting, skewness and kurtosis are described using the scheme proposed by Folk and Ward (1957). To determine grain size, samples of air-dried sediment <2 mm were soaked overnight in a solution of 5% Sodium hexametaphosphate dissolved in de-ionised water to deflocculate any very fine-grained aggregates. Grain size distributions between 0.02 and 2000mm were determined by laser diffraction spectrometry using a Malvern Mastersizer 2000.

Samples for geochemical analysis were measured non-destructively using an Olympus Vanta portable XRF and elemental concentrations are reported in ppm. Measurements of elemental composition provide insight into sediment sources and depositional environments (Parker *et al.* 2006; Cohen *et al.* 2022).

Chronology

A combination of Accelerator Mass Spectrometry (AMS) radiocarbon and Optical Stimulated Luminescence (OSL) dating was undertaken to determine the chronology of occupation and to determine sediment accumulation rates from the sampled sections.

The chronology for UAQ2 relies on a series of 48 radiocarbon and 10 OSL dates from across the excavated site (n=56) (Table 3.1). These include samples collected from the open face of a sand quarry, which exposed a section through the site and was sampled in 2000 (n=2 OSL) and in 2005 (n=5 ^{14}C). Dates from the present study included samples from Sectors 1 and 2 A5/B5 (n=38 ^{14}C and n=5 OSL), Sector 2 H3 (n=1 ^{14}C), Sector 2 D0 (n=1 ^{14}C), Sector 5 O17 (n=3 ^{14}C) and from the human burials Couche 03 and 10 (n=3 ^{14}C). Additionally, OSL samples were dated from a cliff section at the base of the dune from section D3 (n=3 OSL).

Table 3.1. List of the number of samples collected for radiocarbon and OSL dating.

UAQ2 Sectors	^{14}C Number of Samples	OSL Number of Samples
S1 B5	38	5
S2 H3	1	
S2 D0	1	
S5 O17	3	
D3 dune		3
Quarry (2000/2005)	5	2
Total	**48**	**10**

Radiocarbon dating

Radiocarbon AMS ^{14}C samples were dated at a number of laboratories, including the Laboratoire LOCEAN (CNRS/Université of Paris 6), Lyon 1 Laboratory (ARTEMIS Program), Laboratory of Poznan, Oxford University Radiocarbon Laboratory, MPI-GEA (Jena), and the Curt-Engelhorn-Centre Archaeometry, Mannheim. Due to the lack of preserved charcoal at the site, most dates were obtained from marine shells (mainly on *Marcia* sp. but also *Terebralia palustris*, *Hexaplex kuesterianus*, and *Pinctada radiata*). Only one date from UAQ2 was derived from charcoal (from S2 D0). Three ash samples were also dated from S1 B5. Therefore, paired shell and charcoal samples, used for determining a marine reservoir effect, could only be applied for a few layers and species (*sensu* Lindauer *et al.* 2017). Four paired ages have been previously obtained from UAQ36 (Méry *et al.* 2019). This will help for an overall interpretation of the site, but not for a detailed chronology as the marine reservoir effect is species-specific and temporally variable depending on environmental changes (Lindauer *et al.* 2017; Lindauer 2019).

The reservoir effect accounts for an obvious age shift of marine organisms, as oceans can store carbon for over 1000 years during which a part of the radioactive ^{14}C decays. This so-called 'old carbon' is then incorporated, e.g. via food, into the organisms. Shells include it as apatite or calcite. To correct the age, usually paired samples of shell and a terrestrial material (often charcoal) are used. The reservoir effect is the difference of the age between the terrestrial sample and the shell minus the mean value of the Marine20 dataset (representing the mean of all the oceans, which is currently around 500 years). ΔR = R(t)-Marine20, where R(t)= Age shell – age terrestrial sample. If the values of ΔR are positive, the difference is more than 500 years. Negative values are also possible when the age is less than the 500 years from the Marine20 dataset (details in Lindauer *et al.* 2017; Lindauer 2019).

The shell-derived ages were calibrated using CALIB 8.10 using the Marine20 calibration curve (Heaton *et al.* 2020). Within the Gulf region few marine reservoir calculations have been determined. At UAQ36 paired charcoal and *Marcia* sp. shells from the same contexts in UAQ36 yielded marine reservoir values for *Marcia sp.* of ΔR 68±91 years and ΔR 13±36 years based on the Marine 13 calibration (Méry *et al.* 2019). When corrected to the newer Marine 20 dataset these values change to -163±125 and -191±52 respectively. The Calib 8.10 marine database only has one value for the Gulf region from Qatar from a pre-bomb sample on a shell (species *Pinctada radiata*) collected alive in the 19th century (Southon *et al.* 2002). The Marine 13 value for this sample was previously reported ΔR 180±56, however the correction value based on the Marine 20 dataset for this sample is ΔR 46±53, showing a difference of *c.* -135 years. This value is differing slightly to the values determined for paired shell and charcoal radiocarbon dates from Neolithic contexts at UAQ36. The problem here is that the environmental changes since the Holocene were significant and therefore values from this database only provide an indication, but can be very different from the real values of the period of interest (Lindauer 2019), therefore applying a universal value to all samples is problematic. The single charcoal sample from S2D0 and three ash samples from S1B5 were calibrated using the Intcal20 Northern Hemisphere radiocarbon calibration (Reimer *et al.* 2020). All radiocarbon ages are calibrated to 2σ and reported in the text in BCE. For uncalibrated ^{14}C ages and ages determined in cal. yrs BP the reader should consult the radiocarbon tables, as these are reported alongside the BCE ages.

OSL dating

Samples were collected by hammering light-proof 50-mm opaque PVC cylinders horizontally into the vertical faces of freshly cleaned exposures prepared at each site. To avoid depleting the OSL signal, samples were taken without exposure to daylight. The ends of the cylinders were sealed with black tape and immediately packed into opaque plastic bags. Five samples were collected from square B5 in Sector 1 , and three samples were collected from the exposed cliff section at the base of the dune (site D3).

The two OSL samples collected from the open exposed sand quarry face in 2000 were dated at the Oxford Luminescence Dating (OLD) Laboratory. For this study, field gamma spectrometry measurements were made using an EG&G MicroNomad portable NaI detector. For the samples dated at the Freiburg Luminescence Laboratory (FLL), bulk sediment samples were collected in a 30 cm radius around each OSL sample for dose-rate determination. The concentration of dose rate relevant elements (^{40}K, Th, U) was determined using a high-resolution gamma spectrometer (similar to the procedures described in Preusser and Kasper 2001).

For Equivalent Dose (D_e) determination, sand-sized quartz and feldspar (Freiburg only) grains, respectively, were separated from bulk sediment samples (Stokes 1992; Preusser *et al.* 2008). Isolation of the minerals grains involved treatment with dilute HCl to remove carbonates, wet sieving, a heavy liquid separation using sodium polytungstate solution (δ = 2.58 g cm $^{-3}$ and δ = 2.70 g cm $^{-3}$). The quartz fraction was etched using HF (48%, 60 minutes) to remove any remaining non-quartz contaminants, and the outer *c.* 10 µm of the quartz grains. The Oxford samples were additionally treated with H_2SiF_6 (40%, 48 hours).

At the OLD Laboratory, D_e was calculated using a Single Aliquot Regeneration (SAR) procedure (Murray and Wintle 2003). Using a Risø reader, the OSL signal was stimulated by exposing aliquots to blue 470 nm (18 mW cm $^{-2}$) light. Prior to optical stimulations each aliquot was preheat (260 °C, 10 s), and following each an additional series of step were undertaken, which included a 5 Gy test dose, pre-heat (220 °C, no hold) and optical stimulation. Eight aliquots of each sample were measured and then combined to estimate the sediment population age.

At FLL, samples were measured using a Freiberg Instruments Lexsyg Smart device (Richter *et al.* 2013) using blue diode stimulation for quartz (458 nm, 50 mW cm^{-2}) and IR stimulation for feldspar (850 nm, 110 mW cm^{-2}). D_e of small aliquots (2 mm for quartz and 1 mm for feldspar) was determined using SAR procedures (modified after Murray and Wintle 2003). For the D3 dune site, both quartz and feldspar were dated from the same three samples. A preheat of 230 °C for 10 s was found appropriate for quartz in dose recovery tests. For feldspars, post-IR (pIR) infrared stimulated luminescence (IRSL) was applied (Buylaert *et al.* 2009), with a preheat at 250 °C for 60 s, a first IR stimulation at 50 °C for 90 s (IRSL), and a subsequent second IR stimulation at 225 °C for 100 s (pIR-225). Different statistical models were tested to extract the average D_e based on the spread of individual D_e values. These analyses imply the absence of partial bleaching or post-depositional mixing in the samples under consideration. Thus, the Central Age Model (CAM) was used to calculate the average D_e. While quartz OSL dating is expected to be reliable for the time range under consideration, comparison with feldspar IRSL ages allows cross-checking for dosimetric issues that may arise when sampling complex and heterogeneous outcrops. OSL ages are reported in BCE, with actual OSL dates reported in parenthesis alongside in ka BP, to align and

Figure 3.1. UAQ2 D3 cliff section showing 3.4 m of exposed dune sand with weakly developed Aridisol at 50–100 cm below the surface. A homogeneous, massive aeolian sand unit, which grade into finely bedded sands with bioclast inclusions below, underlies this.

provide continuity in age reporting with the calibrated radiocarbon ages.

Results

The results are presented based on key sections investigated at UAQ2 and UAQ36 are described below.

UAQ D3 dune cliff section (25°34’40.73”N 55°39’25.51”E)

The main site of UAQ2 overlooks a coastal sabkha, which in the past would have been a tidal inlet. A 310 cm trench (UAQ D3) was excavated in March 2013 into a former cliff line exposed in the dune ridge to the northeast of the main excavation (Figure 3.1). This section was extended downwards by augering to a depth of 490 cm. The description of the cliff section and auger hole sediments is shown below in Table 3.2. 39 samples were collected for sedimentological analysis along with three OSL samples for dating. OSL, IRSL, and pIR dates from the D3 section are shown in Table 3.3. As the latter always show higher age estimates compared to OSL, these are not considered in the following presentation.

The results of the sedimentological and geochemical analyses are shown below in Figure 3.2 and 3.3. No geochemical results were available for Us 16-12. The lower units Us 16-15 comprise sandy facies (~83-88%) with silts and clays (11-17%) and bioclast inclusions including ostracods. Two phases of coarser, moderately well sorted grained sediment facies (Us 13 and Us 9-8) separate three phases with finer grained poorly sorted sediments. The coarser grained units suggest sediments were most likely

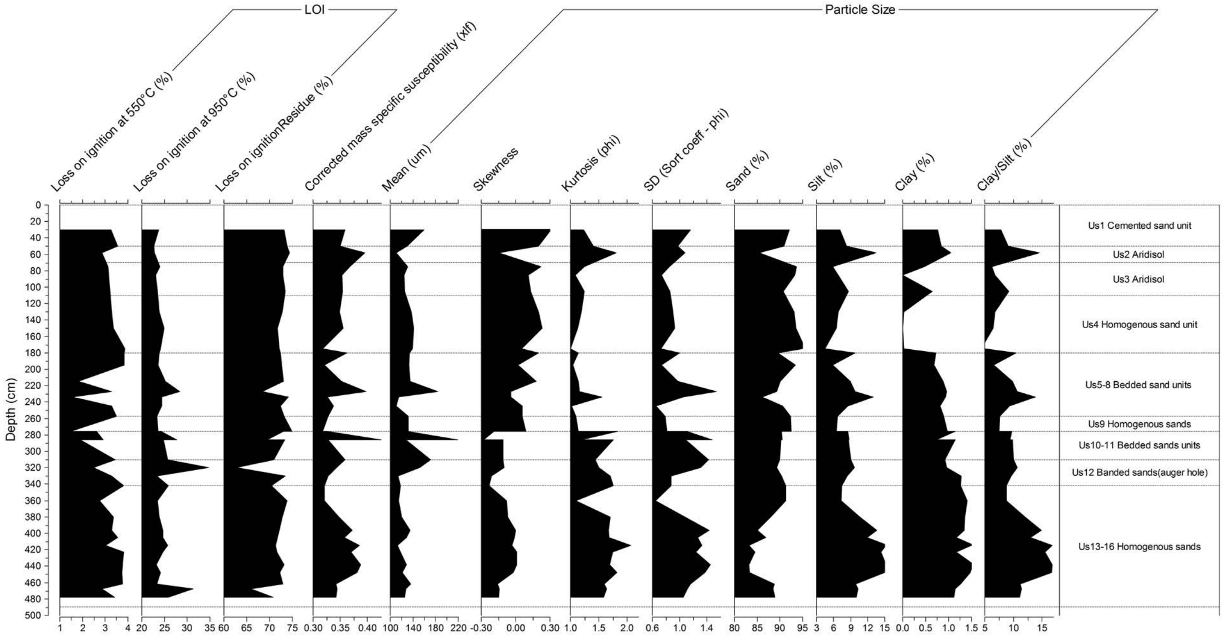


Figure 3.2. Physical properties of the UAQ2 D3 sequence.

Table 3.2. Sediment description UAQ2 D3 section and auger borehole.

Depth (cm)	Description	Unit
0-50 cm	Lightly cemented fine sand unit 2.5Y 7/4. Some burrows with carbonate-lined root casts. Sharp contact with unit below. Gypsum crystals diffuse within matrix. Crust at base of unit siltier.	1
50-70 cm	Fine to very fine sand with granular structure, pedy with burrows. Small gypsum tubes along root channels. Palaeosol - pseudo-desertic aridisol 2.5Y 7/3-7/4. OSL sample UAQD3-3	2
70-110 cm	Aridisol grades from fine sand with some silt. Massive structure. Very small shell fragments. No gypsum. 2.5Y 7/4 – 6/4.	3
110-180 cm	Massive fine sand. Occasional shell fragments. 2.5Y 7/4 -7/6	4
180-215 cm	N-S dipping, pinstriped-bedded fine sand unit. Coarse sand, orange 2.5Y 6/6; fine, sand grey 5Y 6/3. OSL UAQD3-2	5
215-227 cm	Fine-medium bedded sands with continuous banding. Orange sand 2.5Y 6/6, grey bands 5Y 6/2.	6
227-245 cm	Coarser grained unit with cemented dipping beds. Small gastropods and ostracods present. Coarse sand, orange 2.5Y 6/6; fine, sand grey bands 5Y 6/3.	7
245-257 cm	Horizontally bedded fine sands with alternating orange and grey bands. Coarse sand lens at 255-253 cm 2.5Y 6/4. Grey very fine sand bands 2.5Y 5/1, coarse sand orange bands 2.5Y 6/6.	8
257-276 cm	Massive, homogeneous unit. Fine sand 2.5Y 6/6	9
276-286 cm	Lightly cemented bedded alternating grey fine and orange coarse silts and sands. More steeply dipping beds cut into lower unit. Discontinuity. Grey fine silty sand 10YR 7/4 – 7/6. Orange medium sand 2.5Y 6/6	10
276-310 cm	Lightly cemented bedded alternating grey fine and orange coarse silts and sands. More steeply dipping beds cut into lower unit. Discontinuity. Grey fine silty sand 10YR 7/4 – 7/6. Orange medium sand 2.5Y 6/6. OSL UAQD3-1	11
310-342 cm (Auger Hole)	Bedded fine sand, slightly with 3mm orange (10YR 6/6) and 1 mm grey (2.5Y 6/4 – 6/3) laminations.	12
242-360 cm	Homogeneous sand 2.5Y 6/6 with small bioclasts inclusions.	13
360-394 cm	Fine yellowish-brown sand with numerous bioclast inclusions, 10YR 6/4.	14
397-490 cm	Fine sand with bioclast inclusions, 10YR 5/4	15/16

Table 3.3. Summary data of luminescence dating. *Note K, Th and U values for RAK/00/2 and RAK/00/5 were measured in situ using field gamma spectrometry and the values applied to determine the D value but were not made available to report here.

Laboratory	Sample	Method	Depth (cm)	K (%)	Th (ppm)	U (ppm)	D (Gy ka^{-1})	n	D_e (Gy)	Age (ka)
Freiburg (FLL)	UAQ D3-OSL3	OSL	60	0.60±0.06	1.50±0.11	1.39±0.17	--	12	no signal	--
Freiburg (FLL)	UAQ D3-OSL3	IRSL	60	0.60±0.06	1.50±0.11	1.39±0.17	--	12	0.21±0.23	modern
Freiburg (FLL)	UAQ D3-OSL3	pIR-225	60	0.60±0.06	1.50±0.11	1.39±0.17	--	12	0.09±0.63	modern
Freiburg (FLL)	UAQ D3-OSL2	OSL	193	0.60±0.06	1.51±0.11	1.58±0.17	1.25±0.06	50	13.41±0.57	10.8±0.7
Freiburg (FLL)	UAQ D3-OSL2	IRSL	193	0.60±0.06	1.51±0.11	1.58±0.17	1.74±0.09	12	17.96±0.54	10.3±0.6
Freiburg (FLL)	UAQ D3-OSL2	pIR-225	193	0.60±0.06	1.51±0.11	1.58±0.17	1.74±0.09	12	24.11±0.48	13.9±0.8
Freiburg (FLL)	UAQ D3-OSL1	OSL	323	0.60±0.06	1.53±0.11	1.23±0.14	1.10±0.05	26	15.35±0.80	13.9±1.0
Freiburg (FLL)	UAQ D3-OSL1	IRSL	323	0.60±0.06	1.53±0.11	1.23±0.14	1.23±0.06	12	16.52±0.37	13.4±0.7
Freiburg (FLL)	UAQ D3-OSL1	pIR-225	323	0.60±0.06	1.53±0.11	1.23±0.14	1.23±0.06	12	21.49±0.36	17.4±0.8
Oxford (OLD)	RAK/00/5	OSL	200	*	*	*	0.88±0.03	8	9.60±0.84	10.9±0.9
Oxford (OLD)	RAK/00/2	OSL	820	*	*	*	1.04±0.04	8	16.80±0.69	16.2±0.9
Freiburg (FLL)	UAQ2-OSL8	OSL	90	0.69±0.06	1.63±0.13	1.25±0.08	1.21±0.06	27	7.50±0.20	6.2±0.3
Freiburg (FLL)	UAQ2-OSL7	OSL	168	0.65±0.06	1.68±0.13	1.13±0.20	1.20±0.05	24	6.70±0.17	5.6±0.3
Freiburg (FLL)	UAQ2-OSL6	OSL	223	0.61±0.06	1.47±0.12	1.20±0.08	1.12±0.05	22	8.23±0.25	7.4±0.4
Freiburg (FLL)	UAQ2-OSL5	OSL	285	0.65±0.06	1.79±0.13	1.31±0.20	1.23±0.05	24	9.77±0.30	7.9±0.4
Freiburg (FLL)	UAQ2-OSL4	OSL	308	0.68±0.06	1.76±0.14	1.25±0.08	1.20±0.05	39	11.00±0.45	9.1±0.6

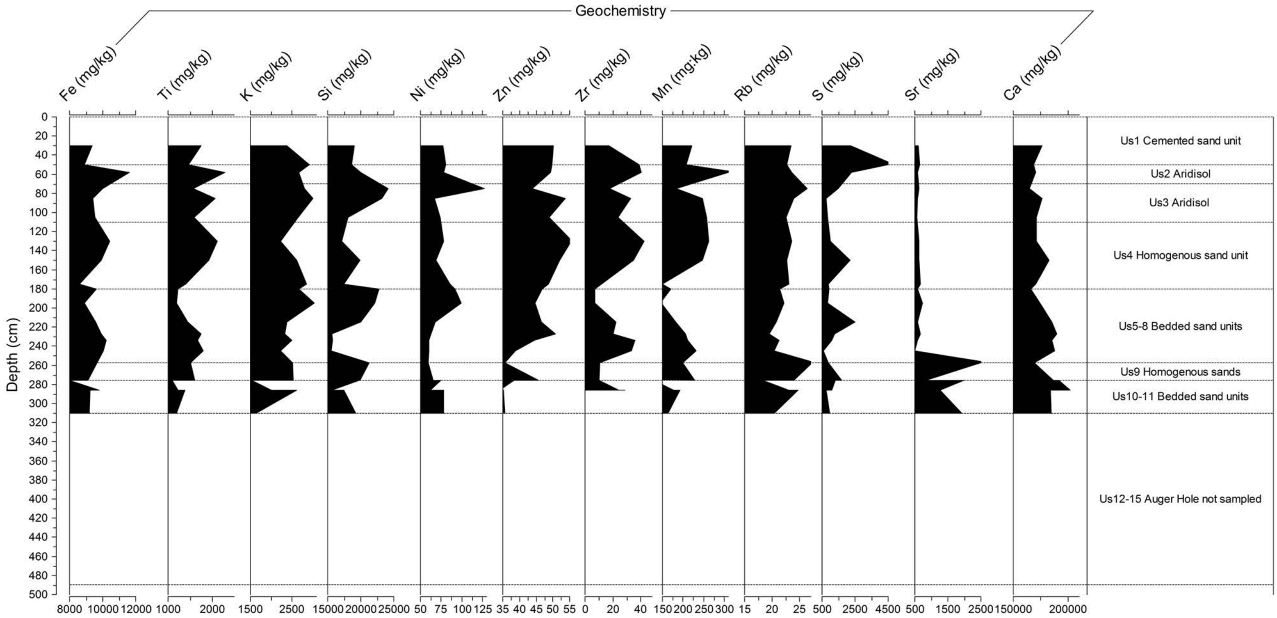


Figure 3.3. Geochemical properties of the UAQ2 D3 sequence. Note geochemical analysis was not conducted on the borehole extension to the exposed section.

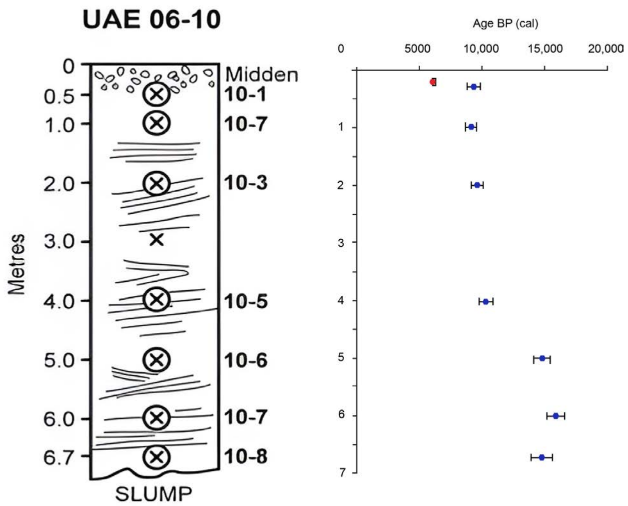


Figure 3.4. OSL sequence from UAQ36.

laid down under a higher energy environment. Units 11 to 5 comprise angle bedded alternating fine grey fine silts and orange coarse aeolian sands, however, Us 9 is homogeneous and massively bedded, whilst Us 8 comprises horizontal pin-stripe bedding. Us 11-9 has higher Sr levels than the units above. Us 4 is a massive sand unit characterised by a low silt and clay content (5-8%) and higher Fe, Ti, Zn, Mn and Zr values. A palaeosol developed indicating a relatively stable landscape with vegetation cover as shown in Us 3 and Us 2 with some finer grained sediment with root casts and animal/insect burrows. Us 1 represents the current dune surface. Us 13 at 323 cm was dated using both OSL and IRSL protocols and yielded ages of 13.9±1.0 ka (OSL) and 13.4±0.7 ka (IRSL) (11900 BCE and 11300 BCE respectively). Unit 5 at 193 cm was dated to 10.8±0.7 ka (OSL) and 10.3±0.6 ka (IRSL) (8800 and 8300 BCE). Unit 2 at 60 cm gave modern ages for both OSL and IRSL signals and either represents very recent deposition or most likely heavily bioturbated sediments within the weak aridisol identified. The UAQ D3 profile comprises aeolian dune sands that were emplaced during the late Pleistocene and forms the northern flank of the main dune ridge on which the UAQ2 is located. The dune was trimmed by marine transgression during the Early to Mid-Holocene, truncating part of the mega linear ridge from the rest of the dune located across the sabkha inlet on which UAQ36 is located.

UAQ36 dune

UAQ36 is located close to Dreamland Aqua Park, on the right side of Route 11 on the coastal road to Ras al-Khaimah. The site sits on top of a high and large Pleistocene dune capped with a shell midden. Atkinson *et al.* (2012) previously investigated the dune at UAQ36 as part of a study into the evolution and chronology of the regional dune systems. In 2006, a 7-m exposure was revealed during quarrying of the dune on the edge of a major coastal inlet and Khor complex 1 km northwest of UAQ2. OSL samples were collected and dated from the underlying dune sands exposed in the quarry section. The ages from this site were reported in Atkinson *et al.* (2012), and the site referred to as Umm al-Qawain airstrip UAE06-10. The section comprised two units. The overlying unit was 4.8 m thick, comprising very fine, to

Table 3.4. Radiocarbon dates from UAQ36 showing paired charcoal samples and *Marcia* sp. shells (collected in January 2018). Ages recalculated from Mery et al. (2019) using the Marine 20 calibration (Heaton et al. 2020).

Laboratory	Labcode	Sample name	C14 age		Modelled		Modelled		ΔR	
			BP	±	cal BP (1 σ)	cal BP (2 σ)	cal BCE (1 σ)	cal BCE (2 σ)		±
Mannheim	MAMS 35678	UAQ36 US1819/104 charcoal	5574	25	6393-6310	6399-6302	4443-4361	4451-4352		
Jena (MPI)	P 17769	UAQ36 1819/104 M1 *Marcia* sp.	5946	15	6459-6191	6614-6047	4472-4331	4570-4086	-150	107
Jena (MPI)	P 17770	UAQ36 1819/104 M2 *Marcia* sp.	5943	17						
Mannheim	MAMS 35679	UAQ36 US1840/104 charcoal	5667	24	6484-6405	6499-6357	4528-4455	4548-4447		
Jena (MPI)	P 17771	UAQ36 1836 M1 *Marcia* sp.	5980	15	6483-6302	6601-6321	4479-4419	4508-4387	-191	52
Jena (MPI)	P 17772	UAQ36 1836 M2 *Marcia* sp.	5977	17						

fine pale-grey/buff sand with little internal structure visible. This was capped by a poorly cemented shell-midden horizon of variable thickness, typically 0.2 m - 0.6 m thick, dominated by various bivalve and *Terebralia palustris* bioclasts. This midden equates to UAQ36 sampled during the French Mission study. The underlying unit is darker and displays shallow inclined thick pinstriped laminae dipping north to north-northwest. There were no discontinuities observed in the section. The ages of seven OSL samples were determined ranging from immediately below the shell midden layer at 0.3 m to 6.7 m (Figure 3.4). The shell midden was dated to 4320-3950 BCE (OxA-16858) from a shell of *T. palustris*. The age was recalibrated from that reported in Atkinson *et al.* (2012), using the Marine 20 calibration (Heaton *et al.* 2020) and applying the ΔR -191±52 offset based on the values derived from the same site as reported in section 3.2.2.1 above. The upper unit below the midden was preserved between *c.* 8500 and 7300 BCE (10.4-9.3 ka), with the lower sequence preserved between *c.* 14000 and 13000 BCE (15.9-14.8 ka), suggesting rates of net accumulation of 3.16 m/ka and 1.50 m/ka, respectively. The upper sand unit dates fall within the error range for the basal OSL date from UAQ2 Sector 1&2.

UAQ36 was initially surveyed in 2012 by the French Mission. On the southwest slope of the main mound, a dense shell mound is composed mainly of *Marcia recens* shells, mingled with many *Terebralia palustris* and *Saccostrea cuccullata* shells. In some areas, there are only oyster, in other areas, only *Marcia*. Numerous flint flakes were found. The midden stratigraphy was *c.* 15-20 cm thick corresponding to the lower limit of the depth reported in Atkinson et al. (2012). An Islamic ceramic sherd Bahla Khunj type was also found at the surface of the site. In March 2013, a test trench of 1 m x 0.5 m was dug, drawn and interpreted. In 2016, the trench was extended and all stratigraphic units previously identified were sampled for bone and shell analyses. The ages (Table 3.4) show occupation between 4500-4100 BCE (Méry *et al.* 2019).

These ages correspond well to the recalculated surface age reported in Atkinson *et al.* (2012) of 4300-4000 BCE from the same site. The excavations conducted at UAQ36 show that the occupation phases were brief, not very intense, and suggest a temporary campsite. As the excavation was limited in scope more intense occupation at the site cannot be excluded (Méry *et al.* 2019).

UAQ2 Sectors 1 & 2 A5/B5

In 2000, Adrian Parker, Andrew Goudie and Stephen Stokes visited the site when there was an active sand quarry (Figure 3.5). This revealed an exposure through part of the UAQ2 shell midden as well as the underlying sand dune. The quarry exposure was *c.* 9 m deep. Two OSL samples were collected from the exposure. The first (RAK/00/2) was at the base of the dune (8.2 m below the ground surface) and the second (RAK/00/5) was beneath the exposed stratified midden section (2 m depth). The quarry face sampled was *c.* 5 m from the Sector 1 and 2 A5/B5 section. These yielded ages of 10000-8000 BCE (10.9±1.0 ka) and 15100-13300 BCE (16.2±0.9 ka), respectively, and date the period of dune accumulation to the Late Pleistocene (Marine Isotope Stage 2, MIS2) (Table 3.3). These ages correspond to other Late Pleistocene dune sequences dated in the region at Sharjah, Al-Daith and Awafi, both in Ras al-Khaimah (Goudie *et al.* 2000; Parker and Goudie 2008; Atkinson *et al.* 2011; 2012). At Awafi, dune sands from two periods have been dated. The first corresponds with the Last Glacial Maximum at *c.* 15000 BCE (17 ka) and the latter between 11000-7000 BCE (13-9 ka), during which a phase of rapid sedimentation occurred at 9000-8000 BCE (11-10 ka) (Goudie *et al.* 2000). Geochemical mapping of the dunes in the coastal region of the Rub' al-Khali suggests that dune sands are derived from the aeolian material from the interior of Arabia, weathered materials from the Oman mountains and deflated carbonate-rich sediments from the floor of the then dry Arabian Gulf (White *et al.* 2001).

The trench in Sectors 1 & 2 A5/B5 was excavated in 2012 to a depth of 215 cm (Us 1- Us 30) and extended in the 2013 campaign from 215 cm to 310 cm (Us 31-Us 38) (Figure 3.6). The sediment stratigraphy was recorded in detail (Table 3.5) and 84 sediment samples were collected for geoarchaeological analyses to help characterise the

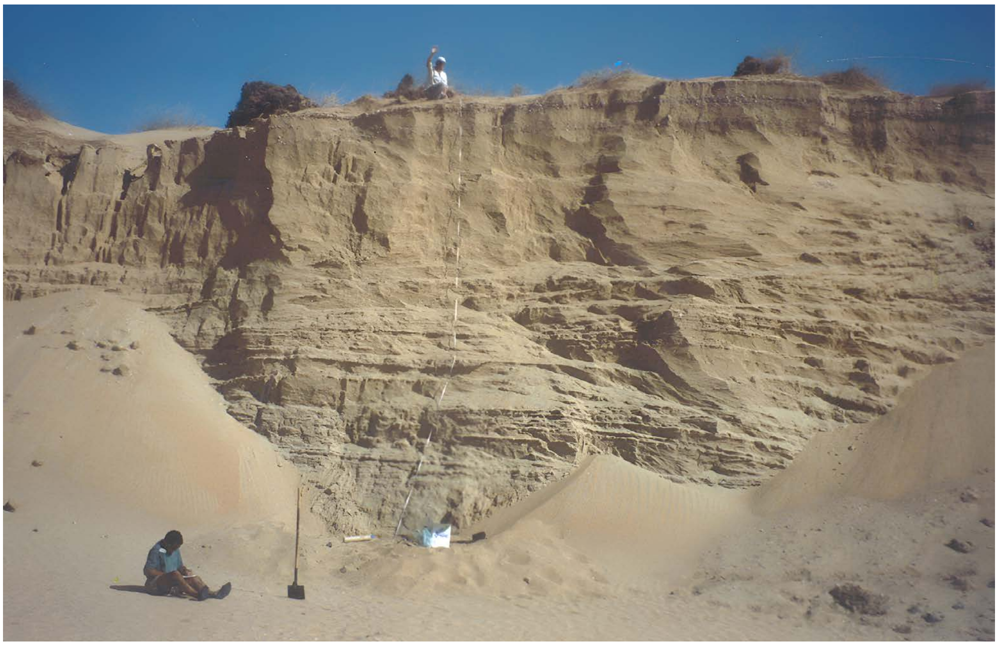


Figure 3.5. A 9 m high quarry section exposed at UAQ2 in 2000. This shows the internal architecture of the dune with bounding surfaces showing several planation phases with clear erosional contacts between phases of dune development and accumulation.

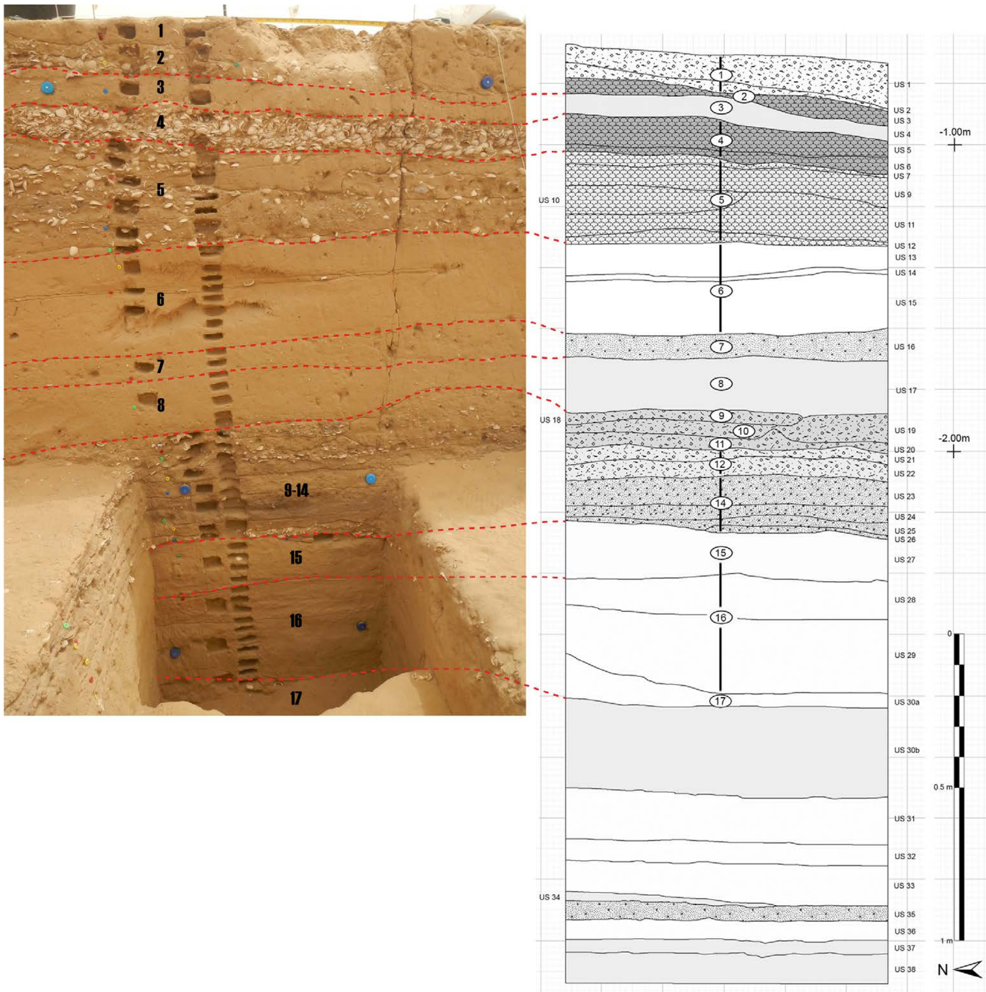


Figure 3.6. Sediment section through Sector 1+2 A5/B5. Base of photo shows level 17 at 2.5 m below the surface (Us30), which is the lowest occupation level. The section was extended into the underlying dune (Us31-38) to a depth of 3.0 m.

Table 3.5. Sediment description for Sector 1+2 A5/B5 profile. Rows highlighted in grey denote occupation layers and those in white aeolian sand-rich sterile or with limited evidence for occupation.

Depth (cm)	Description
0-9 cm	Surface level. Aeolian sand, beige, powdery. 10YR 6/3. Corresponds to Us 1. Level 1 in Sectors 1 and 2.
9-13 cm	Aeolian fine sand, beige. 10YR 6/3. Many highly fragmented shells of *M. recens* plus *T. palustris*, *H. kuesterianus* lying flat. Relatively dense in shells (5% of the volume of the sediment). Us 2 Corresponds to Level 1 in Sectors 1 and 2.
13-16 cm	Aeolian sand, beige. Very dense in shells (25%). Valves of *M. recens* plus fragments measuring several cm. Us 3, Corresponds to Level 2 in Sectors 1 and 2
16-24 cm	Aeolian sand, beige. Few shells (2%), *M. recens* plus *T. palustris*, fragments measuring several mm to several cm. Us 4. Corresponds to Level 3 in Sectors 1 and 2
24-34 cm	Aeolian sand, beige. Very dense in shells (50%), with intact valves. *M. recens* lying flat. Us 5, corresponds to Level 4 in Sectors 1 and 2.
34-38 cm	Aeolian sand, beige. Dense in shells (10%). Valves of *M. recens*, lying flat, plus *T. palustris*. Us 6, orresponds to Level 4 in Sectors 1 and 2.
38-42 cm	Aeolian sand, beige. Not dense in shells (2%) Some fragments and valves of *M. recens* and *T. palustris.* Us 7 corresponds to Level 5 in Sectors 1 and 2.
Not present in main section	Visible only in the northern part of the section. Aeolian sand, beige. Very dense (50%) fragments of *H. kuesterianus* measuring several cm. Us 8 corresponds to Level 5 in Sectors 1 and 2.
42-48 cm	Aeolian sand, beige. Valves of *M. recens*, lying flat, relatively dense (5%). Us 9 corresponds to Level 5 in Sectors 1 and 2.
48-58 cm	Aeolian sand, light grey. Fragments of *T. palustris* measuring several cm, plus fragments of *M. recens* measuring several mm to several cm. Relatively dense (5%). Us 10 corresponds to Level 5 in Sectors 1 and 2.
58-64 cm	US 11 corresponds to Level 5 in Sectors 1 and 2. Aeolian sand, beige. Few fragments (2%) of shells, measuring several mm to several cm, with *M. recens*, *H. kuesterianus* and *T. palustris* not oriented.
64-67 cm	US 12 corresponds to Level 5 in Sectors 1 and 2. Aeolian sand, beige. Few valves (2%) of *M. recens*
67-81 cm	US 13: it corresponds to Level 6 in Sectors 1 and 2. Aeolian sand, beige. Few fragments (2%) measuring several mm of *M. recens*
81-82 cm	US 14: it corresponds to Level 6 in Sectors 1 and 2. Aeolian sand, beige. Rare valves (2%) of *M. recens*, lying flat.
82-100 cm	US 15: it corresponds to Level 6 in Sectors 1 and 2. Aeolian sand, beige. Few fragments of shells (2%) measuring several mm.
100-107 cm	US 16: it corresponds to Level 7 in Sectors 1 and 2. Aeolian sand, beige. Few fragments of *M. recens* (2%) measuring several mm.
107-125 cm	US 17: it corresponds to Level 8 in Sectors 1 and 2. Aeolian sand, beige. Few fragments of *M. recens* (2%) measuring several mm
125-129 cm	US 18: it corresponds to Level 9 in Sectors 1 and 2. Aeolian sand, beige. Dense in shells (10%). Fragments measuring several cm of *M. recens* plus *S. cuccullata*
129-133 cm	US 19: it corresponds to Level 10 in Sectors 1 and 2. Aeolian sand, beige. Few fragments of shells (2%) measuring, few mm plus some fragments of *H. kuesterianus* and *M. recens* measuring several cm.
133-137 cm	US 20: it corresponds to Level 11 in Sectors 1 and 2. Aeolian sand, beige. Dense in shells (10%). Valves of *M. recens* lying flat.
137-143 cm	Aeolian sand, beige. Few valves and small fragments of *M. recens* (<2%). Us21 corresponds to Level 12 in Sectors 1 and 2.
143-148 cm	Aeolian sand, beige. Very few small fragments of shells (< 2%). Us 22, Level 12
148-158 cm	Aeolian sand, brown-black. The colour is heterogeneous in the deposit. Few fragments of *H. kuesterianus* measuring some cm (< 2%). Us 23, Level 14
158-163 cm	Aeolian sand, beige-grey. Few fragments of *H. kuesterianus*, measuring some cm (< 2%). Us 24, Level 14
163-165 cm	Aeolian sand, beige. Relatively dense in fragments of *H. kuesterianus*, measuring some cm (10 %). Us 25, Level 14

Depth (cm)	Description
Not present in sampled section	Aeolian sand, beige. Almost sterile. One valve of *M. recens* Fragments of shells < 375μm. Concentration 5%. Us 26, Level 14
165-183 cm	Aeolian sand, beige-orange. Fragments of shells < 500μm. Concentration 25%. Us27, Level 15 – sterile.
183-196 cm	Aeolian sand, beige. Fragments of shells < 375μm. Concentration 5%. Us28, Us 28, Level 16
196-215 cm	Aeolian sand, beige. Fragments of shells < 375μm plus to valves of shell. Concentration 5%. Us29, Level 16
215-219 cm	More cemented medium fine sand with shell fragments. More grey (10YR 6/3). Section thins away from trench. Massive, no bedding structures. Level 16
219-248 cm	Medium-fine sand with no bedding structures. More red and less cemented with minor sub-mm shell fragments (10YR 6/4). Marcia shell at 220 cm for ^{14}C found at contact between Us30a and b. Lowermost anthropic layer. Very diffuse bedding structures with numerous alternating fine (30b1) to medium (30b2) sand beds. OSL 6 – 220-225 cm. Level 17
248-263 cm	Fine sand with minor sub-mm shell fragments. Slightly more grey and more cemented (10 YR 6/3). Massive. Us31.
263-270 cm	Very fine-fine sand (10YR 6/3). Fewer shell fragments. Minor horizontal bedding. More cemented. Us 32-33.
270-278 cm	Very fine-fine sand (10YR 6/3). Slight angle to bedding, thinning out of the section. Slight increase in shell fragments. Minor horizontal bedding. More grey in colour US 34.
278-283 cm	Fine sand. Red (10YR 6/4). More shell fragments up to 2 mm. Pinches out and thickens into section US35-36.
283-289 cm	Fine –medium sand (aeolian) (10YR 6/4). More orange, less cemented, becoming very fine sand with some horizontally bedded shell fragments at the base. OSL 5 285-290 cm. Us 37.
289-296 cm	Horizontal, very fine to fine sand (10YR 6/3). More grey and more cemented. Very few shell fragments (sub-mm). Us 38.

nature of the sediments and site depositional processes. The sequence was divided into 36 sedimentological units (Us 1-38) and 17 Levels (L1-17). The sequence was described from the base (Us36) upwards to the top of the sequence (Us1). Five OSL and 38 radiocarbon samples were dated from the sequence and are shown in Tables 3.3 and 3.6, and the age depth profiles for all samples are shown in Figure 3.7. The radiocarbon samples show some spread across some of the units and levels. This was in part due to multiple samples being collected and dated from the same horizons but for different selected shell species, which may have different marine reservoir values (*sensu* Lindauer 2019). Due to the lack of charcoal preservation in the sections, no paired dating was conducted to determine the reservoir offset values for each species. Paired charcoal and *Marcia* sp. shell dating was previously undertaken at UAQ36 and the marine reservoir age determined (see the Radiocarbon Chronology section). As a result, the radiocarbon samples were filtered to select *Marcia* sp. shell ages only to reduce noise in the sequence. These are also presented in Figure 3.7 alongside the unfiltered chronology. The sedimentological properties are shown in Figure 3.8 and the geochemical results in Figure 3.9.

Units 38-30 (310-220 cm) – Latest Pleistocene and Early Holocene

Us 38-30 (310-215 cm) pre-dates the rest of the sections excavated at UAQ2 and contains the longest and oldest sequence from the site. The basal sediments of Sector 1&2 A5/B5 (Figure 3.8, Table 3.5) were exposed in the deep sounding and comprise aeolian sands with some millimetre-size shell fragments. These units comprise pale brown (10YR 6/3) to light yellowish brown (10 YR 6/4), moderately well to well sorted, near symmetrical, mesokurtic, fine sands that coarsen up-profile from ~125 μm at the base to ~155 μm at 230 cm. The sediment size fraction was dominated by sand (96-99%) with a low silt component (up to 3%) and no clays. Silt content is higher in Us 38, 33 and the upper half Us 30. The organic content of Us 38-30 is characteristically low (less than 2%), with a low carbonate content as well (~20-22%) in Us 38-30. In the upper part of Us 30, this increases to 26%). The inorganic

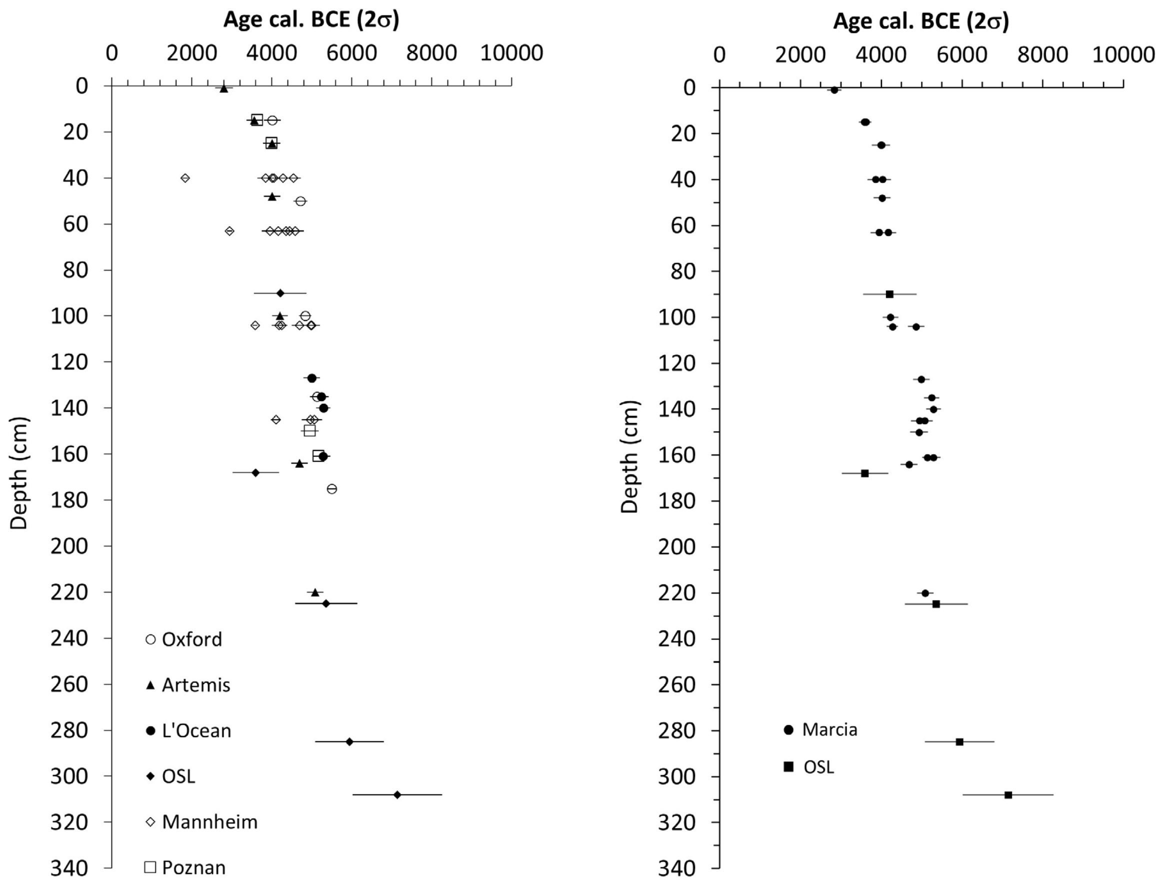


Figure 3.7. Age depth diagram in BCE (left) for all calibrated (2σ) radiocarbon samples and OSL ages and (right) for calibrated (2σ) *Marcia* sp. shell samples and OSL ages from Sectors 1 and 2 A5B5.

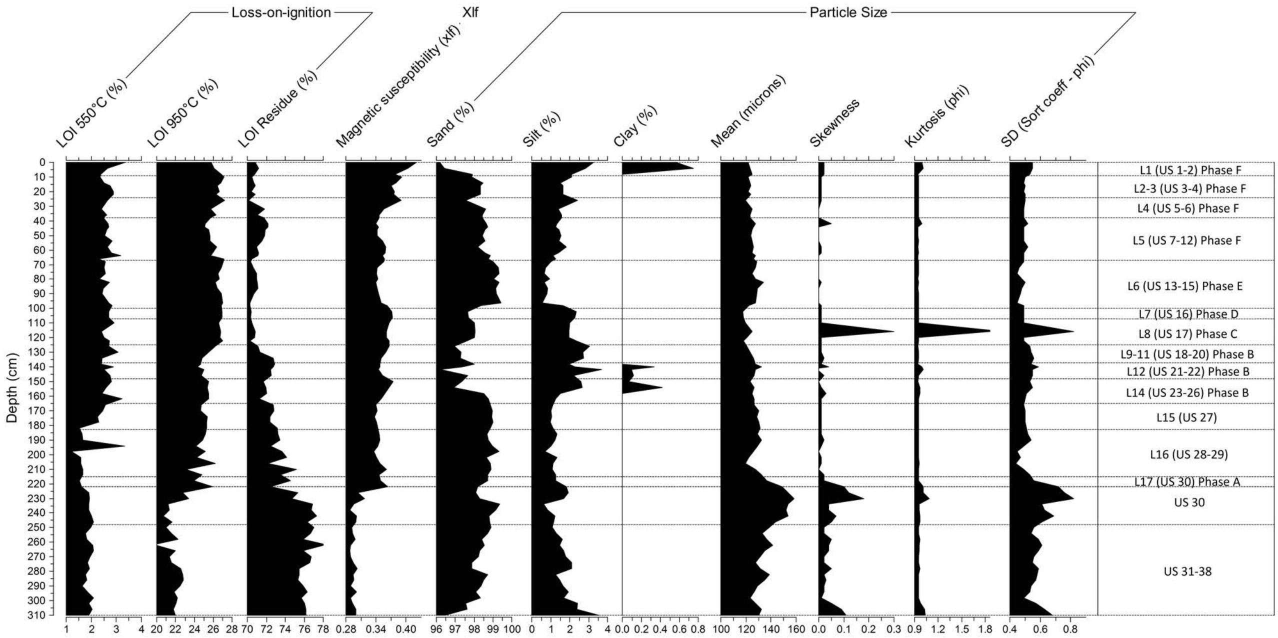


Figure 3.8. Physical properties of the UAQ2 Sector 1+2 A5/B5 sequence.

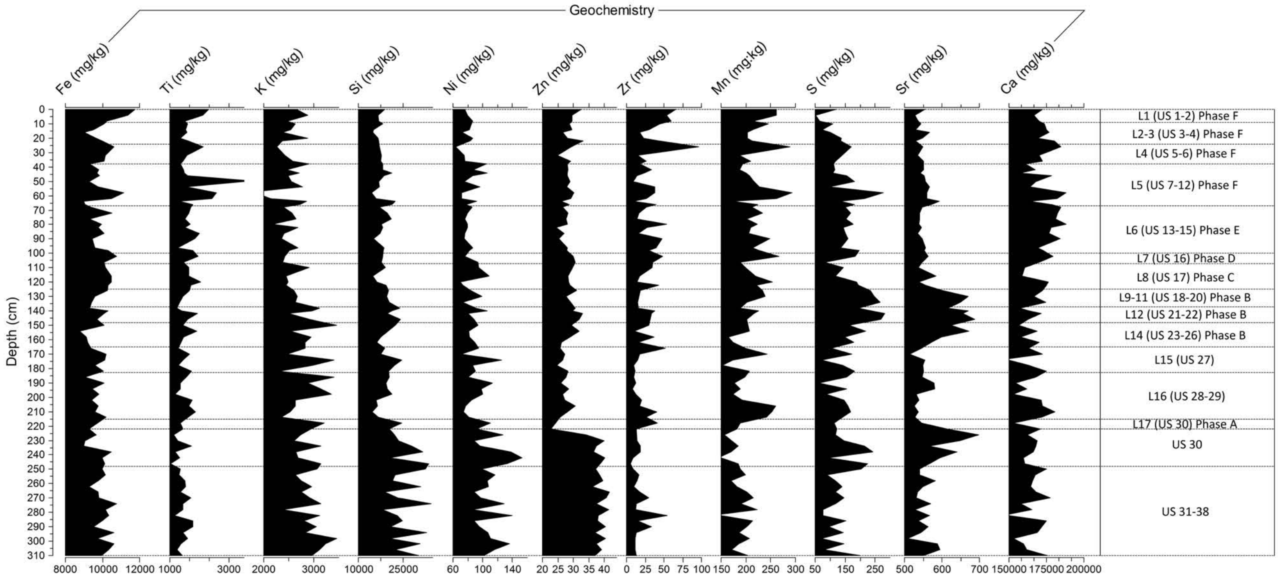


Figure 3.9. Geochemical properties of the UAQ2 Sector 1+2 A5/B5 sequence.

fraction is typically high (75-77%) but decreases in the upper half of Us 30 to 72%. Magnetic susceptibility (χ_{lf}) values are typically low (~0.30 x 10^{-6} kg m^3) until 225 cm, when they increase to 0.36 x 10^{-6} kg m^3. The geochemical sequence (Figure 3.9) in Us 38-30 tend to show high values for Si, Ni, Zn, K and Fe when compared to the rest of the sequence, whilst values for Zr, Mn, Sr, S and Cl tend to be low. In the lower half of Us 30 Si, Ni and Zn are at their highest values. In Us 30, Sr and S values increase with a peak in Sr at 225 cm. The high values for Si, Ni and Zn indicate a detrital component, most likely derived from the Hajar Mountains from weathered ophiolite, as well as materials reworked from Miocene deposits found in Abu Dhabi, and most likely represents aeolian accumulation with a difference provenance to the overlying Aeolian sand components. The low carbonate content (~22%) suggests that clastic input derived from the exposed bed of the Arabian Gulf may not have been the key component for aeolian material at this time. The base of the sequence (Us 38 at 308 cm) was dated to 8260-6020 BCE (9.1±0.6 ka) by OSL. Us 35 (285 cm) was dated to 6800-5080 BCE (7.9±0.4 ka), showing a slow rate of sediment accumulation (~1.6 cm per century), which might reflect a phase of low dune activity during the Early Holocene and low deposition rates. An OSL date at 225 cm (Us 30, Layer 17) gave an age of 6140-4580 BCE (7.3±0.4 ka). Increased sediment deposition occurred during the time of deposition (~10 cm per century). Increased aeolian flux rates have been observed from lake sediment records in the region between 6100-5700 BCE that are linked to an increased phase of aridity in the Early Holocene across SE Arabia at this time (Parker *et al.* 2016). This may be supported by the increase observed in mean particle size here in the UAQ2 sequence. No artefacts were found in the lower units (Us 38-31).

Unit 30 (220-215 cm) – Phase A (Level 17) – Middle Neolithic

Level 17 (Us 30) is the lowest occurrence of anthropogenically derived shell material noted from the section and corresponds with the peak in Sr and S. Level 17 was also located in Sector 7 (see below), where a greater number of *Marcia* shells verify the occupation layer suggested in Sector 1&2. A single valve of *Marcia* in L17 (Us 30), at 220 cm, was radiocarbon dated to 5500-5140 BCE (Ly-10973/SacA36348). Whilst some very small shell fragments were found lower down the sequence (Us 35), these are most likely to be derived from deflated and reworked, coastal shell material during lower sea level conditions (cf. Bernier *et al.* 1986; Lambeck 1996).

Units 29-27 (220/215-165 cm) – Early Holocene (Levels 16-15)

The interface between Us 30 and Us 29 is sloped and varies between 220 cm on the northern side of the section, dipping sharply to 215 cm on the southern side with a sharp, clearly defined contact between these two units. Overall, the units comprise yellowish-brown aeolian well sorted, near symmetrical, mesokurtic, very fine sands with a mean particle size of 120-130 µm. There is an increase in organics, which are low in Us 29 (~1.6%) to 3 % in Us 25-23. Carbonates account for ~25% of the sediment matrix. The clastic, minerogenic component shows a steady decline up profile in these units to ~72%. In Us 29-

27 the sand fraction is high at ~ +98%, with very low silt and no clay fraction. Us 29 and 28 correspond to L16. In Us 29 there is a decrease in Si and Zn when compared to the lower units. Sr and S values are low in Us 29-27. Us 27 corresponds with L15, which contained no evidence for occupation at UAQ2. An OSL date from the top of Layer 15 gave an age of 4180-3020 BCE (5.6±0.3 ka, UAQ2-OSL4). This gave a young age, which may be due to burning from the above layers affecting the dose rate and OSL signal.

Units 26-18 (165-125 cm) – Phase B (Levels 14-9) – Middle Neolithic

In Us 23-21, there is a distinct increase in finer grained sediments with silts (up to 3%) with some clays. These units comprise a series of stratified and interbedded shell deposits rich in structures, including post-holes, pits, and fireplaces with evidence of burning in individual units. Magnetic susceptibility shows higher values with a peak in Us 23 (L14), which is most likely associated with burning. Activities are related to the exploitation of marine, mangrove as well as inland resources. S and Sr show distinct increases in Phase B, which is likely associated with the burning of shell material. This phase is likely to reflect a phase on increased landscape stability with reduced aeolian activity and intense occupation phase at the site. The lower units in Phase B comprise shells including *Hexaplex kuesterianus*, whilst towards the top of the phase the shells show dominance in *M. recens*. Flint and shell tools (mainly in *Callista* spp.) were present throughout Phase B. Knapping and retouching of lithics (flint, radiolarite, calcedony, quartz, and rock crystal) are evident throughout. Level 12 is the result of intense activities related to food preparation and consumption, mainly from lagoon and mangrove resources. The chronology for this section is complex, with some age inversions. This is likely due to the intense, rapid shell accumulation and reworking of materials during phases of shell processing, including the digging of fire hearths. In addition, ages vary due to differing reservoir effects across species dated (Fig. 3.7). Using only the *Marcia* sp. ages, this phase of occupation dates between *c.* 5650-4950 BCE, with most ages overlapping at the 2σ range, so are statistically indistinguishable. This marks the peak in Holocene rainfall across the region at this time, as denoted in the Hoti Cave speleothem record (Fleitmann *et al.* 2007).

Units 17-13 (125-67 cm) – Phases C, D, E (Levels 8-6) – Transition Middle to Late Neolithic

Within Us 17 (L8) there is a distinct change in sediment characteristics to finely skewed, very leptokurtic and moderately sorted fine sands. Stratigraphically homogeneous in composition (yellowish fine sand), these characteristics are almost identical to those shown in the lowermost aeolian sediment facies below Us 30 (L16) and are interpreted as being emplaced under a more arid phase. Degli-Esposti *et al.* (2019) recorded a similar layer, almost identical in composition, at Umm al-Quwain UAQ38. Almost no structures (only one fireplace) were found in Level 8, however, 669 artefacts and pieces of raw material were found, making this is the richest level for artefacts after Level 11. The geochemistry shows a sharp fall in Sr and S levels from L8, and an increase in aeolian sand content (~99%) in L6 (Us 15-13, 100 cm - 67 cm), with a slight increase in mean particle size to *c.* 140 microns. The fall in Sr and S is most likely associated with the lack of processed shell and fish material when compared to the Phase B levels. No ages were directly determined from Level 8. Note however that it is possible that the sample Jena 171115 represents a reworked shell which could have been originally associated with the occupation of Level 8, as it provided a date to around 5190-4780 BCE.

Level 7 (Phase D) comprises a much thinner unit (Us 16 – *c.* 7 cm thick) than Level 9. Evidence for occupation is scarcer, with no evidence of fireplaces or post-holes present and only occasional shells and shell fragments of *Marcia* sp. and *Terebralia palustris*, along with some knapping debitage. The chronology for Phase D (Level 7) is based on seven radiocarbon dates, two of which were from *Marcia* sp. However, inconsistencies were observed in the results, particularly those from *T. palustris*, which yielded older dates. These dates fall within the same range as Phase B (Levels 14–9) and likely represent reworked shells. Among the samples, Jena 171111 appears to be the most reliable for dating Level 7, providing a range of *c.* 4430–4070 BCE. This range can be further refined using dates from Level 6, which fall between roughly 4670 and 4270 BCE. This suggests a chronological gap of at least 400 years between Level 9 (dated *c.* 5054 at the latest) and Level 7.

Within Phase E, Level 6 comprised a thick accumulation (up to 30 cm) of yellowish-brown aeolian sand, with two main layers separated by a thin lens of near horizontally bedded *Marcia* sp. valves representing a brief phase of occupation. By linking dates from Level 7, Level 6 can be placed around 4430-4270 BCE. This is further corroborated by an OSL date from the Level 6 (Us14) aeolian unit, which yielded an age range of 4210–3550 BCE (6.2±0.7 ka, UAQ2-OSL8). Stratigraphic evidence indicates that this aeolian unit was deposited after the archaeological activity associated with Level 6.

These units mostly comprise aeolian sands with only sporadic evidence for occupation. Phases C, D, and E (Levels 8–6) indicate a shift towards more arid conditions, characterised by increased aeolian deposition. This change has evidently influenced the archaeological deposition conditions and their taphonomy.

Table 3.6. Radiocarbon ages from Sector 1+2 A5B5, Sector 5 and the 2005 samples collected from the open quarry face section for the corresponding archaeological levels across the site showing ^{14}C age and calibrated ages in BP and BCE (2σ).

Laboratory	Lab Code	Sample	Depth (cm)	Sector	Unit (Us)	Level	Age 14C BP	Error ±	Cal BP (2σ) Lower	Cal BP (2σ) Upper	Cal BP Error ± (2σ)	Cal BCE (2σ) Lower	Cal BCE (2σ) Upper	Cal BCE Error ± (2σ)
Lyon 1 ARTEMIS	Ly-10975	Marine shell (*Marcia* sp.)	1	1 (B5)	1	1	4765	30	5280	4856	212	3331	2907	212
Oxford	OxA-16746	Marine shell (*Terebralia palustris*)	15	2005	3	2	5220	36	5810	5390	210	3861	3441	210
Lyon 1 ARTEMIS	Ly-10969	Marine shell (*Marcia* sp.)	15	1 (B5)	3	2	5390	30	5945	5580	183	3996	3631	183
Poznan	Poz-72250	Marine shell (*Marcia* sp.)	15	5 (O17)	3	2	5400	35	5964	5586	189	4015	3637	189
Poznan	Poz-72318	Marine shell (*Marcia* sp.)	25	5 (O17)	5	4	5770	40	6379	5980	200	4430	4031	200
Lyon 1 ARTEMIS	Ly-10970	Marine shell (*Marcia* sp.)	25	1 (B5)	5	4	5785	30	6382	5998	192	4433	4049	192
Jena	P-13298	Ash	40	1 (B5)	7	5	3511	25	3869	3696	87	1920	1747	87
Jena	P-13299	Marine shell (*Marcia* sp.)	40	1 (B5)	7	5	5663	42	6268	5889	190	4319	3904	190
Jena	P-13300	Marine shell (*Marcia* sp.)	40	1 (B5)	7	5	5796	45	6401	5992	205	4462	4043	205
Jena	P-13301	Marine shell (*Terebralia palustris*)	40	1 (B5)	7	5	5839	37	6451	6078	202	4502	4099	202
Jena	P-13302	Marine shell (*Terebralia palustris*)	40	1 (B5)	7	5	6065	46	6700	6292	204	4751	4343	204
Jena	P-13303	Marine shell (*Terebralia palustris*)	40	1 (B5)	7	5	6299	28	6965	6555	205	5016	4606	205
Lyon 1 ARTEMIS	Ly-10971	Marine shell (*Marcia* sp.)	48	1 (B5)	9	5	5795	30	6390	6005	193	4441	4056	193
Oxford	OxA-16790	Marine shell (*Terebralia palustris*)	50	2005	10	5	5904	35	6530	6143	194	4581	4194	194
Jena	P-13292	Ash	63	1 (B5)	11	5	4294	26	4956	4829	64	3307	2880	64
Jena	P-13293	Marine shell (*Marcia* sp.)	63	1 (B5)	11	5	5742	26	6320	5947	187	4371	3998	187
Jena	P-13294	Marine shell (*Marcia* sp.)	63	1 (B5)	11	5	5953	49	6594	6186	204	4645	4237	204
Jena	P-13295	Marine shell (*Terebralia palustris*)	63	1 (B5)	11	5	6120	41	6763	6345	209	4814	4396	209
Jena	P-13296	Marine shell (*Terebralia palustris*)	63	1 (B5)	11	5	6193	40	6851	6424	214	4902	4475	214
Jena	P-13297	Marine shell (*Terebralia palustris*)	63	1 (B5)	11	5	6343	46	7041	6590	226	5092	4641	226
Oxford	OxA-15819	Marine shell (*Terebralia palustris*)	100	2005	15	6-7	5974	34	6600	6216	192	4651	4267	192

Laboratory	Lab Code	Sample	Depth (cm)	Sector	Unit (Us)	Level	Age 14C BP	Error ±	Cal BP (2σ) Lower	Cal BP (2σ) Upper	Cal BP Error ± (2σ)	Cal BCE (2σ) Lower	Cal BCE (2σ) Upper	Cal BCE Error ± (2σ)
Lyon 1 ARTEMIS	Ly-10972	Marine shell (*Marcia* sp.)	100	1 (B5)	15	6-7	5990	30	6620	6244	188	4671	4295	188
Jena	P-171128	Ash	104	1 (B5)	16	7	4765	21	5581	5471	55	3632	3522	55
Jena	P-171111	Marine shell (*Marcia* sp.)	104	1 (B5)	16	7	5795	15	6384	6014	185	4435	4065	185
Jena	P-171112	Marine shell (*Marcia* sp.)	104	1 (B5)	16	7	6680	20	7363	6989	187	5414	5040	187
Jena	P-171116	Marine shell (*Hexaplex kuesterianus*)	104	1 (B5)	16	7	5975	15	6593	6229	182	4644	4280	182
Jena	P-171113	Marine shell (*Terebralia palustris*)	104	1 (B5)	16	7	6695	20	7381	7009	186	5432	5060	186
Jena	P-171114	Marine shell (*Terebralia palustris*)	104	1 (B5)	16	7	6670	20	7351	6979	186	5402	5030	186
Jena	P-171115	Marine shell (*Terebralia palustris*)	104	1 (B5)	16	7	6435	20	7136	6728	204	5187	4779	204
LOCEAN Paris	LOC-235	Marine shell (*Marcia* sp.)	127	1 (B5)	18	9	6692	25	7380	7003	189	5431	5054	189
Oxford	OxA-16789	Marine shell (*Pinctada radiata*)	135	1 (B5)	20	11	6232	35	6893	6472	211	4944	4523	211
LOCEAN Paris	LOC-236	Marine shell (*Marcia* sp.)	135	1 (B5)	20	11	6921	29	7570	7253	159	5621	5304	159
LOCEAN Paris	LOC-237	Marine shell (*Marcia* sp.)	140	1 (B5)	21	12	6974	29	7618	7295	162	5669	5346	162
Jena	P-171129	Ash	145	1 (B5)	22	12	5245	20	6171	5929	121	4222	3980	121
Jena	P-171117	Marine shell (*Marcia* sp.)	145	1 (B5)	22	12	6655	20	7332	6961	186	5383	5012	186
Jena	P-171118	Marine shell (*Marcia* sp.)	145	1 (B5)	22	12	6755	20	7424	7083	171	5475	5134	171
Poznan	Poz-72320	Marine shell (*Marcia* sp.)	150	2 (H3)	23	14	6650	40	7341	6941	200	5392	4992	200
Poznan	Poz-72635	Charcoal	161	3 (D0)	24	14	6200	35	7245	6990	128	5296	5041	128
LOCEAN Paris	LOC-238	Marine shell (*Marcia* sp.)	161	1 (B5)	24	14	6960	26	7602	7285	159	5653	5336	159
Lyon 1 ARTEMIS	Ly-10974	Marine shell (*Marcia* sp.)	164	1 (B5)	25	14	6430	30	7137	6717	210	5188	4768	210
Oxford	OxA-16791	Marine shell (*Pinctada radiata*)	175	2005	27	15	6590	35	7278	6884	197	5329	4935	197
Lyon 1 ARTEMIS	Ly-10973	Marine shell (*Marcia* sp.)	220	1 (B5)	31	17	6770	35	7448	7088	180	5499	5139	180
LOCEAN Paris	LOC-165	Marine shell (*Marcia* sp.)	55	5	10	5	5677	32	6269	5906	182	4320	3957	182
LOCEAN Paris	LOC-166	Marine shell (*Hexaplex kuesterianus*)	180	5	27	15	6555	31	7247	6852	198	5298	4903	198
LOCEAN Paris	LOC-164	Marine shell (*Marcia* sp.)	195	5	28	16	6741	30	7420	7061	180	5471	5112	180

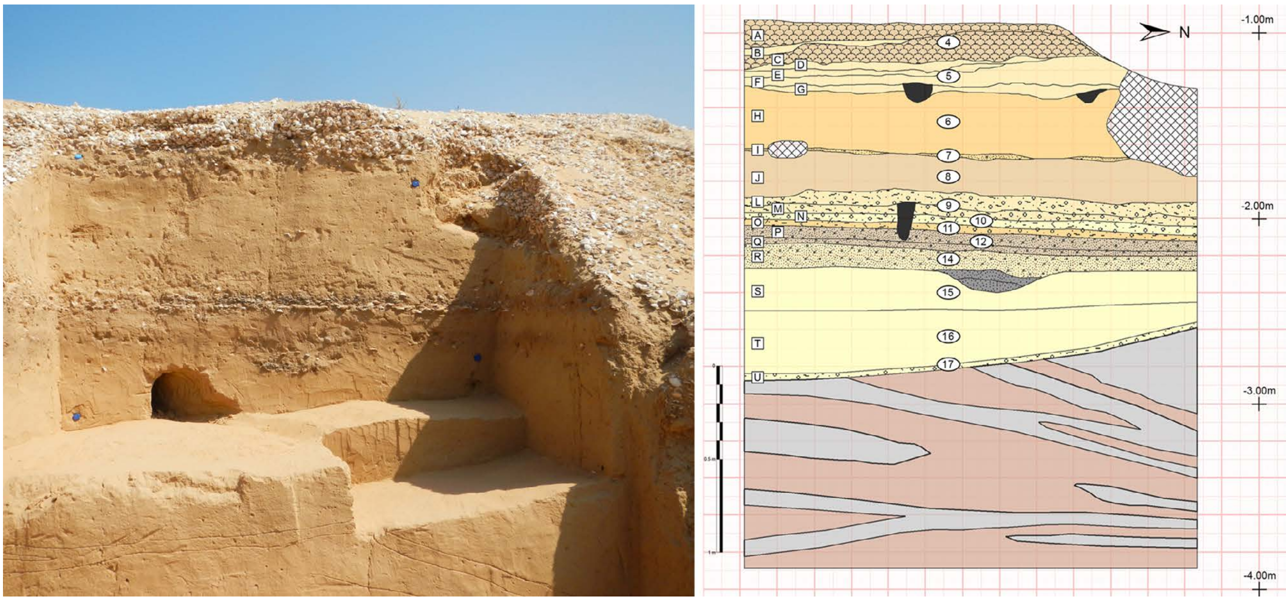


Figure 3.10. Sector 7 with Level 17 (=Us 30) exposed at the bottom of a small sounding with *Marcia* sp. and *Circe* sp. shells representing the earliest phase of occupation at UAQ2. The contact represents a bounding surface where the original dune has been truncated by aeolian erosion and deflation of the underlying red sand units, overlain by a later phase of aeolian deposition.

Units 12-3 (67 cm - 9 cm) – Phase F (Levels 5-2) – Late Neolithic

Levels 5 to 2 (Phase F) are characterised by huge accumulations of shells separated by thin layers or lenses of aeolian sand. Mean particle size is relatively constant across all Levels, c. 120 microns, comprising near symmetrical, mesokurtic, well-sorted sand. There is an increase in silt content (c. 2%) compared to L6 below. Some minor peaks in S and Sr are observed, which, along with increasing MS values, may be associated with the processing/burning of shell/fish materials at the site. L5 comprises six units (Us 12-7) based mostly on the variation in shell density and ash contents observed in these units. L5 has an increase in magnetic susceptibility, most likely related to the burning of shell material. Artefacts recovered from Level 5 are low.

Level 4 (Us 6-5) comprises a yellowish-brown (10 YR 5/4) fine sand layer, which is very dense in shells (up to 50%), with multiple sub-layers of intact horizontally bedded *Marcia* sp. valves. Intact or fragmented valves of *Marcia* sp., burnt or unburnt, represent two-thirds of the shell waste, and *Terebralia palustris* are more numerous than *Hexaplex kuesterianus*. Compared to Level 5, fewer objects were found from this level across the site, mostly comprising lithic debitage. Seven *Marcia* sp. shells were dated from Levels 5 and 4 (Us 12-4) to 4650-3940 BCE. All these ages overlap at the 2σ range and represent multiple brief phases of occupation at the site over a relatively short period of time.

Level 3 (Us 4) is a 3-14 cm-thick layer of yellowish-brown aeolian fine sand unit and includes few valves of *Marcia* sp. and shell fragments. This level is almost sterile with very low artefact density comprising occasional lithic debitage. This unit was not dated. Level 2 (Us 3) comprises a yellowish-brown (10 YR 5/4) fine sand layer, dense in shells (up to 25%). It is up to 20 cm thick and is the last well-defined occupation layer at the site. The shell composition is different from Levels 5 to 3 with *Marcia* sp, accounting for ~95%, and artefact density is also very low. Two *Marcia* sp. shells from Level 2 (Ly-10969 and Poz-72250) yielded almost identical ages of 4015-3630 BCE. Level 2 is younger than for Levels 5 and 4, with no statistical overlap at the 2σ range between these Levels (Table 3.6). This indicates a chronological gap in occupation between Levels 5/4 and Level 2, which are separated by aeolian Level 3. Level 1 (Us 2-1) shows an increase in the silt and clay fractions, along with an increase inorganic content and χ_{lf} values. This most likely relates to weak pedogenic development at the surface. A *Marcia* sp. shell at the surface in Level 1 was dated to *c.* 3330-2910 BCE.

UAQ2 Sector 7

Phase A (Level 17) – Late Pleistocene/Early Holocene and Middle Neolithic

Sector 7 provided the opportunity for tracing US30 (Level 17) across from Sectors 1 and 2. It also permitted insight into the dune's sedimentological stratigraphy. The different levels were labelled with letters following an independent order (Figure 3.10); these were then correlated with the general sequence of the site.

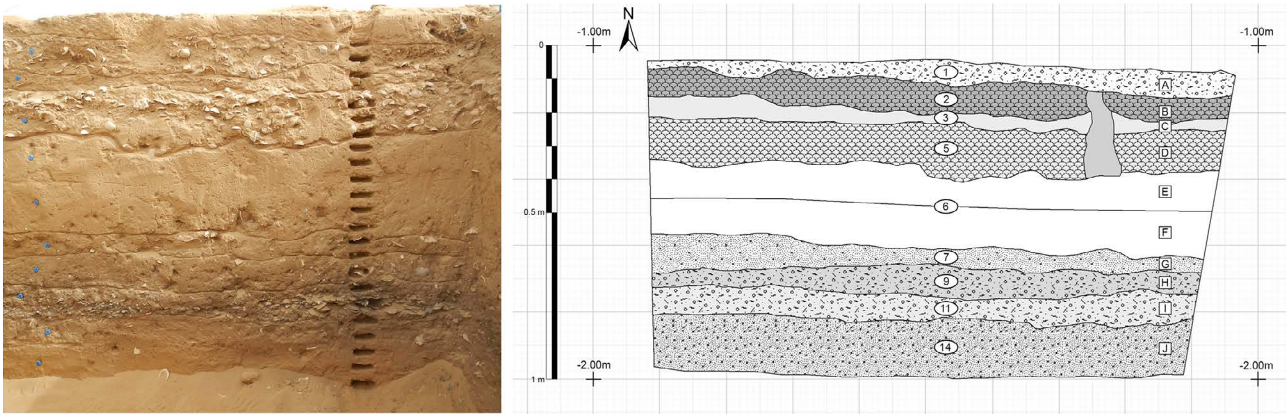


Figure 3.11. Sediment profile for UAQ2 Sector 3 T23 showing stratigraphy and sample locations.

Table 3.7. Sediment description for Sector 3 T23 profile indicating Units (Us) and Levels. Levels highlighted in grey represent occupation layers; rows in white relate sterile or low occupation levels.

Depth (cm)	Description	Us	Level
0-12 cm	Aeolian sands at surface, beige, very loose.	Us 1 A	1
12-18 cm	Dense shell layer (*M. recens*, plus *S. cuccullata* and *T. palustris*). Sand thickens towards the north-east. A concentration of *T. palustris* (C5) was observed in square S23.	Us 2 B	2
18-23 cm	Aeolian sand, beige, and almost sterile.	Us 3 C	3
23-36 cm	Dense shell layer, mostly *M. recens*, plus *S. cuccullata* and *T. palustris.*	Us 4 D	5
36-48 cm	Aeolian sand, beige, and almost sterile. Few fragments or valves of *M. recens.*	Us 5 E	6.1
48-61 cm	Aeolian sand, beige, and almost sterile. Darker than Us5	Us 6 F	6.2
61-67 cm	Aeolian sand, beige, with *H. kuesterianus* and *S. cuccullata.* Very few *M. recens*, except in two concentrations of intact valves, C8 and C9 (square S22).	Us 7 G	7
67-73 cm	Aeolian sand, interface between level 7 and Level 11. The level becomes progressively grey, with an increase of the density of *M. recens.* One concentration of stones, C14, and one concentration of valves of *M. recens*, C15.	Us 8 H	9
73-82 cm	Black level, dense in fragmented shells. Two hearths, F16 (*T. palustris* plus *H. kuesterianus)* and F17 (valves of *M. recens*), and one concentration of *M. recens*, C16.	Us 9 I	11
82-94 cm	Ashy, aeolian sand, beige. Few *H. kuesterianus*, *S. cuccullata*, fishbone. Two hearths, F19 and F20. Ashy sand.	Us 10 J	14
94-100 cm	Aeolian sand, beige, almost sterile.	Us 11	15

Below the main anthropogenic sequence, which occurred between Levels 1 to 14, a series of thick, sterile sandy layers were identified corresponding to Us 28-29. A distinct erosional contact, denoted by a clear bounding surface, inclined westwards, was visible. At the contact of this horizon, a thin layer characterised by the presence of flat-lying *Marcia* and *Circe* shells was found. This layer was correlated with Level 17 (Us 30) in Sector 1 and 2, which too had an inclined contact with the underlying sterile sands (corresponding to Us 21-38 in Sectors 1 and 2 A5/B5). Significantly, the inclination of Level 17/Us 30 from east to west is in contrast to that of the underlying sandy deposits. This indicates a substantial erosive event that altered the dune morphology prior to the first episode of human occupation at the site.

The lower, geological sandy layers displayed pin-stripe banding, with reddish, more coarsely grained levels alternating with finer grained pale yellow ones, mirroring the succession of wind-blown accumulations.

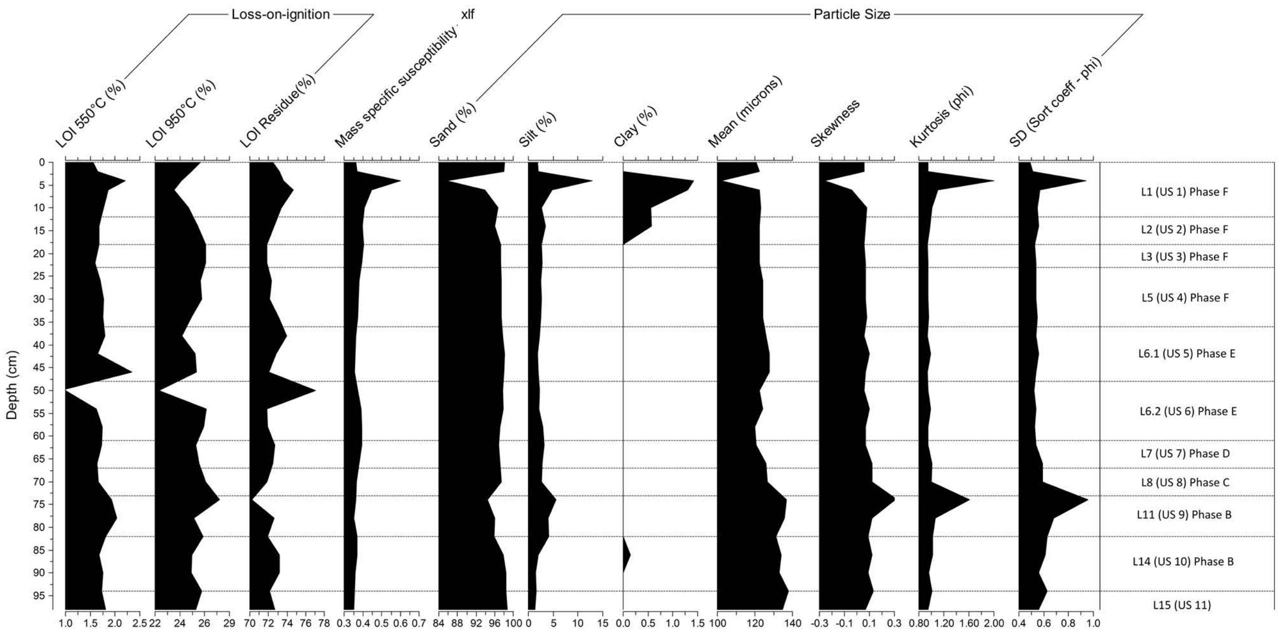


Figure 3.12. Physical properties of the Sector 3 T23 profile.

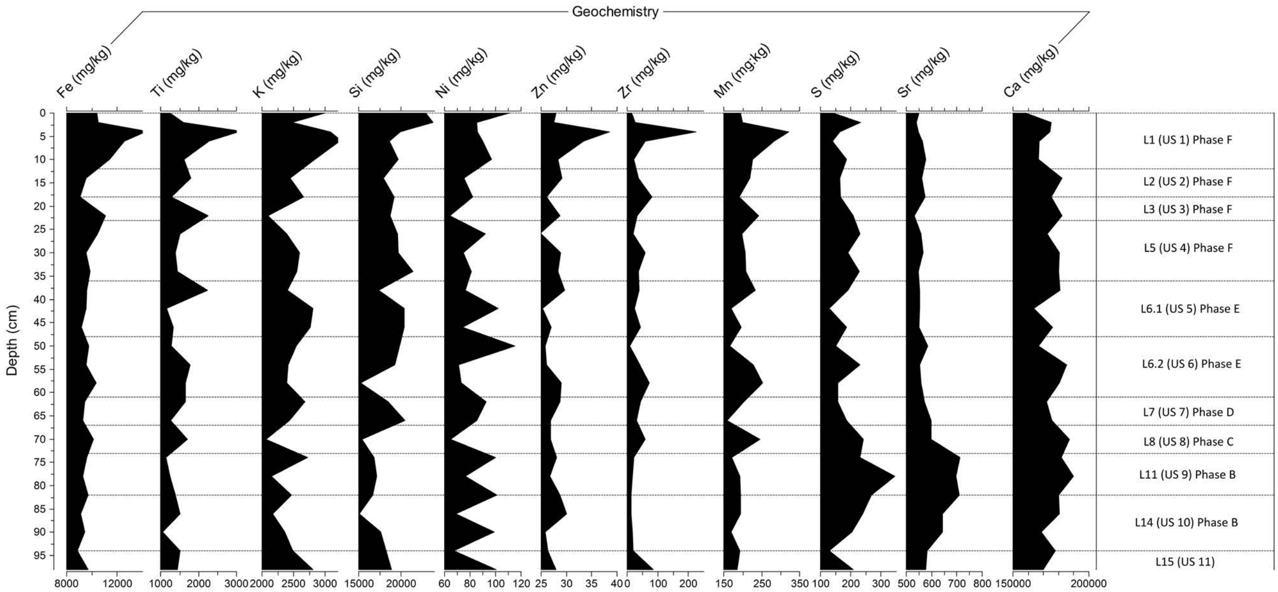


Figure 3.13. Geochemical properties of the Sector 3 T23 profile.

At the bottom of the exposed section, a layer was reached that displayed a reddish colour with a coarser grain size, together with the inclusion of abundant small black and red particles. These correspond to Us 31-38 in Sectors 1 and 2, which showed a distinct difference in geochemistry with high values for Zn and Ni. These may be derived via aeolian input from ophiolite rich sediments sourced from the Hajar Mountains or deflated from wadi systems that extend out from the mountains towards the Gulf, e.g. Wadi Dhaid and Wadi Iddayyah (Mueller *et al.* 2023).

UAQ2 Sector 3 T23

Samples were collected from Sector 3 T23 for geoarchaeological analyses to characterise the composition of the sediment units (Us) and occupation levels in the vicinity of the graveyard. The T23 section excavated was 100 cm deep. Ten Units (Us) were distinguished in Sector 3 (Figure 3.11 and Table 3.7). Most Us were horizontally bedded, with some lateral variation in the thickness of each unit. 27 sediment samples were collected for physical and geochemical analyses to characterise the nature of the units. The results are shown below in Figures 3.11 and 3.12.

Unit 11 – Pre-Phase B (Level 15)

The lowest part of the sequence (Us 11, L15) comprises archaeologically sterile, beige fine aeolian sand, which is near symmetrical, mesokurtic, and moderately well-sorted with small windblown shell fragments. The particle size range was dominated by sand (98%) with a lesser element of silts (2%) and no clays. Us 11 (L15) is characterised by low organic carbon (~1.8%), carbonate (25%) and inorganic residue (~73%) (Figure 3.12).

Units 10-8 – Phase B (Levels 14, 11, 9) – Middle Neolithic

Us 10 (L14) is represented by beige, sandy aeolian units that show a slight increase in silt (up to 4%) with a very small clay component. In Us 9 (L11) silt levels increase to 6%, with a peak at 76 cm. The sands in Us 10 are near symmetrical, mesokurtic and moderately well-sorted, indicating they are aeolian in nature. In Us 9 the sand comprises >94% of the sediment matrix and displays a fine skew, is very leptokurtic and is moderately well-sorted. The geochemical signature (Figure 3.13) shows that the sands are Si rich with Fe, Ti, K and Zr components that are typical for the region. S and Sr values increase steadily in Us10 and peak to the highest values recorded in the section in Us 9. The increase in S and Sr most likely relates to the ash component from burning of vegetation, fish, shell or bone. There is a slight increase in the χlf signal between 86-82 cm which corresponds to this. This supports the observed stratigraphy for Us 10 (L14), which contained ashy sand and the dark black unit, dense in fragmented shells in Us 9 (L11). Us 10 contained a few shells of *Hexaplex kuesterianus*, *Saccostrea cuccullata*, and fragments of fish bones. In addition, two ashy hearths, F19 and F20, were excavated from Us10 (L14), both rich in shell fragments. Us 9 is also richer in artefacts, with four unpainted Ubaid body sherds, three possible containers in *Anadara* sp., two shell beads, and a grindstone.

Units 7-5 – Phases D-E (Levels 7-6) – Middle Neolithic to Late Neolithic

In Us 7 (L7) the unit is thin (~16 cm thick) and formed of beige, aeolian sand. The sediments comprise ~26-24% carbonates with low organics ~1.5% and high LOI residue ~72%. There is a small increase in χ_{lf} towards the top of Us 7. The sand component increases in Us 7 to ~97%, with silt levels falling to ~3%. The mean particle size decreases to very fine sand, which is nearly symmetrical, mesokurtic and moderately well-sorted, indicating they are aeolian in nature in these units. Si and k increase in Us 7 and peak in the lower part of this unit. S and Sr values decrease across these two units. Shells comprise *Hexaplex kuesterianus* and *S. cuccullata* with very few *M. recens.* Us 7 is richer in artefacts and contains two Ubaid body sherds (one unpainted, the other painted), several shell beads, and one grinding stone.

L6 is a thick accumulation (up to 30 cm) of beige, aeolian sand with two layers (Us 6 (L6.2) and Us 5 (L6.1)) separated by a thin lens of *Marcia* sp. valves lying flat. This appears to have accumulated rapidly. In Us 6 and 5 (L6) there is a sharp decline in organic carbon and carbonates at 50 cm depth and a sharp increase in LOI residue to ~78%. The sediment comprises very fine, to fine sands, which are normally skewed, mesokurtic and moderately well-sorted. Si and K values increase across these units, which are characteristic of the aeolian sand component; S and Sr values are low. The sediments are almost sterile and with few fragments of shell. A projectile point was found in Us 6.

Units 4-1 – Phase F (Levels 5, 3, 2, 1) – Late Neolithic

Us 4 (L5) comprises a 13 cm-thick, dense shell horizon that mostly features *M. recens* with some *S. cuccullata* and *T. palustris.* The shells are intact and fragmented, with some evidence of burning. Carbonate content increases in this unit slightly, along with increases in S and Sr, which are most likely associated with burning. Us 3 (L3) is an almost sterile and thin aeolian sand layer (~5 cm thick) with an associated decline in S and Sr. It is suggested that occupation was occasional but sparse.

Us 2 (L2) is a thin layer (6 cm) comprising yellowish-brown, very fine aeolian sand dense in shells (up to 25%) of *M. recens* with *S. cuccullata* and *T. palustris.* The sand is normally skewed, mesokurtic and moderately well-sorted. There is a small increase in silt content and the presence of some clays. Sr values increase slightly in this unit, most likely associated with the burning of shell material. Us 1 comprises the surface unit, with loose friable reworked sands, but with an increase in silts (up to 12%) and clays (1.5%); χlf peaks at 4 cm. This most probably represents a weak superimposed pedogenic overprint. The sediments, dominated by very fine sands, are strongly coarse skewed, very leptokurtic, and more sorted. Us 4 to 1 are poor in artefacts but contain some flint of flakes and shell tools of *C. erycina* or *C. umbonella*. A bead of *P. mammilla* was found in Level 4. A possible shell scraper in *Mimachlamys* sp. was found in Level 1.

UAQ2 Sector 5 (U20 + V19)

In 2012, two profiles were sampled in Sector 5 for geoarchaeological analyses from a stepped trench in adjoining squares (U20 and V19) so as to provide a complete sequence of samples (Figure 3.14). 74 samples were collected spanning a total depth of 146 cm from the two combined sections. The upper 80 cm of the sequence was sampled from U20 (40 samples - Us 1-7). The lower

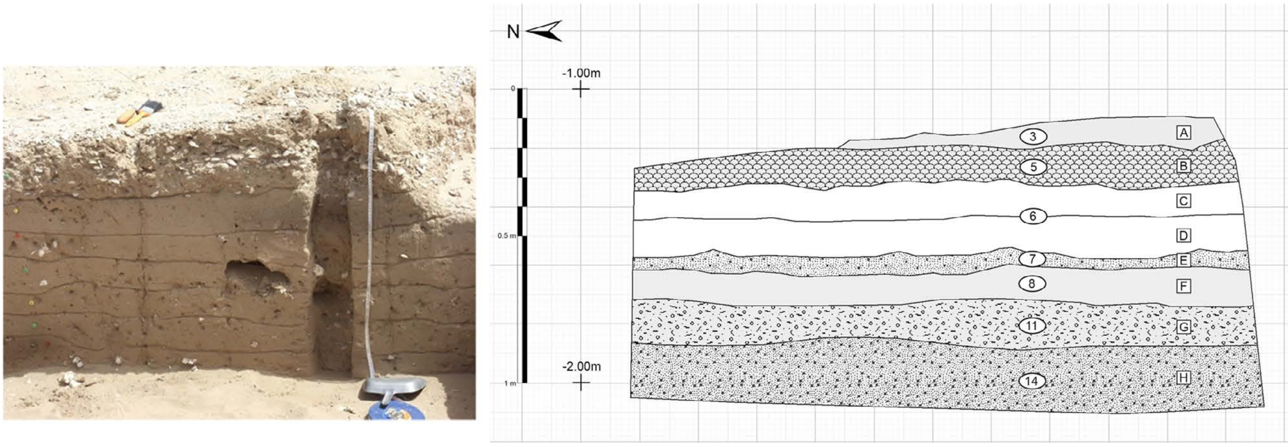


Figure 3.14. Sediment sampling profiles and combined section drawing from Sector 5 U20/V19.

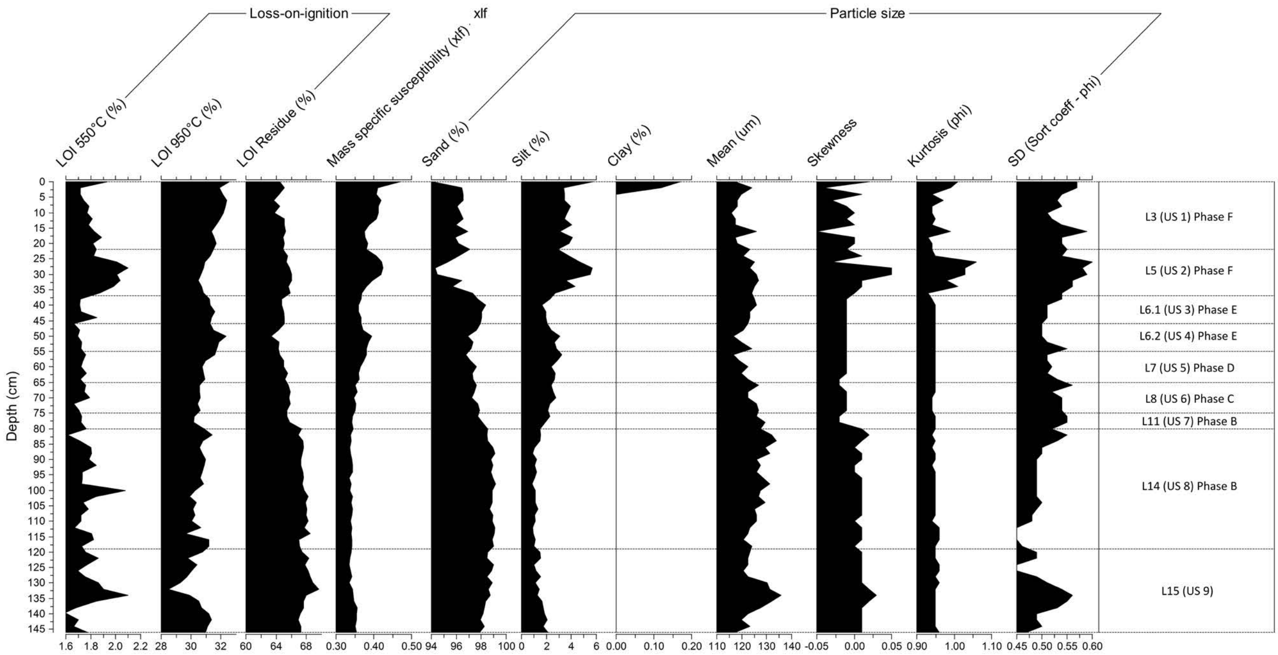


Figure 3.15. Physical properties of the Sector 5 U20/V19 combined profile.

part of the sequence was sampled from V19, from which 34 samples were taken (Us 8-9 – 66 cm total depth) (Table 3.8). Table 3.6 shows the ages derived from Sector 5.

Unit 9 – Pre-Phase B (Level 15)

The basal unit Us 9 from Sector 5 U20/V19 equates to Layer 15 and is archaeologically sterile. This layer comprises fairly homogeneous, carbonate-rich sands (28-31%) and fine sands (98%) with a mean size of 125-135 μm) (Figure 3.15). Silt forms amount to *c.* 2%, with no clays. The particle size data exhibit near-symmetrical, mesokurtic, and well-sorted characteristics typical of aeolian sediments. The magnetic susceptibility χ_{lf} values are typically low throughout this unit. The sediment geochemistry reflects the nature of the sand, comprising Si, Fe, K, Ni and Ca. S and Sr values are low (Figure 3.16).

Units 8-7 – Phase B (Levels 14, 11) – Middle Neolithic

The sediments in Us 8 (L14) are similar to those described above in Us 9 (L15) and comprise very fine aeolian sand, which is near-symmetrical, mesokurtic, and well-sorted. The unit is ~40 cm thick, stratigraphically homogeneous, and appears to have developed rapidly. Similar to Us 9 (L15), the sediment geochemistry reflects the nature of the sand – comprising Si, Fe, K, Ni and Ca, with low S and Sr values. Occasional shell and crab remains were observed. L14 in Sector 5 equates to the pit fill of Grave 2, which was cut into L15 below. L14 denotes the Grave 2 pit

Table 3.8. Sediment description for Sector 5 V19/U20 profiles indicating Units (Us) and Levels. Levels highlighted in grey represent occupation layers; rows in white relate sterile or low occupation levels.

Depth (cm)	Description U20 & V19	Us	Level
0-22 cm	Shell bed (25%) dominated by *Marcia* sp. Fine sand matrix. Corresponds with Level 3.	Us 1 A	3
22-37 cm	Fine sand unit with occasional shell fragments (5%). Ash lens at 28-37 cm. Corresponds with Level 5.	Us 2 B	5
37-46 cm	Fine sand with v occasional shell fragments of *Marcia* and *Terebralia* (1-2%). Corresponds with Level 6.1.	Us 3 C	6.1
46-55 cm	Fine sand unit with horizontal *Murex* layer and occasional shell fragments (1-2%). Corresponds with Level 6.2.	Us 4 D	6.2
55-65 cm	Fine sand with occasional shell fragments. Corresponds with Level 7.	Us 5 E	7
65-75 cm	Fine sand with occasional shell fragments. Corresponds with Level 8.	Us 6 F	8
75-80 cm	Very fine sand with *Murex*. Ash lenses along section. Corresponds with Level 11.	Us 7 G	11
80-119 cm	Very fine sand. V occasional shell and crab remains (<1%). Corresponds with Level 14.	Us 8 H	14
119-146 cm	Sterile very fine sands. Corresponds with Level 15.	Us 9	15

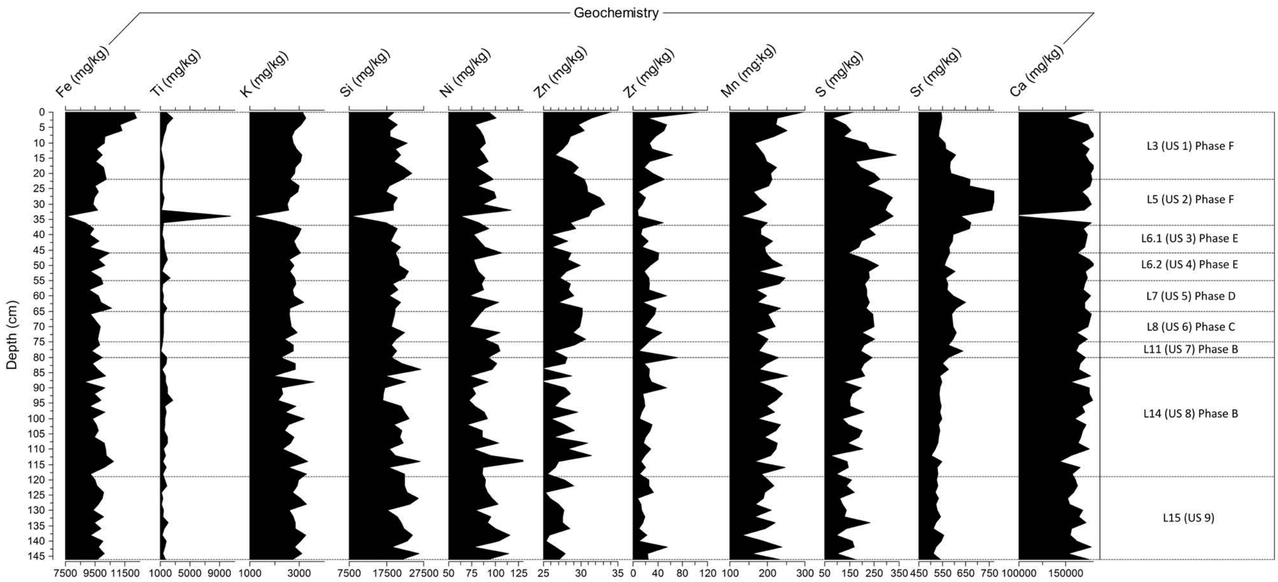


Figure 3.16. Geochemical properties of the Sector 5 U20/V19 combined profile.

fill in Sector 5, and *Marcia* sp. shell are dated to 5470-4900 BCE (LOC 164 and LOC 166, Table 3.6).

Us 7 (L11) comprises a thin (5 cm) layer that shows a subtle change in sediment characteristics, with fine sands that are moderately well-sorted but still mesokurtic and near-symmetrical in nature. Silt levels start to increase up-profile from Us 7 (L11). Us 7 (L11) contained some murex shells, with ash lenses noted along the section indicative of burning, which most likely account for the increase in Sr and S values, although the changes are slight. L11 equates to the cover of the last level of the necropolis and was dated to 4320-3960 BCE (LOC 165, Table 3.6).

Units 6-3 – Phases C, D, E (Levels 8-6) – Transition Middle to Late Neolithic

Us 6-3 (L8-6) are characterised by moderately well-sorted, fine sands (~97%) that exhibit mesokurtic, near-symmetrical particle size characteristics. The mean grain size shows a slight fining in all of the units from 125-115 µm, with an increase in silt content to ~3%.

The sediments in Us 6 (L8) and Us 5 (L7) contained occasional shell fragments. Us 4 (L 6.2) contained a thin layer of murex shells. Within the unit there is a slight increase in carbonate content and the small peak in magnetic susceptibility values most likely represents some burning. Us 3 (L6.1) shows a slight decrease in silt and carbonate contents and magnetic susceptibility; the sediments contained occasional shell fragments of *Marcia* and *Terebralia*. The geochemical values for Us 6-3 mostly reflect the nature of the sand matrix, as characterised by the high values in Si, Fe and K, which do not vary much, and the Ca values reflect the high dune carbonate fraction. S values increase slightly within these units when compared to Us 9 and Us 8.

Units 2-1 – Phase F (Levels 5 and 3) – Late Neolithic

The sediment in Us 2 (L5) comprises a fine sand unit with occasional shell fragments (5%). Sand content decreases to ~94%, with an associated increase in silt (~6%). The sediments display a normal grain size distribution, which is moderately sorted with higher mesokurtic values, but not leptokurtic. An ash lens was noted at 28-37 cm, with a distinct peak in organic content that increases to 2.1%, and a decrease in carbonate content to ~30%. An increase in magnetics is associated with the burning associated with the ash lens, along with a rise in Sr from ~500-700 mg/kg, and S from 120 to 240 mg/kg. With the exception of a spike in Ti at 34 cm, and associated declines in Ca, Fe, Si and K, the values for the sand geochemical component do not vary much within this unit. The uppermost unit (Us 1, L3) comprises a shell bed (25%) dominated by *Marcia.* The sediment matrix is dominated by fine sands (~96%), with a slight decrease in silt. The upper few cm comprised some clays. The organic content values fall to ~1.7% from the previous peak in Us 2. S and Sr values fall this unit and there is a peak in Cl in the upper 10 cm.

Discussion – geoarchaeology and palaeoenvironments

Around one-third of the Arabian subcontinent is covered by sandy deserts. The largest of these is the Rub' al-Khali, the Empty Quarter of Arabia, the largest *erg* (sand sea) in the world, covering *c.* 560,000 km^2 (White *et al.* 2001). This vast sand sea extends into the study region up to the coast of the Arabian Gulf and to the extensive network of alluvial fans, which lie along the mountain front of the Hajar (Parker and Goudie 2008).

During the Late Quaternary, the climate of Arabia has fluctuated between periods of higher rainfall and fluvial activity, dominated by the influence of the Indian Ocean Monsoon (IOM) and drier/arid conditions under the influence of the westerlies (Goudie *et al.* 2000; Parker and Goudie 2008; Mueller *et al.* 2023). The Arabian Gulf region has a rich variety of geoarchives spanning the Late Glacial and Holocene. Integrating geomorphological and palaeoecological records establish the environmental background against which patterns of human activity, provided through the archaeological record of this region, can be set. The coastal desert region of the southeastern Arabian Gulf has been a focal point for human settlement since ~6000 BCE. Changes in the evolution and modification of this landscape under varying climatic conditions have influenced humans living in and exploiting this landscape for food and water, raw materials and trade routes (Parker and Goudie 2008). The UAQ2 site provides the most detailed excavation record from a shell-midden complex in the Arabian Gulf region with multiple phases of occupation.

Lateglacial and Earliest Holocene environments

The dune system, consisting of mega linear dunes up to 80 m in height, represents the primary geomorphological feature of the UAQ2 region. The ridge crests trend from SSW-NNE, with interdune corridors *c.* 2 km apart (Parker and Goudie 2008; Atkinson *et al.* 2012; Farrant *et al.* 2015). In places, the dune crests have been reworked into smaller secondary forms, which include branching linear dunes up to 20 m high with tuning-fork junctions orientated NW to SE (Goudie *et al.* 2000; Parker and Goudie 2008). Under current wind conditions, the primary megadune ridges are transverse to the NW 'Shamal' winds, resulting in the superimposition of secondary patterns on the linear megaridges.

Between Sharjah and Ras al-Khaimah, the dunefield has been reshaped into coastal parabolic dunes that merge into the main linear dune system. The dunes exhibit increasing redness towards the north and northeast, approaching the mountains due to reduced carbonate content, while closer to the coast, they appear paler due to increased carbonate content from coastal deflation (White *et al.* 2001).

The dating of dune-building activity in the UAE falls into three primary age ranges. The first occurred between 20000-18000 BCE (22-20 ka), corresponding to the Lateglacial Maximum (LGM). The main phase of dune accumulation took place between 14000-7000 BCE (16-9 ka) (Goudie *et al.* 2000; Parker *et al.* 2004; Parker and Goudie 2008; Atkinson *et al.* 2011; 2012; Leighton *et al.* 2013; Farrant *et al.* 2015; Thomas and Bailey 2019). This period of accumulation is attributed to high sediment availability, with low accumulation in the preceding Late Glacial attributed to high wind speeds limiting preservation (Leighton *et al.* 2013). During the wetter Early and Mid-Holocene, former interdunal lakes and wetlands indicate a general absence of dune accumulation, suggesting a more stable, vegetated dune system (Parker *et al.* 2004;

Preston *et al.* 2015; Leighton *et al.* 2013). Dune reactivation and reworking occurred post 4000 BCE (6 ka) under drier conditions (Parker *et al.* 2004; 2006; Goudie and Parker 2008; Preston *et al.* 2015; Leighton *et al.* 2013; Thomas and Bailey 2019).

Both UAQ36 and UAQ2 are located along the same extending, SW-NE trending, mega linear dune ridge. Dune sections at UAQ36 (Atkinson *et al.* 2012; Méry *et al.* 2019) and UAQ2 (this study) contain Late Pleistocene and earliest Holocene aeolian sands, accumulated between 14000 to 7000 BCE (16-9 ka, Table 3.3), which relate to the main phase of dune accumulation across the region. During the onset of this accumulation phase, the Arabian Gulf was dry, as a result of global lower sea levels, making the dune field more extensive before parts were submerged and reworked by rising sea levels during the Late Glacial and Early Holocene transition. From the Late Glacial until *c.* 12000 BCE (14 ka), the Gulf was free from marine influence, but by 10500 BCE (12.5 ka), marine incursion into the central Gulf basin had begun (Lambeck 1996). As sea levels rose, the sediment supply from the previously dry Gulf basin was significantly reduced, limiting sediment supply from this source.

The lower sections of the dune sequences at both sites are characterised by pin-striped, bedded sands with coarser-grained orange sands and finer grey, silt-rich laminations (observed in the D3 cliff dune section and the basal sand sections exposed in Sectors 1 and 2 (A5B5) and Sector 7 (section 14)). These lower units include small bioclast inclusions, such as foraminifera, likely derived from deflated materials from the exposed bed of the Arabian Gulf during lower sea levels in the Late Glacial period. The lower sections of dunes at UAQ2 and UAQ36 are dated to *c.* 14000 BCE (16 ka). At UAQ2, the dune sands exhibit higher Sr and Ca values derived from the bioclastic component. These are overlain by massive sand units, which are slightly coarser, moderately well to well-sorted, and display lower Sr and Ca levels with higher siliclastic components rich in Fe, Ti, Zn, Mn and Zr. An age of 7100 BCE (OSL 9.14±5.6 ka) was determined from Us 38 at the base of the Sector 1 and 2 A5/B5 section, suggesting a change in sediment supply, with a reduced component coming from reworked sediments derived from Arabian Gulf sources. It is likely that during the Lateglacial/Early Holocene transition, sediment supply from the exposed bed of the Gulf was reduced due to marine transgression, limiting the supply of finer grained silts and bioclasts. By 7000 BCE (9 ka), both sites were still some distance from the coast, as marine transgression did not reach the sites until later in the Mid-Holocene. The reduction in sediment supply, coupled with the onset of the Early Holocene Humid Period (EHHP), stabilised the dune system across the region (Parker *et al.* 2004; Preston *et al.* 2013; 2015).

During the Lateglacial-Holocene transition, an increase in atmospheric precipitation resulted from the intensification and northwards shift of the summer Indian Ocean Monsoon (IOM) (Fleitmann *et al.* 2007; Preston and Parker 2013). This interpretation is supported by fluvial, lacustrine, and speleothem records from regions such as the southern Rub' Al-Khali, Dhofar mountains, Yemen Highlands, and central Hajar mountains (southern Yemen, Oman) dating from *c.* 8500 BCE (10.5 ka) (Lezine *et al.* 2008; 2010; Fleitmann *et al.* 2007; Cremaschi *et al.* 2015). While dune accumulation was prevalent in the northern Emirates between 14000-7000 BCE (16-9 ka) there is evidence for activation of the fluvial systems across the region, indicating increased rainfall. For instance, in the Wadi Dhaid catchment, a radiocarbon date of 9250-8350 BCE (Ly-3924) was determined from the base of a fluvial terrace at Fallaj al-Mualla (Dalongeville and Bescancon 1997; Dalongeville 1999).

Indication of human occupation in the region is limited, with the earliest dated evidence found at Wadi Wutayya (Oman) (Uerpmann and Uerpmann 2003) and inland around the area of Jebel Faya (Uerpmann *et al.* 2013). At Wadi Wutayya, a fire hearth yielded and age of 9200-8800 BCE (Hv12964). At Jebel Faya NE-01, projectile points, relating to the Fasad typology ('Faya' sub-type), were found in association with marine *Lunella coronata* shell fragments dated between 8700-8300 BCE (Hd-26089, Hd27511) (Uerpmann *et al.* 2012). The presence of marine shells reflects a coastal connection for the first Holocene occupants at Jebel Faya. Nearby, at Nad al-Thamam, i.e. fragmentary shell (*Pleuroploca trapezium*) that could only have reached this inland site through human activity and dated to 7000-6450 BCE (Hd-24356). In Wadi Hilo, located in the Hajar Mountains in Sharjah, a series of fire pits associated with stone structures were dated to the Early Holocene. Ages were dated to 8290-8000 BCE (MAMS 15102), 7800-7600 BCE (MAMS 15103), and 7580-7480 BCE (MAMS15106) (Uerpmann *et al.* 2018). These sites indicate human activity extending back to the early 9th and late 10th millennia BCE.

Within the study region, Fasad-related points were found on Pleistocene mega linear dune sites at UAQ37 and UAQ45, indicating the presence of hunter-gatherers in this part of the region. The range of sites with Fasad point finds extends from the desert of Rub al Khali to the Dhofar region and the coastal sites of the Ja'alan, including Ras al-Jinz RJ-37 (Charpentier and Crassard 2013). These lithic projectile points have served as defining artefacts (*fossiles directeurs*) for Early Holocene human occupation prior to the development of the Arabian Neolithic, likely relating to an autochthonous Early Holocene population in Arabia.

Early to Mid-Holocene Environments

During the Early Holocene, increased precipitation and reduced sediment availability led to the stabilisation of dune systems across the region. Leighton *et al.* (2013) demonstrated that dune records from SE Arabia show an abrupt decline in net dune accumulation rates between 7000 and 4000 years ago (9-6 ka). Concurrently, a series of interdunal lakes and wetlands developed across the region from *c.* 7000-4000 BCE (9 ka - 6 ka BP), corresponding to the Early Holocene Humid Period (EHHP) (Preston *et al.* 2015; Parker *et al.* 2016). The onset of lacustrine sedimentation at two key sites, Awafi and Wahalah at *c.* 7050 BCE (9 ka), appears to have occurred later than most other Arabian palaeolake records. For instance, lacustrine deposits from al-Hawa, Yemen are dated to 9050 BCE (Lezine *et al.* 2007) and from Mundafan in the southwest Rub' al-Khali 7750 BCE (Rosenberg *et al.* 2011). In contrast, in the study region, continued dune emplacement characterised the corresponding period, persisting into the earliest Holocene, as recorded in several dated sequences that ceased forming *c.* 7550 BCE (9.5 ka) (Goudie *et al.* 2000; Atkinson *et al.* 2011; 2012).

Most palaeoclimate studies from central and southern Arabia link the arid-humid transition to the steady northwards migration of rainfall associated with the Indian Ocean Monsoon system, supported by $\delta^{18}O$ data from Omani speleothem records (Fleitmann *et al.* 2007). Whether this source of moisture was as significant north of 23°-24°N, including the study region, remains unclear. Some researchers suggest that Mediterranean low-pressure systems were more important in northern Arabia (Schulz and Whitney 1986; Arz *et al.* 2003), though their impact across the Peninsula is poorly defined (Berger *et al.* 2012).

Palaeoclimate records indicate maximum wetness occurred across Arabia between 7050-5050 BCE (Fleitmann *et al.* 2013; Cremaschi *et al.* 2015). Palaeobotanical evidence from Awafi palaeolake indicates the development of a mixed C_3-C_4 grassland vegetation, with a peak in scrub tree taxa (primarily *Vachellia* - formerly described as *Acacia* – and *Prosopis*) between 6550-5650 BCE (Parker *et al.* 2004; 2016). At both Wahalah and Awafi, increases in organic content and the presence of the ostracod species *Cyprideis torosa* and the gastropod *Melanoides tuberculata* confirm the onset of a stable lacustrine environment and the development of permanent waterbodies at this time (Preston *et al.* 2015).

The records from Wahalah and Awafi indicate a long-term shift to drier conditions from *c.* 5750 BCE. This shift coincides with a decline in woody vegetation and a slight increase in xeric taxa in the Awafi record, suggesting reduction in moisture availability (Parker *et al.* 2004). Lacustrine conditions persisted until *c.* 4500 BCE. Despite overall phase landscape stability during the EHHP between 7050-4050 BCE, several pulses of increased detrital sediment input are recorded in the lacustrine records at both Awafi and Wahalah; these changes, occurring at 6350-5950, 5550-5250, and 4550-4250 BCE (Preston *et al.* 2012) are also identified in the Hoti Cave $\delta^{18}O$ record from the Hajar in Oman, which show a series of positive shifts, implying reduced precipitation, between 6250-6050, 5550-5250, and from 4350 BCE (Fleitmann *et al.* 2007). The first of these shifts corresponds with the global 6.2 BCE (8.2 ka) cooling event at 6250 BCE, associated with a short-term weakening of the monsoon system (Gupta *et al.* 2003). This event has been reported in other Arabian palaeolake records (Lézine *et al.* 2010), the northern Arabian Sea (Staubwasser *et al.* 2003), and the Indus region (Dixit *et al.* 2014).

Middle Neolithic during Phase A

At UAQ2, from the main Sector 1 and 2 A5/B5 trench, Us 35 was dated to ~6000 BCE (OSL date of 7.94±0.43 ka), while the lower part of Us30 was dated to ~5400 BCE (OSL age of 7.36±0.39 ka). These short phases of dune deposition correspond to the Hoti speleothem record, indicating drier conditions at these intervals, as well as to UAE lake records showing increased aeolian sediment flux during the same periods. The dune record at UAQ2, truncated with a clear bounding horizon at the top of Us30, marks a phase of wind erosion followed by a phase of stability before the re-onset of sediment accumulation. This period denotes the sea level transgression.

The stratified coastal site at UAQ2 provides evidence of the oldest Neolithic occupation identified in the northern part of the United Arab Emirates (Méry *et al.* 2019). The first evidence for human occupation (Phase A) at UAQ2 comes from Level 17 (Us30) in Sectors 1, consisting of a single layer of sparse edible shells (*Marcia* sp. and *Circe* sp.), indicating an initial, probably occasional, human presence. This layer rests directly on the eroded dune contact beneath it. A *Marcia* shell from Sector 1 and 2 A5/B5 was radiocarbon dated to 5500-5140 BCE (Ly-10973/SacA36348), corresponding with peaks in both strontium (Sr) and sulfur (S) within the section profile. Level 17 (Us30) in Sector 7, where a greater number of *Marcia* and *Circe* shells were present, suggests the same occupation layer as in Sectors 1 and 2.

Occupation of the site during the Neolithic coincides with the Mid-Holocene marine transgression in the Gulf region – with sea levels about 1 m higher than today *c.* 5250 BCE (Parker *et al.* 2020). Ages from the island of Marawah and Ghagha, off the coast of Abu Dhabi, predate the initial occupation at UAQ2. Five charcoal ages at MR11 yielded age ranges between 5840-5530 BCE (Beech *et al.* 2019). More recent discoveries from GHG14 and GHG63 push the chronological boundaries of coastal Neolithic occupation in the UAE back to 6640-6490 BCE (Al Hameli *et al.* 2023). Levels 16 and 15 (Us 29-27) above the first occupation level at UAQ2 comprise *c.* 55 cm of aeolian dune sand with no evidence for human occupation, indicating a phase of rapid dune accumulation under more arid conditions. This rapid phase of accumulation is based on the statistically indistinguishable ages from L17 (Phase A), L17, and L14-L9 (Phase B), which are separated by Levels 16 and 15.

Middle Neolithic during Phase B

At UAQ2, Levels 14 to 9 in Sector 1&2 A5/B5 (Us 26-18), Levels 14-9 in Sector 5 T23, and Levels 14-11 in Sector 5 V20/U19 all correspond to Phase B. The age range for this phase of occupation is 5650-4950 BCE, i.e. Middle Neolithic. This period represents a dense phase of human occupation at UAQ2. The sediments comprise much finer sand with some silts and clays, deposited under more stable landscape conditions. These units include a series of massive, stratified and interbedded shell deposits (*c.* 60 cm thick), rich in structures, including post-holes, pits, and fireplaces (with evidence of burning in individual units). Evidence for burning is also shown in geoarchaeological analyses, with increased magnetic susceptibility values and higher levels of strontium (Sr) and sulphur (S) associated with the breakdown of shell and marine resources, likely due to burning related to in situ food preparation and processing. The chronology for this section is complex, with some age inversions, likely due to the intense accumulation of shell and reworking of materials during phases of shell processing, including the digging of fire hearths. Additionally, ages vary due to differing reservoir effects across the shell species dated.

The two tombs excavated in 2012 (Méry *et al.* 2016) were dug into Level 14 and the sterile Level 15 beneath in Sector 5. Based on the descriptions of Phillips (2002), it is possible that some of the graves excavated in the early 1990s were contemporaneous with Level 11. Inhabitants at UAQ2 also exploited terrestrial food sources available in the surrounding landscape, as indicated by the evidence for hunting. Medium to large herbivores (*Gazella* and *Oryx*), carnivores (*Vulpes* and *Felis*), and birds (Aves) are represented, especially in Levels 11 and 12. The study of Levels 14 to 9 shows that UAQ2 communities also herded caprinids (*Capra*).

Inland at Jebel Faya (FAY-NE10), a small cave deposit contained charcoal dated to occupation periods of 5180-5060 BCE (Hd-26,117) and 5220-4950 BCE (Hd-26118) respectively (Uerpmann *et al.* 2013). This indicates human occupation in the interior concurrent with the occupation at UAQ2. This phase of occupation marks a peak in Holocene rainfall across the region, as denoted by the depletion in $\delta^{18}O$ values in the Hoti Cave speleothem record at this time (Fleitmann *et al.* 2013). The presence of lakes at Awafi and Wahalah (Preston *et al.* 2015; Parker *et al.* 2016) evidences the continued presence of savannah grassland across the region during this period (Parker *et al.* 2004).

Middle to Late Neolithic (Phases C-E)

Phase C (Us 17) comprises Level 8, whose material culture aligns with a Middle Neolithic occupation. Despite the absence of structures (only one fireplace) in L8, this level yielded 669 artefacts and raw material pieces, making it the second richest in artefacts after Level 11. A reworked shell from Level 7, but potentially originating from Level 8, provided a radiocarbon date of 5190-4780 BCE. This date aligns with the proposed chronology, as it does not overlap with the Late Neolithic period.

However, within the 18 cm-thick Us 17 (L8), there is a notable change in sediment characteristics to finely skewed, very leptokurtic and moderately sorted fine sands. These sediments are stratigraphically homogeneous, composed of yellowish, fine sand and resemble the lowermost aeolian sediment facies below Us 30 (L16), suggesting deposition during a more arid phase. Degli-Esposti *et al.* (2019) noted a similar layer at Umm al-Quwain UAQ38. Geochemical analysis shows a sharp fall in Sr and S levels from L8, alongside an increase in aeolian sand content (~99%) in L6 (Us 15-13, 100 cm - 67 cm), with a slight rise in mean particle size to *c.* 140 microns. The decrease in Sr and S is likely due the reduced presence of processed shell and fish material compared to Phase B levels.

Level 7 is much thinner unit (Us 16 – 7 cm thick) and shows scant evidence of occupation, with no fireplaces or post-holes, and only occasional shells and shell fragments of *Marcia* sp. and *Terebralia palustris*, along with some knapping debitage. Radiocarbon dating estimated Levels 7 and 6 to date between 4430 and 4270 BCE. This is further supported by an OSL date obtained from Unit 14 in Level 6. Archaeological evidence links these levels to the Late Neolithic period. Within Phase E, Level 6 consists of a thick accumulation (up to 30 cm) of yellowish-brown aeolian sand, with two main layers separated by a thin lens of near horizontally bedded *Marcia* sp. valves.

The sedimentology of Phases C-E is characterised by thick aeolian sand deposits (~60 cm), associated with sporadic evidence for occupation. It expresses a shift to more arid conditions with increased aeolian accumulation. This corresponds with arid conditions recorded at Wahalah at 4650-4450 BCE (Preston *et al.* 2015, Parker *et al.* 2016) and reduced precipitation inferred from the Hoti Cave

$\delta^{18}O$ speleothem record. Between 4550-4350 BCE, the Hoti Cave speleothem record shows a dramatic +3 per mil shift in $\delta^{18}O$, indicating a significant weakening of rain-bearing systems across the region (Fleitmann *et al.* 2007). This reduced precipitation phase likely influenced changes in human activity and occupation patterns (Parker and Preston 2008; Preston *et al.* 2012; Preston and Parker 2013). It has been suggested that the concentration of human occupation inland at Jebel Buhais was due to increasing regional aridity, the availability of water from springs at this site, and completion for water resources with evidence for conflict (Uerpmann *et al.* 2008). Interestingly, this climatic event also marks the transition from the Middle Neolithic and the Late Neolithic at UAQ2.

Late Neolithic (Phase F)

Phase F at UAQ2 encompasses Levels 5-1 (Us 12-1) in the upper ~65 cm of the sequence, corresponding to the Late Neolithic period. This phase is characterised by substantial shell accumulations interspersed with thin aeolian sand-rich units, specifically in L5 (Us 11 and 7) and L3 (Us 4). This phase marks a shift in the subsistence economy, with a focus on exploiting lagoon and mangrove resources. Evidence for domestic or residential occupation is sparse, as indicated by the limited number of associated objects compared to Phase B. Instead, multiple pulses of brief, seasonal occupation centred on shell processing and consumption are suggested.

Levels 5 and 4 are dated to 4650-3940 BCE, with Preston *et al.* (2015) suggesting that during the latter part of this period, interior occupation declined, while coastal settlement along the southern Arabian Gulf coast increased between *c.* 4250-3850 BCE. This shift may reflect a concentration of settlements along the coast due to greater marine resource availability as the interior became increasingly arid. After this period, there is scant evidence for occupation at UAQ2.

Level 3 indicates increased aeolian activity, likely due to heightened aridity. This is supported by the palaeolakes from Awafi (Parker *et al.* 2004; 2006; 2016) and Wahalah (Preston *et al.* 2015), which indicate lake lowering and an increase in aeolian influx due to reactivated dunes and vegetation loss under intense arid conditions. At Wahalah, over 5 m of dune sediment accumulation occurred between 3850-3550 BCE. The speleothem record from Hoti Cave in the Hajar Mountains of Oman records a significant decrease in rainfall *c.* 4150 BCE, with speleothem growth ceasing *c.* 3550 BCE due to insufficient rainfall (Fleitmann *et al.* 2007). Mangrove ecosystems along the east coast of Oman collapsed *c.* 4050 BCE as a result of reduced precipitation, leading to decreased freshwater input and increased salinity (Decker *et al.* 2020).

The Dark Millennium

This increase in aridity corresponds to an abrupt decline in the number of archaeological sites and dated occupations across the Gulf region *c.* 3950 BCE, referred to as the 'Dark Millennium', lasting until the onset of Early Bronze Age (Uerpmann 2003). An exception is a short phase in occupation indicated in Level 2. The chronological gap between Levels 4 and 2, with no statistical overlap at the 2σ range, and the archaeological sterility of Level 3, supports this. In Level 2, a thin, yet dense layer of *Marcia* sp. shells with *Terebralia palustris* fragments was dated to *c.* 4015-3630 BCE. The only other site with evidence of occupation during this time is the dugong mound on Akab Island, dated to 3520-3230 BCE (Méry *et al.* 2009). These sites denote the terminal late Neolithic in the region, indicating that while human populations declined and many sites were abandoned during the Late Neolithic, occasional occupations continued during this intense arid phase.

The Early Bronze Age

The surface layer, Layer 1 (Us 1), dates to the Early Bronze Age, *c.* 3330-2910 BCE. This indicates a significant hiatus in occupation and sediment deposition at the site since the brief occupation shown in Level 2, *c.* 3630 BCE. This hiatus reflects a broader regional trend of reduced human activity and occupation during the Late Neolithic, transitioning into the Early Bronze Age.

Material culture – Technology, typology, provenance and exchange in the Arabian Neolithic

K. Lidour, S. Méry, C. Gallou, O. Brunet

Introduction

K. Lidour

This chapter presents the different categories of artefacts found during the excavations of the UAQ2 site. The material culture of this site is particularly abundant and diverse, providing elements of typochronology as well as knowledge of the ancient ways of life of the coastal populations of the northern UAE during the Neolithic period.

It is obvious that, similar to subsistence economies, productive activities notably benefit from the exploitation of marine resources, whether for the making of ornaments or for the production of tools, such as mother-of-pearl fishhooks and shell scrapers-knives. Additionally, the lithic tool assemblage primarily utilises raw materials that are not locally available, unless through expeditions or exchanges over several tens of kilometres inland. Another important aspect of the material culture of Neolithic sites in the northern UAE is the abundance of Mesopotamian pottery sherds, although less so than on the coastal sites of Kuwait and Saudi Arabia, but surprisingly higher than that of the island sites in Abu Dhabi. This observation underscores the significant work that remains to be done in understanding exchange dynamics in the Arabian Gulf region at the beginning of the Holocene.

Pottery

Introduction

S. Méry, K. Lidour

The whole assemblage of pottery recovered at UAQ2 belongs to Black-on-Buff wares identified as Ubaid productions. Such a type of pottery was spread from Southern Mesopotamia across the Arabian Gulf from the mid 6th to the end of the 5th millennium BCE (Oates *et al.* 1977). The Red Arabian Coarse Ware, which is reported together with the imported Ubaid wares at northern Arabian Gulf sites such as Bahra 1 (Smogorzewska 2015), as-Sabiyah H3 (Carter and Crawford 2010), and Dosariyah (Masry 1974; Drechsler 2018), is not present at UAQ2.

The Ubaid phasing was primarily defined by Oates (1960; 1969) (Table 4.1) based on sherds collected from excavations made at Eridu (Tell Abu Sharain, Southern Iraq) in the late 1940s by Safar *et al.* (1981). Further phases were created later on the basis of pottery assemblages consisting of both Late Ubaid and Proto/Early Uruk types, such as Ubaid 0, according to new assemblages recovered at Tell el-Oueili in the 1980s (Lebeau 1987) and Terminal Ubaid or Ubaid 5 (Oates 1976; Forest 1996).

Ubaid pottery encompasses several traditions which occurred from the mid 7th to the end of the 5th millennium BCE, first in Southern Mesopotamia (and Susiana lowlands), and then, across a wider region, integrating further north the Halaf culture from the last third of the 6th millennium BCE.

Its relationships with other contemporaneous pottery cultures, such as the Hassuna and the Halaf in Northern Mesopotamia, the Samarra, and the Choga Mami Transitional in Central Mesopotamia, as well as the south-western Iranian traditions (from the Deh Luran and Susiana), are still not well understood. Indeed, Ubaid pottery appears 'strikingly contour less' in the words of Nissen (1989: 245). Therefore, both the definition and the phasing of the Ubaid horizon have and still remain highly debated (Carter and Philip 2010). The construction of the general typology is complicated by the recurrence, over the course of the different phases, of both quite simple shapes (e.g. rounded bowls and globular pots) and painted decorations (simple geometric patterns probably inspired by weaving or basketry).

It is however generally accepted that the Oueili and Eridu wares (also known as Ubaid 0 and Ubaid 1 respectively) are small-scale pottery productions defining a so-called Pre-Ubaid or Ancient Ubaid period, which is restricted

Table 4.1. Ubaid phasing by Joan Oates (1960; 1969).

Oates 1960	Oates 1969	Corresponding contexts
Eridu Ware	Ubaid 1	Eridu – Levels 19-15
Hajji Muhammad Ware	Ubaid 2	Eridu – Levels 14-12
Ubaid Ware *stricto sensu*	Ubaid 3	Eridu – Levels 12-8
Late Ubaid Ware	Ubaid 4	Eridu – Levels 7-6

to Southern Mesopotamia between *c.* 6500 and 5300-5100 BCE. The Ancient Ubaid wares typically show highly decorative styles essentially based on symmetrical geometric designs. It should be noted that the care taken both to the finishing and the decoration significantly increase between the Ubaid 0 and Ubaid 1 assemblages at Tell el-Oueili. Open shapes predominate during the Ancient Ubaid, including simple bowls, large plates, and curved-shaped beakers.

The Hajji Muhammad Ware (Ubaid 2) fits well within the Ancient Ubaid traditions. This is considered as the golden age of the painted decoration. The geometric patterns are quite structured and very precisely applied. With a perfect mastery of reserve decorations, painted and plain motifs alternate in the general composition (for instance, broken lines are associated with horizontal bands to create painted and plain triangles). Carinated bowls are a diagnostic shape of the Hajji Muhammad Ware. They generally show central and radial decorations, such as the 'sunburst' motif. Emerging *c.* 5500-5300 BCE, the Hajji Muhammad Ware marks the transition to the Ubaid Ware *stricto sensu* or Ubaid 3. That is to say that Ubaid 2 is overlapping both Ubaid 1 and Ubaid 3 and thus does not represent a true chronological phase (Crawford 2010). Assemblages where Hajji Muhammad and true Ubaid productions were found in association have been defined by Oates (1987: 479) as Ubaid 2/3 or Ubaid 3a phases, which occur until *c.* 4800 BCE. The later Ubaid 3b phase no longer contains Hajji Muhammad elements.

Characterised by simple and quite standardised shapes and decorations, the Ubaid 3 Ware is considered as being produced by specialised (but family) pottery workshops, and spread over a wide regional scale. It is said to be linked with the 'Ubaid Expansion Phenomenon', which encompasses the whole Mesopotamia at the end of the 6th millennium BCE. It could be also related to a potential change in the consumption modes of pottery, for instance special events such as feasts vs. domestic daily use (Pollock 2010). The decoration is often limited to simple painted lines or bands – mostly wavy – underlining inflexions of the general shape (rim, neck, carination, etc.). More elaborated decorations still survive for funeral and ritual vessels, according to Oates (1960: 36). Thin-walled ('egg-shell ware') bowls are very diagnostic of this phase, but Ubaid 3 is also marked by the predominance of closed shapes.

The transition towards Ubaid 4 (emerging *c.* 4600-4500 BCE) is more complex to define: the pottery assemblages are characterised by a progressive disappearance of painted decorations – less skilfully painted according to Oates (1960: 39) – as well as the emergence of new shapes such as the 'Knopffußbecher' (or 'pod-shaped cups') and the grinding plates (showing combed incisions in their inside). Ubaid 5 (or Terminal Ubaid) is considered as marking the transition to Uruk wares – by the association of Late Ubaid and Proto/Early Uruk types within the same assemblages (in particular at Uruk Levels XVI-XIIb, cf. Sürenhagen 1999). The Terminal Ubaid, also designated as Late Chalcolithic 1 (LC1) in Northern Mesopotamia according to the Santa Fe SAR (School of Advanced Research) chronological frame, is situated *c.* 4400-4200 BCE (Rothman 2001).

The presence of Ubaid pottery in the Arabian Gulf was first reported by Bibby (1971) after the examination he made of sherds collected near Dhahran in Eastern Saudi Arabia – probably close to the site of Dosariyah (see Burkholder 1972). Paste composition analyses undertaken by Oates *et al.* (1977) have definitively shown that Ubaid pottery was not locally made but imported from Southern Mesopotamia – more than likely diffused by boats along the coast. Later on, it became clear that Ubaid pottery was diffused in the whole Arabian Gulf, from Southern Mesopotamia to the Strait of Hormuz: in Kuwait (Al Wohaibi, cf. Carter and Crawford 2010; Bieliński *et al.* 2015), Eastern Saudi Arabia (Masry 1974), Bahrain (McNicoll and Roaf 1975), Qatar (e.g. De Cardi 1973; Inizan 1988; Al Naimi *et al.* 2011), and the UAE (e.g. King 1998; Haerinck 1991; Jasim 1996; Uerpmann and Uerpmann 1996; Vogt 1994; Beech *et al.* 2005; Méry *et al.* 2019; Degli Esposti *et al.* 2020).

All these discoveries have significantly strengthened the evidence of strong and long-term contacts between southern Mesopotamian and Neolithic Arabian societies who were living on the shores of the Arabian Gulf as far as the 6th millennium BCE. However, the nature of these contacts remains poorly understood. While direct maritime interactions could have been possible between southern Mesopotamia and Arabian sites situated in the northern Gulf, such as as-Sabiyah H3 and Dosariyah, Ubaid pottery as well as Iraqi bitumen was more than likely diffused point to point, given the distance to cover. In the southern UAE, Ubaid pottery could have been less used since excavations undertaken in Delma and Marawah islands (Beech and Elders 1999; Beech *et al.* 2005; 2020; 2022) have highlighted the local production of plaster vessels. The situation is different in northern UAE where plaster vessels were not diffused, nor locally produced. Therefore, Ubaid pottery played an important role in domestic activities, as shown by the UAQ2 discoveries.

The UAQ2 pottery assemblage

S. Méry

General

The UAQ2 pottery finds totals 668 fragments, for a total weight of *c.* 2.5 kg. Among them, 384 are potsherds, the rest of the material comprising 'core splinters' and 'surface splinters'. Surface splinters are fragments with

Table 4.2. Stratified Ubaid pottery at UAQ2, by level (551 fragments).

	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	Total
Splinters						2	3	38	27	31	78	43	16	5	243
Potsherds	3	5		1	7	7	7	51	28	25	108	44	17	5	308

Table 4.3. Stratified Ubaid pottery at UAQ2, by phase (551 fragments).

	Phase B	Phase C	Phase D	Phase E	Phase F
Splinters	200	38	3	2	-
Potsherds	227	51	7	7	16

Table 4.4. Other contexts of Ubaid pottery at UAQ2 (117 fragments).

	Not well stratified	Surface	Unstratified	Total
Splinters	26	3	6	35
Potsherds	14	55	13	82

one preserved surface of the sherd, while core splinters have no preserved surface. Stratified specimens comprise 551 fragments (Tables 4.2, 4.3) – *c.* 82% of the total UAQ2 assemblage. A total of 58 pottery fragments have been collected at the surface of the site (Table 4.4).

The state of preservation of the pottery is rather good, with several rolled (37 fragments, half of which come from the surface of the site) or windblown fragments (33 fragments, two-thirds coming from the surface). It should be noted that the most eroded fragments come not only from the surface of the site but also from the lower stratigraphy (Levels 9-13).

A minority of sherds have been burnt before or after breakage (Table 4.4) (43 fragments, among them 27 in Levels 9-13), indicating the richest occupation levels in terms of domestic activities, and particularly related to food cooking.

Among post-depositional alterations, dendrites of manganese were detected as well as micrite (microscopic granular carbonate deposits) on one of the two surfaces of the sherds, or their section. This mainly applies to finds from Levels 8, 11, 12, and the surface finds.

Among the stratified pottery, fragments were mainly found in the lower levels of UAQ2 (Level 11 is the richest level; Levels 9-14 total 77% of the sherds and splinters), then in Level 8 (16%). From Level 7 the number of fragments decreases drastically (Table 4.2).

The pottery found at UAQ2 is fragmentary, with fragments 1.7 cm - 9.6 cm long (mean: 3 cm) and 3 cm - 7 cm wide (mean: 2.1 cm). The surface area of the sherds is very variable (between 0.5 cm^2 - 48 cm^2), but rarely larger than 15 cm^2. The thickness of the sherds varies from 0.3 cm - 1.9 cm (mean: 0.95 cm), but most measure between 0.8 cm - 1.3 cm, and they are present in all the stratigraphy (Table 4.2).

Paste ware features

All the UAQ2 sherds are classified within the 'Common Ubaid Ware' (Smogorzewska 2015: 67), also described as 'Standard Ware' at as-Sabiyah H3 (Carter 2010: tab. 3.3, Code types 2, 6, 7, 9), or 'Black-on-Buff (Standard) Ware' at Dosariyah (Kainert 2018: 186, Code 2). The Common Ubaid Ware category consists of *c.* 70% of the sherds at as-Sabiyah H3 (Carter 2010: tab. 3.14), and 78% at Dosariyah (Kainert 2018: 185-6). There is a complete absence of coarse and fine wares ('egg-shell ware') at UAQ2, two categories well represented, for example, at Bahra 1 and Dosariyah (Kainert 2018: tab. 7.2; Smogorzewska 2015: 67).

Based on its macroscopic observation, the UAQ2 Common Ubaid Ware is rather homogeneous, with two main groups: 'silty ware' and 'silty sandy ware'. It is important to note that each of these groups is not standardised in terms of granulometry of the paste. Such a continuum is certainly related to the natural variation in the composition of the alluvial deposits, where clays/sands were taken along the alluvial Mesopotamian plain and the banks of the Euphrates or other south Iraq rivers, and the conditions under which the clay was prepared by the potters. It may also be linked to the exchange or trade of pottery among the villages of Southern Mesopotamia.

The paste is calcic, microporous, and often contains a fine and well-calibrated fine sandy fraction. The quantity of visible mineral elements is variable, from very low (2% - 4% in surface) to medium (10% - 15%). This is of course a semi-quantitative estimation as a number of minerals were transformed when fired, e.g. the carbonates may be dissociated due to the firing and this transformation leaves holes in the paste, or some fragile minerals can be torn off, etc. Macroscopically discernible when reaching 0.3 mm - 0.4 mm, the minerals are mostly black to grey, translucent (quartz) or opaque (feldspars, iron oxides, etc.), and sub-rounded to sub-angular. The material is hard and compact; its texture varies from fine to rough depending on the density rather than the dimensions of the minerals and rock fragments.

The ceramics were made from fine clay-marl silts. The finest pastes may have been intentionally refined (decanted) by the potters, the others, on the contrary, may have been tempered, but at this stage of the study there are no objective arguments to determine this. A decantation of the alluvial soils would have allowed enrichment in clay and fine silt fractions.

A number of sherds contain vegetal temper, in the shape of fine grass fragments. There are only very few sherds that contain much vegetable temper: they were intentionally prepared with vegetal temper added to the clay, or the potters may have used alluvial clay naturally containing a grassy fraction.

The shape of some of the sherds and their types of breaks indicate that the vessels were coiled: cracking at the coil joint; an elongated rectangle parallel to the coil joints (Figure 4.1); or so-called 'stair-step' breakage, with detached portions of coils being indicative of this shaping technique. In most cases, the mastery of the coil assembly/joining is clear, with a notable regularity of wall thickness. The fact that the potters used very fine marly clay may have helped the adherence of the coils after heating (Franken 1974: 45). Several sherds, all quite thick (*c.* 10 mm), have a very particular, 'toothed' break and very irregular sections (Figure 4.2). A few other sherds show traces of hand shaping, leaving finger depressions on both surfaces. These sherds are thin and correspond to small pots. The sherds from Level 10 bear more significant surface damage than the other specimens from Phase B.

Well-preserved sherds, especially those associated with the finest paste ware have a carefully smoothed outer surface. Their internal surface was well regularised. Decoration only consists of monochrome dark painting (made from oxide-based pigments), which is thick and applied before firing on the outer surface of the vessel. When unaltered, the paint may be glossy.

The control of the firing process by the Mesopotamian potters was good enough (at least in the case of exported products) to avoid accidental collapse or puffing due to the transition phases of clay minerals when heated. It resulted in a good quality and mechanically resistant ceramic product, meeting the requirements of common, frequently handled pottery vessels in domestic contexts. The firing conditions allowed oxidation at the heart of

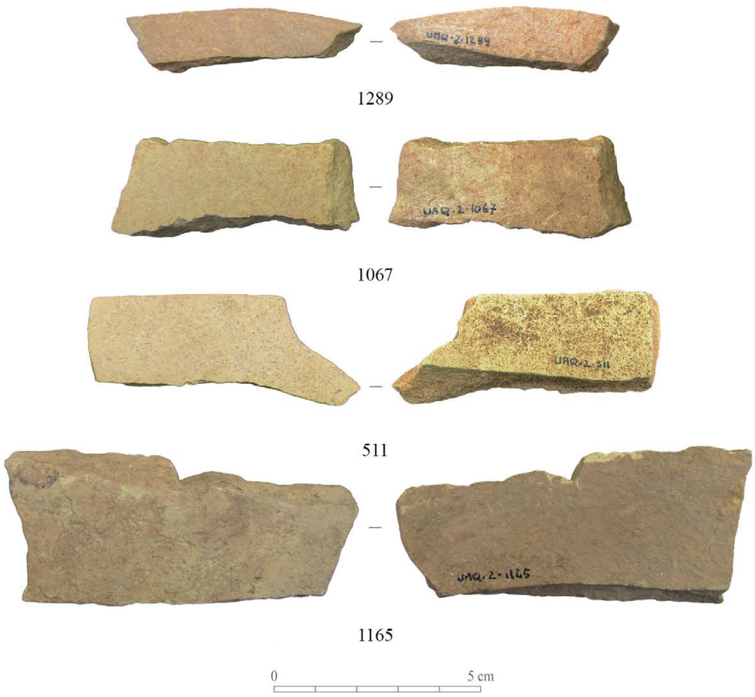


Figure 4.1. Examples of Ubaid pottery sherds showing cracking at the coil's joint.

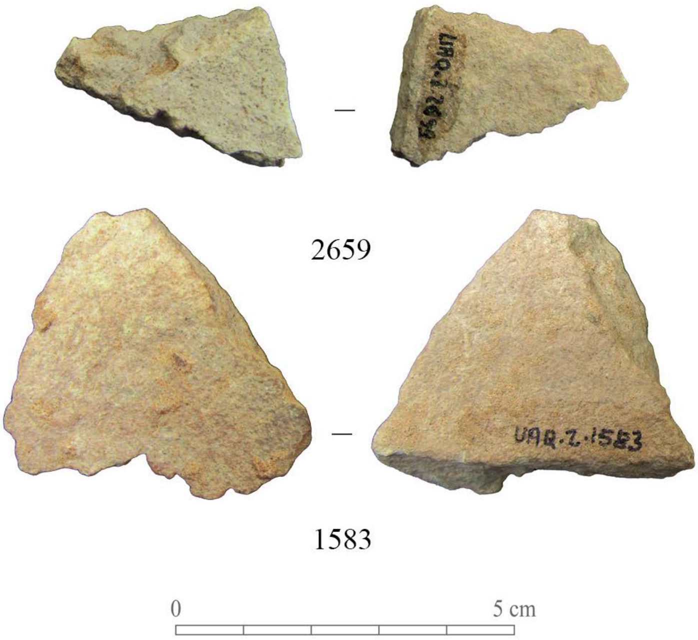


Figure 4.2. Examples of Ubaid pottery sherds showing 'toothed' breaks.

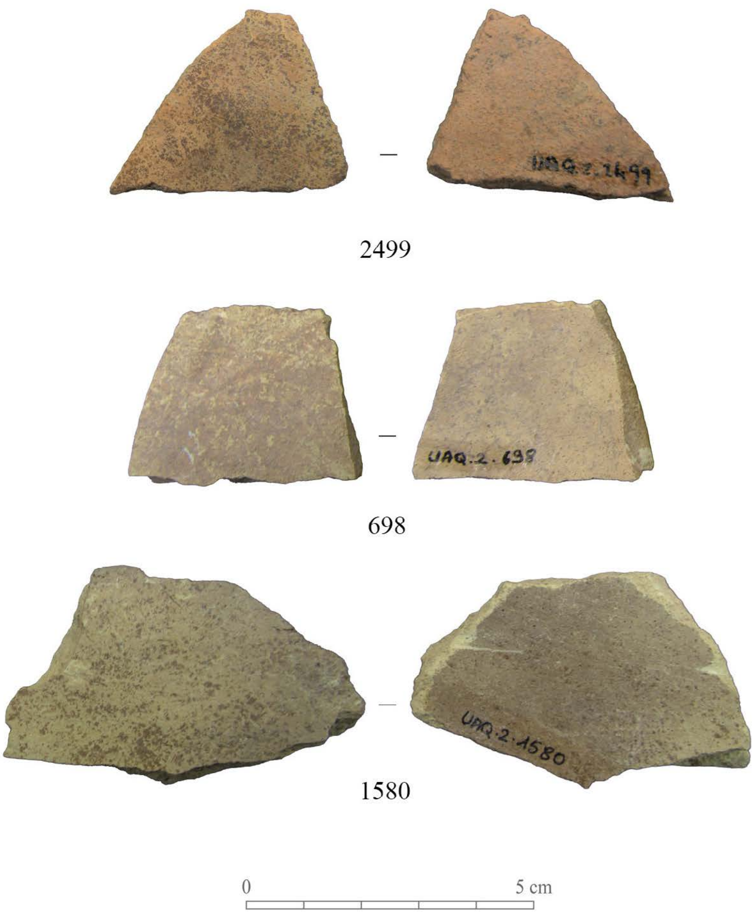


Figure 4.3. Examples of Ubaid pottery sherds showing various degrees of firing: 1. Pinkish-beige (low firing) e.g. UAQ2.2499; 2. Beige to greenish beige (medium firing) e.g. UAQ2.698; 3. Light greenish to medium greenish (high firing) e.g. UAQ2.1580.

the ceramic paste, thus the complete burning of the vegetable matter it contained. The colour of the pottery is mostly uniform: from light beige to medium green, which is related to the degree of firing of marly clays.

As the characteristics of the paste ware are not strictly speaking standardised among UAQ2 Ubaid pottery, and erosion and weathering phenomena also come into play, it was preferred to present the most common cases rather than a strict classification:

- The (few) sherds with the lowest degree of firing are characterised in the UAQ2 assemblage first by a pinkish-beige colour (Cailleux Code: L29, L30, L51; equivalence in the Munsell Code 5 YR 7/3, 10 R 8/2, 2,5 YR 8/4) (Figure 4.3: e.g. UAQ2.2499), and clean to fairly clean but curved breaks with angular/sharp edges. They are often triangular and elongated in the direction of the coil join (horizontal). Their texture is slightly rough, and their surfaces erode in micro-cupules. The thickness of the sherds is between 7.5 mm - 15 mm.
- By far the most frequently represented in the assemblage is a second group of sherds that corresponds to a still moderate, but likely prolonged firing state. These sherds are recognisable first by their beige to greenish-beige colour (Cailleux Code: L71; equivalence 10 YR 8/3 in the Munsell Code) (Figure 4.3: e.g. UAQ2.698) and an irregular to very irregular delineation of their breaks:
    - Some are characterised by a silty fraction, a notable microporosity (rounded vacuoles less than 0.1 mm), a small size (surface area less than 5 cm^2), and the presence of a vegetable fine temper, well discernible in section, giving a flaky but compact appearance. The external wall of the sherds is carefully smoothed with a rib tool (resulting in an even surface and leaving rare and fine U-shaped striations while removing excess clay). The inner surface is carefully levelled. The walls of the sherds are of regular thickness, between 6 mm - 8 mm. The colour of these sherds is beige-white to beige-yellow or greenish (Cailleux Code: mainly L71, otherwise K71 or L92; equivalence 10 YR 8/3 and 5 Y 8/1 in the Munsell Code).
    - Other sherds are slightly thicker and coarser; their external surfaces are not as smooth as those of the previous group or have been slightly eroded. They are also larger, up to 10 cm^2, and their shape is either triangular and elongated or square.
    - The third group, which includes a majority of the UAQ2 sherds, contains the thickest specimens (the 10 mm - 12 mm class is the most commonly represented). They correspond to the sherds that are the richest in fine sand fraction. The shape of the sherds is more often square or rectangular than triangular.
- The sherds with the highest degree of firing are light-greenish to medium greenish (Cailleux Code: L92, M92 or T80; equivalence 5 Y 8/1, 5 Y 7/1, 5 Y 8/2 in the Munsell Code) (Figure 4.3: e.g. UAQ2.1580). The sherds are very hard, their shape is irregular, the breaks are sharp and very irregular, sometimes 'toothed'.

Pottery shapes

No complete or nearly complete vessel forms have been found and diagnostic sherds are quite scarce, with four different types of rims. The sherds come from the lower levels of occupation of the site:

- UAQ2.1056 (Figure 4.4). A small jar rim, found in Level 11, is slightly thickened. It has parallels at as-Sabiyah H3 Periods 1 to 3 (Carter 2010: rim type G, fig. 3.16 n°9) and Tell el-Oueili in the Ubaid 3 levels (Lebeau 1991b: pl. IX n°10).
- UAQ2.2480 (Figure 4.4), found in Level 12, corresponds to the simple and vertical neck of a small jar. Such necks are found at as-Sabiyah H3 Periods 2 to 4 (Carter 2010: rim type I, fig. 3.16 n°11) and have parallels in Ubaid 2 or 3 at Tell el-Oueili (Lebeau 1991b: pl. VII n°8 or pl. X n°2).
- UAQ2.1515 (Figure 4.4), found in Level 11, is comparable to Carter's type H (Carter 2010: 44, 56 n°3), this typical ledged jar rim is known throughout the stratigraphy but more frequently in Periods 1 and 2 at as-Sabiyah H3, and thus dated to the end of the 6th or beginning of the 5th millennium BCE. The same type of rim is documented at Dosariyah (Masry 1974: fig. 33 n°1-2, Kainert 2018: fig. 7.2), and corresponds well to examples from Eridu Level XIII (Safar *et al.* 1981: fig. 89 n°5-6).
- UAQ2.3089 (Figure 4.5). Several fragments of a large bowl with sloping thin wall, were found in Levels 9-12. The rim is slender. In Mesopotamia, parallels for this typical Ubaid 2/3 shape are known at many sites, e.g. from Eridu (especially in levels XIV and XII, Safar *et al.* 1981: figs. 88, 90), and the Ubaid 2 levels at Tell el-Oueili (Lebeau 1991b: pl. I).

Several carinated body sherds have also been recovered (Figure 4.6: e.g. UAQ2.2482), a type of shape which is characteristic at Tell el-Oueili in Ubaid 2 levels (Lebeau 1991b: Pl. I n°6-11) and known at Bahra 1 (Smogorzewska 2015: fig. IV.9 n°3-5) and as-Sabiyah H3 (Carter 2010: fig. 3.9 types A and E, fig. 3.15, rim type A, n°1). UAQ2.2482 is decorated with a black-painted horizontal band, which is strongly characteristic.

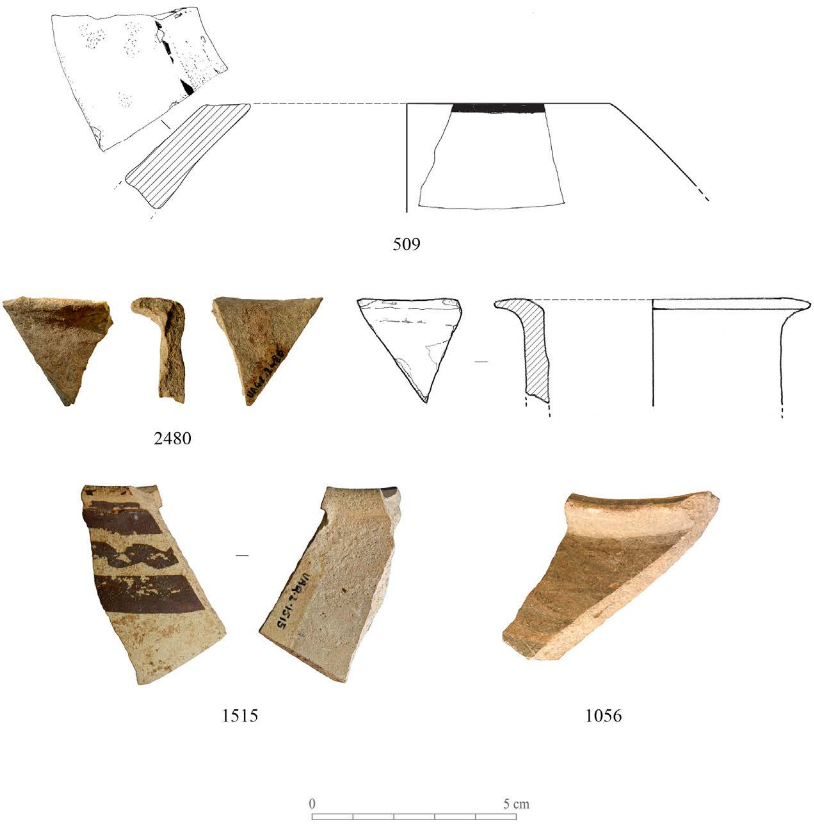


Figure 4.4. Types of pottery rims identified at UAQ2. Drawings: D. Zaros

Figure 4.5. Specimens of bowl sherd showing painted herringbone pattern.

Table 4.5. Types of painted motifs represented at UAQ2.

Motif	Description	Level	ID number	Quantity
A1	Simple horizontal line or band	13	508, 2281	2
		12	507, 2303, 2298, 2482, 2596	5
		11	1501+1510, 1512	2
		2	715, 718	2
		Surface	2553	1
A2	Double horizontal line or band	14	2784	1
		Unstratified	2509	1
A3	Three horizontal lines or bands	7	1144	1
A4	Horizontal and vertical band	11	151	1
B1	Double horizontal line and a wavy line	12-9	695	1
B2	Simple wavy line between two horizontal bands	11	1515	1
C1	Double ladder	11	2508	1
C2	Ladder and a 'net' motif	12	148	1
D1	'Herringbone' pattern	12-9	466+554+2009	3 from the same vessel
E1	Grid	11	1604	1
		14 or 11	Phillips 2002: fig. 5	2
F1	'Reserve line'	8	873	

Painted decoration

Painted sherds are the more numerous among the diagnostic pottery. When legible, the motifs are mainly simple, geometric, and correspond to the categories described in Table 4.5.

Among them, motif categories A and B (straight and wavy line decorations) are quite simple patterns attested all through the Ubaid period (from Ubaid 0 to Terminal Ubaid/Ubaid 5). (Figure 4.6: e.g. UAQ2.2509; see also Figure 4.7). Therefore, they cannot be used as reliable chronological indicators.

On the contrary, patterns C to F are chronologically diagnostic and date from Ubaid 2, 2/3 or 3 in southern Mesopotamia. Such motifs are associated with the lower levels at UAQ2 (Levels 12 to 9) or Level 8 in the case of F1. Examples of dense grids (E1) come from Ubaid 0-3 levels at Tell el-Oueili (Breniquet 1996: pl. XVIII n°1; Lebeau 1991a: pl. II n°1-6, pl. V n°4-6; Lebeau 1991b: pl. I) or Tell al-Ubaid (Vértesalji 1984: taf. 21-23), as well as from Bahra 1 (Smogorzewska 2015: fig. IV.4 n°2) and as-Sabiyah H3 (Carter 2010: fig. 3.18, Code type 7), and Levels 3 and 4 at Ain Qannas in eastern Saudi Arabia (Masry 1974: fig. 18, fig. 31 n°3). One sherd decorated with a grid comes from Level 11 at UAQ2 (Figure 4.6: UAQ2.1604). A few sherds showing the same pattern were previously found in the Umm al-Quwain area, at UAQ2 during the 1990s (Phillips 2002: fig. 5) and at al-Ramlah RA3 (Uerpmann and Uerpmann 1996: fig. 3). Ladder patterns (C1-C2) comparable to the specimens found at UAQ2 in Levels 11 and 12 (Figure 4.6: UAQ2.2508; UAQ2.148) are known at Tell el-Oueili Periods 0 to 2 (Breniquet 1996: pl. XIII n°6, pl. 15 n°8), and as-Sabiyah H3 (Carter 2010: fig. 3.8, Code type 22). They are also reported at al-Ubaid (Vértesalji 1984: taf. 12 aM 27b, aM 27e). Herringbone patterns (D1) (Figure 4.5) are documented at Eridu Level XIII (Safar *et al.* 1981: fig. 89 n°16), Tell al-Ubaid (Vértesalji 1984: taf. 19 aN119a), Tell el-Oueili Period 1 (Breniquet 1996: pl. XXV n°6, pl. XXVII n°5), and Ain Qannas (Masry 1974: pl. X n°1-2, fig. 20 n°2).

Parallels for reserved lines (A5) are well known at Tell el-Oueili in levels associated with Ubaid 2 and 3 (Lebeau 1991b: pl. I n°6, 7, 11, pl. V n°2-9), Eridu Level X (Safar *et al.* 1981: fig. 86 n°32, 35, 37), and in the Arabian Gulf, at Bahra 1 (Smogorzewska 2015: fig. IV.2 n°4, IV.5 n°1) and at as-Sabiyah H3 mostly during Period 1 (Carter 2010: fig. 3.8, Code type 7). The only decoration of this type is associated with Level 8 at UAQ2 (Figure 4.7: UAQ2.873).

Repair, re-use and reshaping of the pottery sherds

Perforated fragments are few, although present in the settlement area in the ancient levels, indicating the repair of vessels, as also noticed at Dosariyah (Kainert 2018: 188).

A thick sherd was reused as an anvil (Figure 4.8: UAQ2.1293): traces of percussion are visible on its outer surface. Another example is reported at Dosariyah (Kainert and Drechsler 2018: fig. 9.6). Two large sherds have been retouched on one edge (Figure 4.8: e.g.

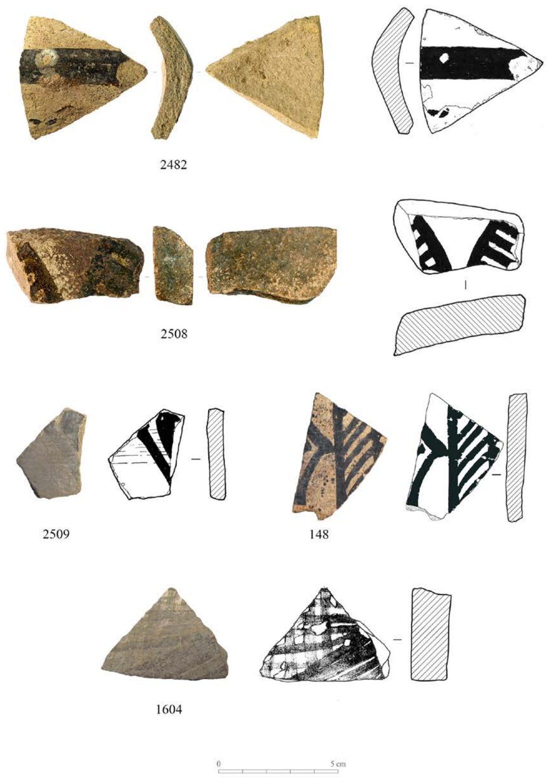


Figure 4.6. Specimens of Ubaid pottery sherd showing characteristic painted decorations. Drawings: H. David.

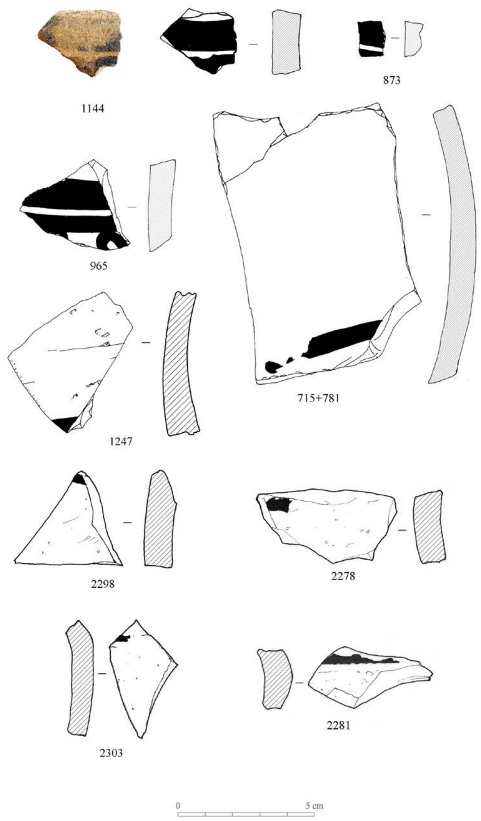


Figure 4.7. Specimens of Ubaid pottery sherds with reserved lines and simple band decorations. Drawings: H. David.

UAQ2.2007). Comparable scrapers made on pottery sherds are reported at Dosariyah (Kainert and Drechsler 2018: fig. 9.4). Several other sherds (Figure 4.8: UAQ2.446, UAQ2.506, UAQ2.1605) were shaped by knapping into discs, *c.* 4 cm in diameter, and find parallels in the Arabian Gulf, for instance at Bahra 1 (Reiche 2015: fig. IV.3) and more rarely at Dosariyah (Kainert and Drechsler 2018: fig. 9.1.b). UAQ2.446 was re-used on its edges as a file or a polisher; UAQ2.1605 seemed to have been to re-shaped into a borer. Several other pieces of pottery, but much smaller (*c.* 1 cm in diameter), were also reshaped. Among surface splinters, several were identified as 'flakes', demonstrating local reshaping of sherds by knapping at UAQ2 (in Levels 8, 10, 11).

The presence of such items and their variety underlines the importance of Ubaid pottery for the UAQ2 communities and its long-term use in daily life at the site. We believe these types of artefacts could be systematically searched for on the sites of the Arabian Gulf, as they open up new perspectives on the regional Neolithic tool kit.

Diffusion and uses of Ubaid pottery

At UAQ2, the vast majority of Ubaid pottery sherds were discovered in Levels 9-14 (Phase B), the oldest of the site's occupation levels and the richest in structures, both architectural and related to cooking activities. These levels of numerous and successive installations were functionally similar and testify to the existence of a relatively perennial residential site. The recurrence of pottery in these levels and its significant quantities suggest that the arrival of Ubaid pottery along the western coast of the UAE was relatively regular throughout this phase. It may also mean that UAE pottery vessels were preserved as valuable items and passed on between generations within the community. This could explain the relative homogeneity of the material at UAQ2.

The sherds of UAQ2 are today the most remote examples of Ubaid pottery in the UAE, together with those from the Jazirat al-Hamra area in the Emirate of Ras al-Khaimah, a distribution that is known to have remained,

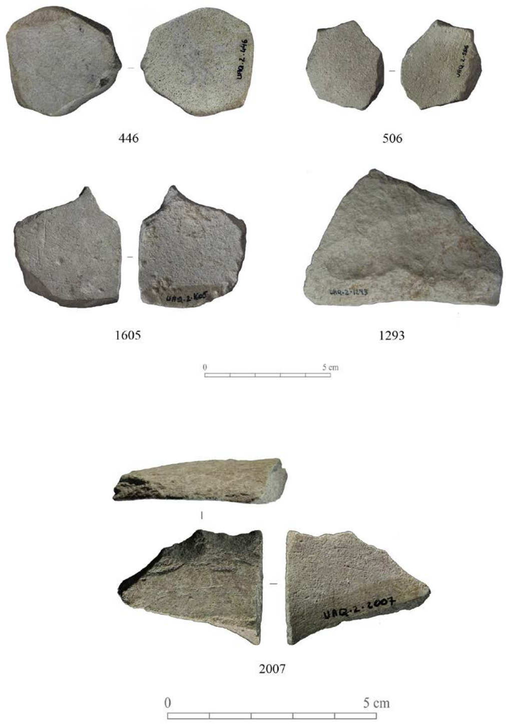


Figure 4.8. Specimens of Ubaid pottery sherds re-shaped and re-used as tools.

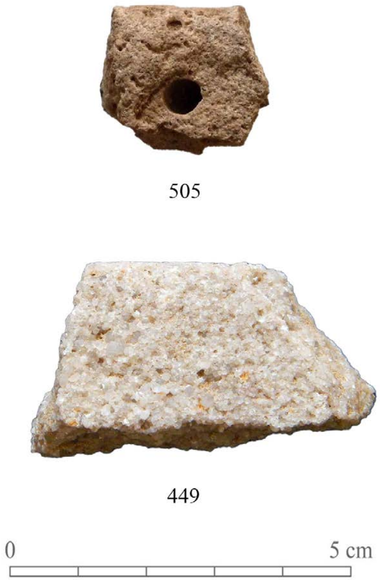


Figure 4.9. Specimens of stone vessel rims.

in view of current discoveries, only in coastal regions of the UAE. Stylistic links are numerous with southern Mesopotamian sites (e.g. Tell el-Oueili, Tell al-Ubaid, or Eridu) and those of the northern and central Gulf (among them, as-Sabiyah H3, Bahra 1, and Dosariyah). The style of the diagnostic sherds (shape and decoration) coming from Phase B mainly corresponds with phases 2 and 2/3 of the Ubaid pottery assemblages from Mesopotamia. This cultural dating is consistent with the radiocarbon analyses obtained at UAQ2, i.e. the second half of the 6th millennium BCE (wide chronological range), or its last third (short chronological range). The scarcity of Ubaid pottery during the 5th millennium BCE at UAQ2 may have been due to changes in the site's occupation, which likely became more episodic. This shift suggests a focus on logistical activities rather than primarily domestic tasks, probably in response to regional aridification. Additionally, inter-site exchange networks, particularly between the Central and Lower Gulf, may have been disrupted. No stylistically diagnostic specimens were identified in the upper levels of the site.

Despite the absence of finer wares at UAQ2, the presence of decorated pottery and functional types, e.g. bowls, cups, small jars, in Levels 9-12 strengthens the idea that Ubaid pottery reached the UAE as items of trade as early as the second half of the 6th millennium BCE (Beech *et al.* 2008: 33). Based on the frequency of sherds found at UAQ2 and discoveries at Dosariyah (Kainert 2018), it can be assumed that Ubaid pottery was more commonly utilised than previously believed for the daily cooking, serving, and consumption of food in coastal Arabia, irrespective of its exotic nature. This perspective contradicts Carter's (2010) hypothesis, which suggested that Ubaid pottery was primarily used in the context of ritualised social events or even feasts – which might have only concerned as-Sabiyah H3 (likely Bahra 1) due to its geographic proximity to Mesopotamia. Small jars could have also been used to collect and store water, milk and, potentially, dairy products. The goods and products that spread out from Mesopotamia not only included pottery but also bitumen (van de Velde 2018) and, possibly, cereals (Parker 2010: 195), perhaps transported in jars. Evidence of such trade is limited, but several bitumen beads were found associated with two skeletons in the 1990s at UAQ2 (Phillips 2002: fig. 5 n°7-8): the source has been localised in Iraq (Connan and Carter 2007). In exchange for pottery and bitumen, goods from coastal Arabia could have included seashell ornaments, pearls, and possibly animal skins (Oates *et al.* 1977; Carter 2002).

Stone vessels

K. Lidour, S. Méry

A few stone vessel sherds of a coastal or hard marine limestone (cf. calcarenite) were also recovered at UAQ2 (Figure 4.9). One rim (UAQ2.449), found at the surface of the site, corresponds to the simple shape of a small bowl

(1.8 cm thick). Another small fragment of rim of the same thickness was also found in Level 13 (UAQ2.505).

No specimen of stone vessel was found at Akab, nor at other sites of the Umm al-Quwain and Jazirat al-Hamra areas, but some specimens are known at Umm az-Zumul (Khor al-Manahil), an inland site located in the Emirate of Abu Dhabi (Kallweit *et al.* 2005). Other sites in the Arabian Gulf have provided examples of stone vessels: Khor (Inizan 1988: 73, figs 30, 40) and Dosariyah (Drechsler 2018: 252-3), as well as surface sites investigated by Edens (1992) in the Rub al-Khali. Examples of Neolithic stone vessels are also documented in the Sultanate of Oman: at Ras al-Khabbah KHB1 (Cavulli and Scaruffi 2008), but also at Ruwayz RWY1 (V. Charpentier pers. comm.) for instance.

Based on ethnographic comparanda (Cavulli and Scaruffi 2008: 9), it was suggested that stone vessels found at KHB1 were used for grinding burnt shells to produce a waterproof product for specific application on fishing nets. Alternatively, the hypothesis of a use as small mortars for grinding food (e.g. cereals, wild plants, as well as dried fish) remains highly likely.

Lithic industry

C. Gallou, S. Méry, K. Lidour

Introduction

The Umm al-Quwain 2 site is an important witness of the transition between the second half of the 6th and the end of the 5th millennium BCE for the Neolithic of Eastern Arabia. The various operations carried out by the French archaeological mission in the United Arab Emirates brought to light a large quantity of artefacts, including 2177 lithic artefacts distributed over 14 stratified archaeological levels, and also lying on the ground surface in the excavation areas as well as in their close proximity.

The aim of the characterisation of the lithic material from UAQ2 was to complete the chrono-cultural specification of this assemblage, and provide a solid basis for future comparisons with lithic material from archaeological excavations to be carried out in the Umm al-Quwain area.

To this end, the various production types and purposes in use during the occupation of the site were identified. Differences and similarities were sought among the operational sequences (*chaînes opératoires*), as well as regarding the treatment of the different raw materials. The search for the origin of the clastic rocks was also a means of highlighting the supply networks for raw materials, as well as the constraints linked to the circulation of human groups in the region.

This data set has contributed to a better understanding of the nature of the occupations at the site as well as some of the social, techno-economic and cognitive behaviours involved in the production of the lithic assemblage found there.

Study protocol

At the UAQ2 site, the lithic artefacts uncovered during the excavation were most often registered to a particular square metre, and less often to a GPS point (x, y, and z coordinates). This can be explained in part by the methods used during the excavation and the pace of the work, but it is mainly due to the fact that the site is a dune of fine loose sand. The lithic artefacts, especially the smallest ones, could move in the Neolithic period as a result of the slightest trampling, especially in levels or areas with loose sediments.

The chosen study protocol includes a description of the anthropic elements (knapping techniques and methods, operational sequence) and of the so-called natural elements (material, weathering, deposition, and taphonomy). The whole approach is part of a technological analysis of the material, contributing to a global and objective vision of certain ‘events’ or ‘changes’ in the lithic assemblage in a given stratigraphic context, while setting clear limits for the interpretation of the site and its industry. Naturally, considering criteria that are not immediately useable makes it possible to collect data for comparative purposes and to place the site in its chronological and regional context, through comparison with the assemblages from other sites. Such an approach is all the more decisive as UAQ2 is currently the only site in the United Arab Emirates presenting such a stratigraphic sequence for the period between the mid 6th/end of the 5th millennium BCE.

The descriptive protocol used here is based on the technological analysis of the different techno-types and pieces that make up the industry and its aim is to identify the operational sequences as well as the associated mental patterns. This information was recorded on an Excel spreadsheet by category: cores, flakes and fragments of flakes, chips, tools, macro-tools, and debris. All the pieces that could be directly studied (C.G.) were measured and weighed. Other parameters considered for each lithic element were their nature (techno-type), surface condition, the raw material used, the general shape, and the description of edges, faces, and active parts.

The degree of clasticity of a particular material was also considered, i.e. rock crystal knapped at UAQ2 is generally unsuitable for shaping artefacts other than flakes, and the products obtained are mostly chips or flake fragments. Another example is radiolarite, which is more difficult to knap compared to chert or chalcedony.

The negatives of removal on the debitage surfaces of the cores and the upper faces of the products were methodically observed so as to identify the debitage techniques and understand the production dynamics at play in the lithic assemblage discovered at UAQ2. As far as this was possible, the analysis led to the identification of, first, the supply processes of raw materials (origin, accessibility and availability, pre-treatment); second, the actions related to production; and, third, the actions related to the transformation of the products by retouch (techniques, methods, order of retouch, and objectives).

The combined results of the macroscopic, technological, and typological analyses (conducted by C.G.) have highlighted the presence of several operational sequences, mainly resulting from the debitage process. Only some of the blanks resulting from the debitage process were modified.

Overall, the different stages of the operational sequences could be identified from the study of the lithic remains, but it was not possible to identify a complete operational sequence (tool category made from a given material or for a particular tool) within the lithic assemblage of the site.

Description of the UAQ2 operational sequences

(Stage of acquisition)

At UAQ2 the lithic elements relating to the stage of raw material acquisition are rough clasts that were intentionally brought to the site to be tested and used. These clasts are of various shapes and sizes, and occur in the form of blocks, tabular blocks or nodules. Blocks, i.e. elements of a rather large size, are rare in the UAQ2 assemblage.

It is impossible to say whether these materials were directly brought to the UAQ2 site from natural deposits or sources. They potentially have varied geographical origins (such as rocky outcrops, ergs, wadi banks, inter-dune lake shores or coastal beaches) but, as shown hereafter, most of these raw materials probably originated from a rocky outcrop *c.* 30 km from UAQ2. As a matter of fact, the local sources are poor.

Without sound data on the paleo-wadis crossing the region, and their flow at the time of the Neolithic occupation (and therefore their capacity to transport raw materials in the form of blocks or nodules), we could only rely on natural materials sampled by our team from outcrops and dune cross-sections located in the Emirates of Umm al-Quwain and Ras al-Khaimah. These materials are rocks and minerals. Publications and reports were also used (see below). Intermediate sites located between the geological or geomorphological deposits and sources and the UAQ2 site are currently unknown.

(Stage of blank production)

During their study, the mineral nature of the cores (flint, chalcedony, radiolarite, etc.) discovered at UAQ2 was identified and recorded, as well as the nature of their support (pebble, block, flake, etc.), the type and number of visible negatives of removal, and the general organisation of the removals according to the exploitation scheme. The dimensions taken correspond to the length, width, and general thickness of the last face processed (known as face 1), the other faces being named face 2 to face *n*. The length and width of the last removal were measured. Other characteristics were recorded, i.e. the number and location of the striking platform on the core, the presence of knapping accidents (plunged flakes, hinged flakes), sustained knapping effort, the state of exhaustion of the piece (no exhaustion to very advanced exhaustion in the case of the UAQ2 lithic assemblage), and the possible or probable reasons for its discard.

At UAQ2 only a few blocks used as cores or as knapping tools related to various functions, i.e. hammer stones, anvils, etc., were recovered and some of these were studied by one of the authors of this contribution (C.G.). These will be dealt with in this chapter, alongside the remainder of the lithic industry.

The blanks resulting from the debitage processes are grouped together here under the following terms relating to products and by-products: flakes and flake fragments (it should be noted that their orientation was difficult or even impossible to discern on products the proximal part of which was broken), blades, bladelets, and intentionally retouched blanks.

Awaiting use-wear analysis, unretouched flakes with natural cutting edges were assumed to be flakes not tools. Flake fragments are classified as products broken by anthropic or natural actions during the Neolithic or more recently (thus from the surface, as all the stratified are Neolithic on the site). Systematic observations of the upper face/surface of the products and by-products provided information about the production phase (number of negatives of removal and the debitage method used).

As is the case for numerous other studies, the assessment of the butts was a perfectly good indicator of the degree of preparation of the striking platform, as well as of the method of percussion used (morphology of the bulb, see Inizan *et al.* 1994; Pelegrin 2000). The assessment of the knapping accidents made it possible to evaluate the degree of skills of the knappers, depending on the raw materials and the techniques used. The quantification of the various types of products made it possible to assess the types of blanks that were sought, and the methods and techniques used to produce them.

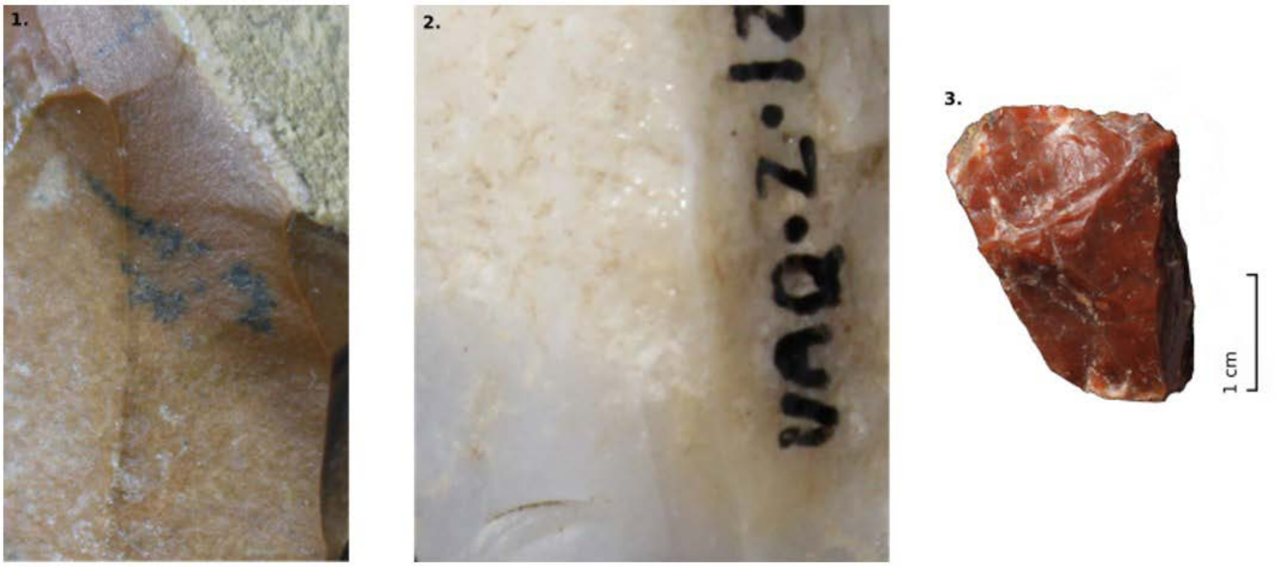


Figure 4.10. Main types of surface alteration observed on the lithic industry of UAQ2: 1. Whitish patina; 2. Aeolation; 3. Stigmata of thermal fracturing and rubefaction. Photos: C. Gallou.

Splintered pieces were classified as tools even though these are unretouched blanks. Their unworked edges are chipped and crushed, showing that they were used as tools. Their nature, extent and position were observed and recorded during the study.

(Stage of modification)

The stage of modification of a blank corresponds to the shaping of tools by retouch and in our case most often aims to modify the morphology of the cutting edges.

Morphometric and technological criteria, such as the shape of the piece and the type, position, extent, angle, and shape of retouch, enable the typological identification of the tool and its techno-functional interpretation. The length, width and thickness of the tools found in great variety at the UAQ2 site were measured. Projectile points, endscrapers, sidescrapers, splintered pieces, pieces with marginal retouch, and borers, are the most common elements encountered.

(Debris and fragments)

Lastly, the debris and fragments correspond to unshaped fragments produced by human actions, but which could not be reliably linked to a specific debitage phase. These pieces show fractures and breaks that provide potential information about the taphonomic processes involved at UAQ2 and the management of raw materials by its inhabitants, regardless of whether the knappers were beginners, occasional knappers, or specialists.

(Surface alteration of the lithic pieces)

Macroscopic observation made it possible to identify several types of surface alteration on the material recovered from UAQ2, i.e. mechanical alterations, abrasions on the edges or surfaces, surface patina, as well as anthropic or natural thermal deterioration (Figure 4.10).

Three degrees of weathering were identified on the UAQ2 lithic material recovered from UAQ2: 1) fairly 'fresh', slightly blunted; 2) blunted ridges but with 'fresh' areas; 3) pronounced blunting, with very 'softened' edges and sharp edges. The degree of weathering is partly related to the source material, ranging from soft (shale) or fairly hard rock (calcarenite, radiolarite) to hard minerals and rocks (e.g. rock crystal, flint, chalcedony). As far as the extent of patina is concerned, three cases were present: 1) scattered (extent less than or equal to one third of the piece); 2) covering *c.* half of the piece; 3) covering over half of the piece. This information was linked to the chronology of the site and the nature of the level (surface, exposed soil, slightly exposed soil, unexposed soil, etc.).

Two types of thermal weathering were also identified during the study: one related to heating through human action, the other to a natural breakdown due to sudden temperature changes in hot desert environments (e.g. day/night alternation). These elements were considered in the database, based on the types of stigmata and their extent (scale from 1 to 3).

Raw material procurement

The sources of many of the raw materials were identified on the Jebel al-Ma'taradh, in the alluvial plain of Wadi Dhaid (Charpentier *et al.* 2017). This site, which is almost 1 km long, is located *c.* 40 km directly south-south-east of the UAQ 2 site. The route leading from UAQ2 to the Jebel al-Ma'taradh follows wadi Dhaid for *c.* 30 km.

Jebel al-Ma'taradh is a primary source of rocky outcrops hosting most of the raw material types identified among the industries of the UAQ2 site, e.g. black, dark-brown or light-brown flints, chalcedonies (agate, carnelian, chrysoprase – isolated or combined within the same block) and radiolarite (Table 4.6; see also Table 4.7).

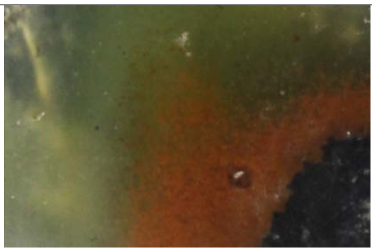
This rock massif was explored by German geologists in the 1980s (mentioned by Vogt 1994). Since then, the area has been surveyed by many archaeologists, e.g. members of the Sharjah mission from the University of Tübingen (Uerpmann *et al.* 2008) and the French mission in the United Arab Emirates. Although some uncertainty prevailed for a long time regarding this issue, it must be noted that the borders between the Emirate of Sharjah and the Emirate of Ras al-Khaimah are now marked by fences: as a matter of fact, the Jebel Ma'taradh clearly belongs to the Emirate of Ras al-Khaimah and not to the Emirate of Sharjah.

Under the umbrella of the Department of Antiquities and Museums of the Emirate of Ras al-Khaimah (the authors thank Christian Velde, resident archaeologist at the Department of Antiquities of Ras al-Khaimah, for his kind support during the surveys), and under the direction of Vincent Charpentier, the French archaeological mission carried out more systematic surveys on the Jebel Ma'taradh between 2008 and 2010 with the aim of identifying the provenance of the clastic materials discovered during archaeological excavations carried out by the team, more particularly at Umm al-Quwain UAQ2.

On the outcrops the raw materials are present in various forms and sizes. They appear in the form of ledges (radiolarite), blocks included in the rock in situ, or tabular blocks procured from veins or breccia. Extraction stigmata could be identified, but these cannot be dated (Charpentier *et al.* 2017). On the slopes and at the foot of the outcrops the materials are present as blocks or tablets. Debitage products are attested to on the piedmonts. In 2018 the French team working at UAQ2 once again surveyed the massif. The rocks mentioned in the 2010 publication were all identified as well as a large number of radiolarites. According to the experiments carried out by V. Charpentier (Charpentier *et al.* 2017), the chalcedonies stemming from the Jebel Ma'taradh exhibit fair, even outstanding clastic properties, especially carnelian, but also black, dark-brown, light-brown and dark-red flints. Chrysoprase shows more varying qualities. On the outcrop high-quality rocks in most cases have homogeneous textures creating regular diffusion of the shock wave during knapping. Generally, the cortex is thin and can be removed in a few steps. Lower quality materials display internal defaults (cracks, inclusions), thick cortex and a heterogenous matrix (coarse grain, tenacity or brittleness), which makes the diffusion of the percussive shock waves more random.

Table 4.6. Raw material types identified among the lithic industry of UAQ2 (photos: C. Gallou).

	Photograph	Description
Black flint		The black flint is opaque, mat and very homogeneous. Its texture is smooth. It can be fine grained or slightly coarser. Its white-beige cortex is thin and granular. This variety has been identified in the Jebel al-Ma'taradh massif and occurs in the form of blocks of varying sizes.
Dark-brown flint		Apart from its colour, the brown flint is similar to the black flint. The two flint types are combined within the deposit of the Jebel al-Ma'taradh and occur in the form of blocks or tablets with varying sizes.

	Photograph	Description
Light-brown flint		The light brown flint is opaque, mat and homogeneous. Its texture is very smooth and very fine-grained. Small black veins and cracks are present on its surface. In the deposit of the Jebel al-Ma'taradh it is combined with agglomerates of chalcedony and occurs in the form of blocks.
Red or banded red flint		The red flint is opaque and mat and it occurs in the form of blocks. Its smooth and very fine-grained matrix exhibits small and thin white or black veins. Its presence in the deposit of the Jebel al-Ma'taradh, where it is combined with light-brown flint, is well attested. It is also combined with chalcedony agglomerates.
Beige/yellow or light brown/yellow opalescent flint		The opalescent flint is extremely fine and homogeneous. Its surface is smooth and glossy. This flint variety is opaque and has a beige-yellow or brown-yellow colour. Its source or sources are still unknown. Among the lithic industry discovered at UAQ2 it is present exclusively as finished products brought to the site (such as endscrapers on blades).
Chert		No petrographic analyses have so far been carried out to identify the nature of this stone. This chert is opaque and generally of a light-beige, grey, yellow or brown colour. Its surface is slightly grained and characterised by many white opaque grains (up to 1 mm), as well as some brown-black grains.
Translucid or milky white, beige to light-brown chalcedony		Chalcedony is a mineral with a siliceous, very homogeneous and smooth appearance. It is white or beige to light-brown, translucid or rather milky. Its cortex is porous. At the source of Jebel al-Ma'taradh chalcedony occurs as tablets stemming from veins or in the form of erratic blocks.
Chrysoprase		This type is a variant of chalcedony. It has a green colour and a translucid appearance. Its smooth and shiny texture exhibits black micro-inclusions. It is combined with the chalcedony formations of the Jebel al-Ma'taradh and appears in the form of blocks or veins.

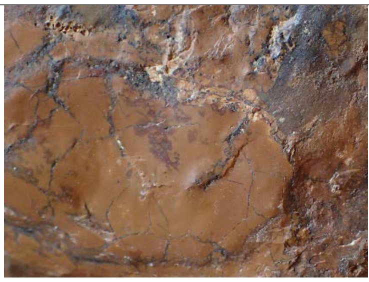
	Photograph	Description
Flecked chrysoprase		Its matter is opaque and it has a blue-green to grey colour, while its surface presents a large number of black dendrites. Its appearance varies from smooth and homogeneous to more grained. The speckled chrysoprase is combined with the chalcedony formations of the Jebel al-Ma'taradh and occurs as blocks.
Agate		The agate is built up of stratified layers of chalcedony with varying compositions. The agate varieties of the Jebel al-Ma'taradh are opaque or translucid and have various colours. Their cortex is irregular and contains light-coloured inclusions in a brown matrix. On the Jebel al-Ma'taradh they are combined with the chalcedony formations and occur in the form of blocks.
Carnelian		Carnelian is a semi-precious variety of chalcedony with a deep to dark-red-orange characteristic colour. Opaque or translucid, its appearance is smooth, shiny and very homogeneous. Combined with the chalcedony formations of the Jebel al-Ma'taradh, it occurs in the form of small blocks presenting an outstanding clastic quality.
Radiolarite		On the Jebel al-Ma'taradh the radiolarite matrix is opaque and characterised by fine or coarser grains with brown-red or brown-orange colours. Its matrix contains white or black radiolarians or small inclusions. In situ, it occurs in the form of blocks or banks.
Quartz		Quartz, with a translucent or milky appearance (in most cases) is opaque and white. It is not very suitable for knapping. It was not possible to identify the origin of the quartz discovered at UAQ2.
Rock crystal		Rock crystal, which is transparent and colourless, is a hyaline variety of quartz rather unsuitable for knapping. The origin of this mineral and its potential source(s) could not be identified.

Table 4.7. Quantification of the lithic pieces by clastic raw material and phase.

	Stage I	Stage II			Stage III	Isolated	Total	%
	Phase B	Phase C	Phase D	Phase E	Phase F			
Flint	302	104	35	54	34	114	643	46.36
Chalcedony	65	68	9	29	24	29	224	16.15
Radiolarite	15	30	2	31	60	61	199	14.35
Chert	21	40	9	18	23	17	128	9.2
Chrysoprase	47	16	7	3	2	15	90	6.4
Agate	11	6	1	1	4	7	30	2.1
Crystal rock	21					1	22	1.5
Carnelian	1	2		1	2	3	9	0.6
Quartz	3	2	2		1	1	9	0.6
Sandstone	2	1			2	2	7	0.5
Calcarenite		1			1	1	3	0.22
Eocene sandstone				1		1	2	0.14
Quartzite	1					1	2	0.14
Indeterminate	2	8		3	2	2	17	1.23
Total	491	278	65	141	156	256	1387	

Figure 4.11. Illustration of the two surface states: 1. Water-rolled cortex; 2. Unrolled cortex. Photos: C. Gallou.

Certain raw materials present in the UAQ2 lithic assemblage were not identified on the Jebel al-Ma'taradh or in its surroundings. This applies to opalescent flint, rock crystal, sandstones and quartz materials (Table 4.6). Their absence on the Jebel massif is an argument for the existence of additional, as yet unlocated primary sources. Quartz and sandstone materials may have been collected in a secondary position in the form of pebbles originating from the banks of the wadis or their mouths, from the lakesides of ancient interdunal lakes, or from littoral beaches, as is suggested by the presence of lithic pieces with water-rolled cortex at UAQ2 (Figure 4.11).

The rock crystal cut at UAQ2 is generally unsuitable for shaping artefacts other than flakes, the products obtained being mostly chips or flake fragments, which were abandoned at the site. Rock crystal flakes are rare in the assemblage except for the two levels dated to the second half of the 6th millennium: these pieces probably had a special status and were most likely taken somewhere else. Another example is radiolarite, which is more difficult to knap compared to flint or chert.

Certain procurement places remain unknown today, especially those hosting quartz and opalescent flint, bearing in mind that similar geological formations in the northern part of the United Arab Emirates may have yielded identical materials to those of the Jebel al-Ma'taradh massif. Thus, black flint and possibly radiolarite were identified in the Sharjah emirate on the Jebel al-Faya (Uerpmann *et al.* 2008: 68-9). The procurement of lithic raw materials therefore required the establishment of a complex circulation network based on logistic expeditions, 'imports' or exchange. In addition, intermediate and as yet completely unknown sites may have existed. The precise distance between UAQ2 and the source(s) remains unknown, although it is necessarily greater than the straight-line distance. It depends on the itinerary chosen by the groups: the crossing of the dune field that separates UAQ2 from the deposit, or, more likely, the route through the palaeowadis.

Results of the lithic analysis

The lithic material was recovered during the various excavation and ground surveying campaigns carried out at UAQ2. The surface condition of the artefacts from the stratified levels is generally good, although a few pieces show surface alterations or organic remains mixed with sand. All the pieces with very dull and weathered surfaces come from the ground surface.

A total of 1387 pieces out of 2177 lithic artefacts registered at UAQ2 have been studied (*c.* 64%). Almost 82% of this total (n = 1132) stem from stratified contexts and a few pieces are isolated finds or were collected out of any archaeological context or on the ground surface.

The stratified material will be presented here by phase and level, from the most ancient to the most recent. For the purpose of the present study, the results have been grouped together according to the three main stages of the occupation of the site (Tables 4.7, 4.8): Stage I (Middle Neolithic), corresponding to Levels 14-9 (Phase B); Stage II (Transition Middle to Late Neolithic), corresponding to Levels 8-6 (Phases C, D, and E); and Stage III (Late Neolithic), corresponding to Levels 5-1 (Phase F) (Table X4). Of the stratified materials, *c.* 43% were assigned to Stage I, 43% to Stage II (mainly from Level 8), and only 14% to Stage III.

The industry of Stage I (Phase B)

This stage corresponds to Phase B, covering the lower levels of UAQ2 (Levels 14-9, across the five sectors of the site) (Table 4.9). This is the earliest occupation at the site, dated to the second half of the 6th millennium BCE. These levels included a total of 1120 lithic artefacts, 492 of which have been studied. The greatest concentration of lithic artefacts was found in Levels 10 and 11. Level 11 yielded the most abundant remains, with 138 lithic artefacts. Levels 10 and 12 are well represented (over 100 artefacts each). The remaining levels produced fewer finds, but all contained lithic artefacts.

Stage I groups together six distinct levels that correspond to a significant thickness of accumulated stratified deposits:

Table 4.8. Quantification of the lithic artefacts and debitage waste by phase.

		Stage I	**Stage II**			**Stage III**		
		Phase B	**Phase C**	**Phase D**	**Phase E**	**Phase F**	**Total**	**%**
Tools	Blanks	1					1	0.09
	Knives	2					2	0.19
	Bifacial pieces	2	3		1	1	7	0.65
	Denticulated pieces	2	1		8		11	1.02
	Notches	3	1	2	2	2	10	0.93
	Borers	8	3	2	4	3	20	1.86
	Endscrapers	22	5	3	4	1	35	3.25
	Splintered pieces	40	21	4	18	4	87	8.08
	Sidescrapers	12	6	3	7	1	29	2.69
	Projectile points	14	1	1	1	3	20	1.76
	Marginal retouch	13	4	1	2	5	25	2.32
	Retouched tool fragments	7	4			2	13	1.21
Cores		8	11	3	7	6	35	3.25
Flakes		59	47	12	23	29	170	15.78
Blades and bladelets		18	12	5	1	1	37	3.44
Fragments		23	22		7	5	57	5.29
Chips		239	117	24	51	29	460	42.71
Debris		16	19	5	5	10	55	5.11
Indeterminate pieces		3	1				4	0.37
Total		492	278	65	141	102	1078	

Table 4.9. Quantification of the lithic artefacts and debitage waste assigned to Stage I by level.

		Level 9	Level 10	Level 11	Level 12	Level 13	Level 14	Total
Tools	Blanks	0	0	1				1
	Knives	0	2	0				2
	Bifacial pieces	0	0	1			1	2
	Denticulated pieces	0	0	1		1		2
	Notches	0	1	1			1	3
	Borers	1	0	5	2			8
	Endscrapers	1	4	7	5	1	4	22
	Splintered pieces	8	14	7	4	1	6	40
	Sidescrapers	1	3	4			4	12
	Projectile points	1	1	7	2	1	2	14
	Marginal retouch	1	5	1	2	2	2	13
	Retouched tool fragments		3	1		3		7
Cores		1	2	2	1		2	8
Flakes		5	17	11	15	5	6	59
Blades and bladelets		2	6	6	4			18
Fragments		2	4	10	5	1	1	23
Chips		19	55	70	68	9	18	239
Debris			9	3	3		1	16
Indeterminate pieces					1	1	1	3
Total		42	126	138	112	25	49	492

Level 14 corresponds to the initial occupation at the UAQ2 site that yielded artefacts. It is represented in all the sectors of the site that underwent excavations or test excavations. It has a low density of lithic pieces (n = 48). Flint is the predominant raw material, followed by chalcedony (white or beige chalcedony, chrysoprase, agate), radiolarite and chert. The initial stage of debitage, i.e. the phase of decortication of the initial block is attested by a single cortical flake in this level, whereas the phase of exploitation is represented by two cores and a large number of chips stemming from debitage and retouch. The cores are unipolar or bipolar with lateral shaping, while the frequency of incipient cones on these pieces testifies to an intensive exploitation of the blocks. One core (UAQ2.115 – not illustrated), which displays heating stigmata, has two opposed striking platforms linked to the two main debitage tablets. The removal scars on these latter have a lamellar shape; one of the faces of this core shows secondary lateral removals linked to the shaping phase. Unmodified products stemming from debitage are large (length to width ratio comprised between 1 and 1.99). The products transformed into tools are well attested in Level 14 and are characterised by their variety: notch on flake, tool on bifacial blank, endscrapers (including an endscraper on blade, UAQ2.116), sidescrapers (including a sidescraper made from a plunged blade), splintered pieces of varying shapes and made on various blanks, tools with opportunistic marginal retouch. The endscraper UAQ2.116, which is broken, was made from a flint blade produced with a longitudinal unipolar technique and displays abrupt, subparallel direct and invasive retouch on its edges. Its distal edge exhibits serious splintering and crushing, most probably linked to the use of the tool. A new striking platform was created based on the break, which is indicated by the incipient cones at this point, which, however, could not be finished off. Two projectile points with bifacial retouch and lozenge section were also recovered from Level 14. They show denticulated retouch (or teeth) made by pressure flaking on both faces. The first projectile point (UAQ2.2526), made from chalcedony and of high quality, was broken at its base during use and presents the special characteristic that it was discovered with skeleton A of the cemetery in Sector 5. As discussed in Chapter 2, it was suggested that this projectile point was not or could not be removed from the chest of this individual after the shooting. The distal edge of the point was broken. The second projectile point (UAQ2.1324) was discovered in the close vicinity of the burial. Significant crushing identified on distinct tools recovered from Level 14 is proof of their use, however, their usage cannot be precisely identified in the absence of use-wear analysis. Re-uses of tools, including those made by new striking platforms created on breaks, are attested.

Level 13 is found only in the eastern half of Sectors 1 and 2, but the density of artefacts (n = 25) there is proportionally identical to that of Levels 12-10 at the site. The same raw materials as in Level 14 were used, in the same relative proportions; only rock crystal is attested as a new raw material in the assemblage. About 25% of the assemblage are products stemming from debitage, including two very wide complete flakes, whereas the other items are thin and even very thin. All originate from a unipolar longitudinal knapping method but present different types of butts (facetted, flat, linear). Two Siret flakes attest to knapping accidents during the detachment of the product. The modification phase is clearly present. The tools are slightly less varied compared to the preceding level; however, a bifacial projectile point made of chalcedony and with denticulated retouch is attested (UAQ2.2312). Its general fusiform shape is slightly stocky and its section oval shaped. The presence of an endscraper made on a blade (UAQ2.524) and of a splintered piece made from opalescent flint are worth mentioning (UAQ2.2473). A fragment of a double or convergent sidescraper was used as a blank with significant crushing at its distal and proximal edge, showing that it was re-used until it was completely exhausted. In addition, several tools and tool fragments have been identified. As regards Level 13, the re-use of pieces, i.e. of raw material, is frequent and may have reached complete exhaustion. This was already the case as regards the assemblage stemming from Level 14.

Level 12 displays a large concentration of lithic material (n = 112). Flint remains the most frequent raw material. The portion of rock crystal increased, mainly including 'cassons' and chips stemming from debitage: such an increase is linked to the presence of a debitage working place. Chalcedonies (translucid white, beige or light-brown chalcedony, agate, chrysoprase) and radiolarite are attested, while quartzite is identified for the first time. All phases of debitage and retouch are present within the assemblage, although the operational sequences are often incomplete. Only one core has been identified, which was made from chalcedony, and a multipolar knapping technique was used which highlights a rather simple management of the debitage surfaces. A unipolar knapping method was exclusively used for all the products. The retouched tools are comprised of endscrapers on blades. The artefact UAQ2.448, made from red flint, exhibits short parallel retouch on its edges forming a convex line in the distal part. The piece UAQ2.2308, which was also made on a blade, bears low-angle parallel and extended retouch on its right edge. The item UAQ2.557, made from a flake, has an oval shape and displays scaled retouch on its edges. Level 12 also yielded a single bifacial projectile point with serrated edges (denticulated retouch), which is fusiform and has an oval-shaped section (UAQ2.556). It was knapped from a piece of chalcedony and is rather large, although damaged at its proximal and distal ends. Lastly, once hafted, a lozenge-shaped microlith may have been used as a micro-borer (UAQ2.2344). The splintered pieces, on varying blanks, were made from chalcedony or flint (among which one piece from red flint and one from opalescent flint) and were re-used at some point. As is the case in Level 13, tools with marginal retouch are present. Certain tools are possibly unretouched, which needs to be confirmed by use-wear analysis. Chips from this level have varying forms and sizes; a large number of debris and indeterminate pieces were also registered.

In Level 11, the lithic artefacts attributed to Stage 1 are the most numerous (n = 138). The main raw materials used are flint, followed by chalcedonies (white, beige or light-brown chalcedony, chrysoprase and agate), as well as chert, radiolarite, sandstone and quartz. The portion of rock crystal has significantly decreased. The two cores discovered in this level are bipolar cores on anvil and present an advanced state of exhaustion. Their re-use cannot be excluded. The flakes were produced using a unipolar or convergent knapping method and are mostly wide. The tools are varied, with the most characteristic type being the group of fusiform projectile points with denticulated retouch:

- UAQ2.1526 is a bifacial, very elongated lozenge-shaped bifacial point with thin ends. Bifacial denticulated retouch was made by pressure on both faces of its mesial portion.
- Two pieces are thicker and fusiform (UAQ2.1524, UAQ2.1531). The base and the end of these points are more strongly curved and their teeth are less deep compared to UAQ2.1526.
- Other points are fusiform and have an oval-shaped section as well as covering bifacial retouch (UAQ2.1522, UAQ2.1530, UAQ2.2313).
- A single fusiform projectile point with an oval-shaped section that has no teeth (UAQ2.1823). This is a different point type or a preform destined for a projectile point with serrated edges.

A large variety of endscrapers, all made from flint (except for one piece made from chrysoprase), on blade supports, or on more or less regular flakes, could also be identified in Level 11. These endscrapers are also less numerous compared to the other levels (UAQ2.1528, UAQ2.1529, UAQ2.2174). Their materials, blanks, shapes, sizes and retouch types vary. They can show different retouch depending on the edges, even on the same edge, as well as a concavity on one of the lateral edges. The carenated endscraper made on a blade UAQ2.1529 displays long, invasive, abrupt or semi-abrupt retouch on all the lateral and distal edges. A rough-out of an endscraper (UAQ2.1824) made from opalescent flint is particularly informative: an initial series of more or less long and abrupt retouches was made on all the edges of an elongated and wide laminar flake (or a blade potentially) produced with a unipolar knapping method, in order to provide it with a triangular shape at either end. Further, more invasive low-angle retouch was then carried out starting from the base of the piece after material thinning through removal; retouching was possibly stopped because of this removal, which would have too strongly impacted the shape of the piece. Final parallel retouch was carried out by pressure. The splintered pieces, which are still well represented in this level, are in an advanced stage of exhaustion: they illustrate the frequent re-use of these intermediate pieces. Crushing is visible on either end of the piece. The micro-borers are also varied and are preferentially made on blanks with a natural shape presenting an end that may serve as the active part. Little retouch is added to this type of micro-borer. By contrast, the presence of a double borer with overall retouched edges testifies to a real intention to modify the shape of the blank in order to transform it into a borer (UAQ2.2221).

The studied lithic material of Level 10 is slightly less abundant (n = 126) but apparently suffered greater surface damage compared to the material of the other levels attributed to Stage I, including more strongly marked patinas and aeolisation of the surfaces. These alterations may be linked to longer exposure following the abandonment of the settlement than was the case during the first occupational stage of the site. The proportions of raw materials are close to those of the preceding level, including flint, chalcedonies (white chalcedony, chrysoprase and agate), chert, radiolarite, and rock crystal. Two bipolar cores on anvil were recovered from Level 10. The exploitation of one of these (not illustrated) was stopped because of a knapping accident (hinge termination). In most cases the flakes are large and were produced by unipolar flaking. Chips are the predominant elements within the assemblage. Several pieces display remains of water-rolled or unrolled cortex, something attested on flakes and flake fragments as well as tools. There is a great variety of the latter – as regards the blanks, shapes and retouch – whether these are endscrapers, sidescrapers, notches or tools with marginal retouch. Among the endscrapers, UAQ2.1827 is made from tabular chert. This is an endscraper with denticulated Clactonian retouch which may have served as a core and exhibits strong splintering. A piece made from black flint (UAQ2.944) has been retouched on its lateral edges; the break in its distal part was re-used thanks to irregular and scaled retouch. The splintered pieces take the form of various shapes and blanks and are in an advanced state of exhaustion. The presence of unretouched flakes and reuses of tools after breakage are noteworthy. The surface damage is indicative of their post-depositional exposure.

Level 9 is the topmost in situ level assigned to Stage I at the UAQ2 site. It has yielded 42 lithic pieces. The raw materials used are the same as in the preceding levels; however, rock crystal has become rare. The percussion material is represented by two pieces made from sandstone and from beach rock which display plane abrasion sides. The production stage is represented by a single, quite large core made from chert (UAQ2.1344). This core was exploited according to the bipolar method with a main debitage platform and a faceted striking platform established on a former debitage platform. This core may have been discarded because of too much crushing or because of the progressive loss of what the knapper considered to be a perfect bend shape. Flakes and flake fragments are rare among the assemblages and only a few pieces can be assigned to a distinct debitage method (convergent, longitudinal unipolar, orthogonal). Generally, the complete products are very large or large and they are thin. A single bladelet is associated with Level 9. The only projectile point (UAQ2.1550, made from radiolarite) of Level 9 is a bifacial fusiform piece with denticulated retouch, which is smaller than that of the projectile points of the preceding levels. The splintered pieces vary as regards their blanks and shapes and these are the most numerous tools. Among the remaining pieces are sidescrapers and tools with marginal retouch produced from blanks with a suitable shape for this kind of modification. A micro-borer made from an elongated flake was also identified (not illustrated). Its distal end has a naturally pointed shape and exhibits small scars; the short and scaled retouch on its distal edge makes it possible to highlight the bevelled shape of the tip. Among the chips are several elongated specimens that may correspond to chips stemming from retouch. Some of these are also hinged.

(Synthesis)

Stage I groups together six distinct levels on a large stratigraphic thickness. Levels 13-10 show the greatest density of lithic material, the abundance and variety of which mirrors the importance of the human occupations. The state of macroscopic preservation of the material is quite fair, which may be explained by the depth at which the pieces were buried. Nonetheless, some pieces exhibit aeolisation marks and above all whitish patina, which is indicative of post-depositional exposure on the ground surface. This applies most particularly to Level 10 marking the end of the significant presence of lithic materials for Stage 1. Stigmata related to heat-processing (pre-heating in order to facilitate knapping or to modify the colour of the raw material) are rare in these assemblages. However, certain pieces suffered significant mechanical alteration due to their use.

Although the assemblage is rather small, the variety of the raw materials and of the operational sequences illustrates the diversity and complexity of the lithic assemblages recovered from the early occupation levels of UAQ2. Nonetheless, the numerous gaps identified in the operational sequences make it impossible to reconstruct all the production stages related to the material. The absence of raw-material sources in the close vicinity of the site explains the considerable pressure linked to the raw materials. Thus, only in rare cases could the initial stages of core preparation be attested, whereas the chips, which are overrepresented compared to the other lithic categories, attest to frequent knapping and retouching activities in all the sectors excavated related to Stage I. The general state of exhaustion of this industry also indicates that the producers exploited and even overexploited the available clastic matter, which explains the scarcity of cores for example. Many pieces show several stages of exploitation and use and were only discarded once they had become unusable. It appears to be significant that certain raw materials were identified for only the final stages of the operational sequences, which dealt with cores, tools or re-used tools. This is notably the case for the artefacts made from fine-grained opalescent flint. This implies that the production of these objects took place outside the UAQ2 site and that they were brought there, used, and then abandoned in situ.

Other types of gaps were identified, such as the absence of distinct operational sequences. Blade industry is a perfect example of this. Tools such as certain endscrapers and large bifacial projectile points indeed require large blade preforms. However, unmodified blades and cores associated with this blade technology are absent among the remains excavated at UAQ2. Were the cores of this type exploited to an extent that they no longer displayed any marks of blade debitage? Were the products manufactured elsewhere and brought to the site? Were the still exploitable cores and products taken away, depending on the occupation cycle of the site? There is no information which would enable us to decide between these hypotheses, even if we favour the assumption that manufacturing took place elsewhere.

As early as the beginning of Stage I, and during this entire phase, the various assemblages at UAQ2 show two types of quality: pieces of outstanding craftsmanship, and pieces that were manufactured in a more expedient way. The outstanding pieces – mainly endscrapers on blades and projectile points – were in most cases made from high-quality raw materials such as opalescent flint or chalcedony. Their manufacture required specific and standardised debitage techniques as well as fine pressure-retouching techniques. Discovered among this high-quality assemblage were not only almost intact pieces but also some fragments showing stigmata, indicating their reuse as production blanks. The endscrapers identified in these levels are of several types. As is the case for the projectile points the endscrapers made on blades of remarkably high quality may have been manufactured away from the UAQ2 site, whereas the remainder of the endscrapers made on flakes were made in situ. In most cases the other tools are more opportunistic and seem to be linked to short-term needs. These retouched blanks are far from being standardised and are highly varied as regards their raw materials, shapes and sizes. Retouching, in many cases marginal and irregular retouch, was intended to prepare the future active parts of the tool and only rarely had an impact on the global morphology of the blank, which therefore makes it difficult to link these elements to a specific tool type. In many cases these are re-exploitations of retouched pieces or tools, even of cores. Splintered pieces were used for most of these types of tools. At the UAQ2 site, they may have been used for working distinct materials, i.e. marine shells or bones. The presence of two opposed splintered edges is indicative of their possible use as an intermediate piece to split materials; however, in the absence of use-wear analyses, none of these hypotheses can be confirmed. The state of exhaustion of these splintered pieces is highly advanced.

Micro-borers made on various blanks are also attested. Their end is sometimes modified by retouch in order to reduce the width of the piece. The micro-borers may have been used for the manufacture of shell beads, i.e. spondylus beads, attested from Level 13 on, as well as oyster mother-of-pearl. One of their ends or even both ends show significant splintering.

The lithic industry of the lower levels of the site may therefore attest to short-term as well as long-term production aims. It seems likely that these two categories of elements were created by different knappers, however the absence of certain stages of the operational sequences makes it impossible to refine our hypothesis regarding this topic.

The industry of Stage II (Phases C, D, and E)

Stage II groups together three distinct levels (Level 8-6). These levels show significant density of lithic materials compared to the amount of excavated sediment. The assemblage represents the greatest stratigraphic thickness of the site, including alternating thick sand deposits and shell layers. Only Level 7 was dated by radiocarbon to between 5058-4855 cal. BCE. These levels yielded 484 lithic artefacts (Table 4.10).

Level 8 yielded nearly two thirds of the artefacts (58%). This level contained the most abundant material of the UAQ2 site, and its density cannot be directly compared to that of the other occupational layers excavated at UAQ2 – in that we are not dealing here with a real settlement layer. Level 8 is a thick sand deposit and may correspond to one or more settlement levels disturbed during the reactivation of the dune. Level 7 is a thin occupation level, evidenced by a thin layer of edible shells (among which complete valves of *Marcia* spp.) combined with a substantial number of lithic artefacts (n = 65). Level 6 is a sand layer, as is the case of Level 8, and it was also disturbed by a reactivation of the dune.

The first level of Stage II, Level 8, reveals the highest density of lithic artefacts (n = 278). The technical and morphological analysis of these artefacts shows that their

Table 4.10. Quantification of the lithic artefacts and debitage waste of Stage II by level.

		Level 6	Level 7	Level 8	Total
	Bifacial pieces	1		3	4
	Denticulated pieces	8		1	9
	Notches	2	2	1	5
	Borers	4	2	3	9
	Endscrapers	4	3	5	12
	Splintered pieces	18	4	21	43
	Sidescrapers	7	3	6	16
	Projectile points	1	1	1	3
	Marginal retouch	2	1	4	7
	Retouched tool fragments			4	4
Cores		7	3	11	21
Flakes		23	12	47	82
Blades and bladelets		1	5	12	18
Fragments		7		22	29
Chips		51	24	117	192
Debris		5	5	19	29
Indeterminate pieces				1	1
Total		141	65	278	484

characteristics match those of the industry attributed to Stage I. It is understandable due to the taphonomic impact caused by the reactivation of dune activity between Level 8 and Level 7. Flint remains the most representative raw material, followed by chalcedony. Chert is still present in Level 8, followed by radiolarite, chrysoprase and agate.

Level 8 yielded the largest number of cores at the site (n = 11). The flakes are generally large, and some have a more elongated shape. Blades and bladelets are also present. The category of tools is mainly represented by splintered pieces which, as with Stage I, are of various shapes and were made on various blanks. There are also tools with marginal retouch, various sidescrapers, a micro-borer, a fragment of a bifacial piece, a notch, and a great variety of endscrapers including endscrapers on blades, as well as a single carenated endscraper. Chips are the largest category, as at preceding levels. Only one denticulated arrowhead was recovered.

Level 7 clearly contained less abundant materials (n = 65), however, compared to the volume of excavated sediment it is as dense as Level 8. Flint is the main raw material used and chert increases. The other raw materials used are chalcedony and chrysoprase, and some elements made from radiolarite and agate are also present. Chips remain the most representative category. The overall large products are made using a unipolar technique. The most numerous tools are splintered pieces, followed by endscrapers, and lastly sidescrapers. These two categories of tools display a variety of shapes and blanks. As a new characteristic, certain endscrapers exhibit a very irregular shape. Both sidescrapers and endscrapers are varied. Borers were also identified, perhaps linked to shell-working or the processing of softstone, as well as woodworking. One arrowhead was recovered.

Level 6 contained 141 lithic artefacts. Flint remains the predominant raw material, but the portion of radiolarite increases. The raw materials identified in the preceding levels, i.e. chalcedony, chert, a few pieces made from agate and chrysoprase, are still in use. This level yielded the second highest number of cores at the UAQ2 site after Level 8. These latter were produced with various, initially bipolar, techniques. The products are large and include notches, endscrapers, sidescrapers, borers, tools with marginal retouch, splintered pieces, and projectile points: the tools stemming from Level 6 show a wide variety of types. Splintered pieces are the most representative. The only projectile point attested, UAQ2.906, although exhibiting bifacial retouch, differs from those discovered in the preceding levels by its unique carenated shape. Chips are the most numerous among this industry.

(Synthesis)

The same cultural and technical knowledge evidenced in Stage I can be found again in Level 8, although certain traits are different. Thus, only a few endscrapers on blades and projectile points are attested in this level. Distinct changes appear progressively from Level 7 on and concern the selection of the raw materials as well as the tool types. Whereas the pieces of the preceding levels were mainly knapped from flint, radiolarite is increasingly used. In Level 8 large endscrapers are still present and then disappear. Certain pieces, such as endscrapers on blades and bifacial pieces, highlight the continuous standardisation effort made by the knappers.

The endscrapers of Level 6 have the most irregular general shape. In many cases they were made on flakes and their retouch is rather scaled and irregular. The disappearance from Level 7 onwards of the projectile types typical of Stage I and Level 8, but also the emergence in Level 6 of a potential new type of bifacial projectile points (UAQ2.906) (type 3), is noteworthy – although we are dealing here with a unique piece. The disappearance of the fusiform projectile points showing denticulated retouch (types 1b and 2b) can be confirmed.

As is the case for Stage I, a great scarcity of available raw materials can be stated, as well as the presence of a greater number of cores in Levels 8 and 6 – which may suggest more significant knapping activities compared to the preceding levels and including Level 7. Caution should however be exercised, at least in the case of Level 8, which is a disturbed level of an occupational layer belonging to Stage I (or more likely of several levels given the large quantity of material found therein). Other characteristics remain unchanged. Thus, the debitage techniques remain rather simple and are in most cases unipolar or bipolar. They are more indicative of a management of the debitage surfaces than of a volumetric conception of the cores. The retouched flakes and tools also remain scarcely standardised and are mostly represented by splintered pieces (which are reused pieces).

The industry of Stage III (Phase F)

Stage III is represented by Levels 5-1, which are dated to the second half of the 5th millennium BCE. They are representative of the latest occupation at the site. They consist of an accumulation of thin levels with a high density of faunal remains – mainly marine shells. These levels are the poorest in artefacts at Umm al-Quwain UAQ2 and only yielded a small number of lithic pieces (n = 102) (Table 4.11). Compared to the lithic industry of the lower levels, these pieces were subject to major alteration processes, a taphonomic phenomenon linked to the composition of these layers, which are almost exclusively comprised of shells.

The industry related to Stage III totals 102 artefacts. Level 5 is the most abundant, whereas Levels 1-4 are each comprised of fewer than 20 artefacts. In each of these levels, chips are the most representative category of debitage waste.

Level 5 yielded 42 artefacts. This is the first level of UAQ2 in which radiolarite is the most frequently used raw material. The portion of flint has strongly decreased, and chert is more abundant than chalcedony. For the first time at UAQ2, a core on flake, which stems from Level 5, exhibits bladelet negatives. In addition to several products and indeterminate pieces the tools of this same level are comprised of a projectile point (UAQ2.1223) with a very irregular shape and no denticulated retouch, a sidescraper, an endscraper, a splintered piece, two notches, and three micro-borers.

Level 4 yielded only 16 lithic pieces. Radiolarite is once again the most representative raw material, followed by chert, chalcedony, and agate. Not a single piece made from flint could be identified among the material under study. The presence of a fragment of a multipolar core is noteworthy. In addition, a broken bifacial projectile point with denticulated retouch was discovered, however it is likely to be a residual piece.

Table 4.11. Quantification of the lithic artefacts and debitage waste of Stage III, by level.

		Level 1	Level 2	Level 3	Level 4	Level 5	Total
	Bifacial pieces		1				1
	Notches					2	2
	Borers					3	3
	Endscrapers					1	1
	Splintered pieces		1	1	1	1	4
	Sidescrapers					1	1
	Projectile points		1		1	1	3
	Marginal retouch		1	1		3	5
	Retouched tool fragments		1		1		2
Cores		1	1		2	2	6
Flakes		4	4	6	5	10	29
Blades and bladelets				1			1
Fragments			1	1	2	1	5
Chips		8	2	2	4	13	29
Debris		4		2		4	10
Total		17	13	14	16	42	102

Level 3 also yielded only a few lithic pieces (n = 14). Radiolarite is abundant, followed by chalcedony, chert and a very few pieces of flint. The products are large and the tools identified are splintered pieces and those with marginal retouch.

The number of lithic pieces is similar in Level 2 (n = 13). Radiolarite remains predominant, followed by flint, sandstone and chalcedony. Beach rock and Eocene sandstone are attested, but are each represented by a single artefact. The only core, made from chalcedony and using unipolar debitage, corresponds to the re-use of a tool made on flake. It shows a highly advanced state of exhaustion as well as knapping accidents that led to the abandonment of its exploitation. Only a few flakes could be identified. The tools are varied and not standardised, including the fragment of a bifacial piece, marginal retouch, splintered pieces, and a sidescraper made from Eocene sandstone.

Level 1 is the last occupational level of the UAQ2 site. It also yielded few lithic materials (n = 17). Radiolarite remains important, whereas flint dominates the assemblage. The other raw materials used are chalcedony, quartz, quartzite, and beach rock. A single core is attested, which is a bipolar piece with strong patina and hinge terminations. The flakes have flat butts and exhibit significant knapping accidents, i.e. Siret accidental break or hinged terminations. Several fragments of macrolithic pieces were also identified in this level. The knapping activities are generally simple, but pressure retouch was also observed, indicating more complex activities.

(Synthesis)

The assemblage of Stage III thus greatly differs from that of Stage I and of Level 8. As a matter of fact, radiolarite is the predominant raw material at the expense of flint. Moreover, new types of lithic artefacts appear, i.e. projectile points made from radiolarite with very irregular shape and bifacial retouch. These projectile points were not identified previously. The tools are also less varied, which may be explained by the small size of the assemblage; however, the common tools identified in the preceding levels are still present, mainly splintered pieces as well as tools with marginal retouch. Although more sophisticated tools can be occasionally identified, i.e. endscrapers, sidescrapers, notches, and borers, these are much less standardised compared to those of the preceding levels. The few tools that were discovered were apparently made on a greater variety of blanks, depending on the needs and different activities that took place at the site. They could, in particular, have been used for the processing of food resources, i.e. marine shells.

The presence of cores shows that knapping activities were carried out at the site (Figure 4.12). In most cases simple techniques (unipolar or bipolar) were used. However, as is the case for the levels of Stages I and II, distinct stages of the operational sequence are lacking and therefore indicate that knapping activities took place at the raw material source(s) or in intermediate settlement places. Globally, the industries are much more basic compared to those of Stages I and II.

Discussion

Lithic technology and raw material economy

The lithic assemblages, distributed over 14 levels, provide complementary information to the other studies carried out at UAQ2 and aid in the interpretation of the site. The stratigraphic sequence is particularly important and covers the transition between the second half of the 6th and end of the 5th millennium BCE. This transition coincides with a phase of climatic deterioration registered in the northern part of the UAE (Parker *et al.* 2004; Preston *et al.* 2015). This climatic deterioration probably contributed to an adaptation of the mobility patterns and settlement types of the sites. At UAQ2 this resulted in technical and material evolutions in the lithic industry during the occupational stages, although the assemblage is consistent overall and is in keeping with the Neolithic of Eastern Arabia.

The artefacts are in quite a fair state of preservation, except for some pieces that exhibit whitish patina and stigmata of aeolisation, more particularly in Level 10, and pieces with altered surfaces in Levels 5-1.

All the production stages are present at the site and are related to a large number of knapping sequences. It was possible to evidence that some of the industry, in particular flake production and blank retouch, was made and used in situ. However, the fact that several stages of the debitage process are lacking indicates that certain artefacts, in particular the projectile points and the endscrapers on blades, were brought to the UAQ2 site as already finished products or as debitage blanks.

The wide variety of raw materials used at the UAQ2 site makes it possible to assume highly varied and 'ramified' knapping sequences, some elements of which indicate in situ manufacturing. Indeed, the raw material blocks and cores occur as tabular blocks, blocks, or products stemming from debitage. The quantities of raw materials exploited at UAQ2 change throughout the evolution of the site. Flint is the most used raw material in the levels assigned to Stage I, which are the most ancient occupations of the site, followed by chalcedony and rock crystal. The presence of further rocks (radiolarite, chert, chrysoprase, agate, etc.) is more sporadic. Only from Level 6 on does radiolarite play a more significant role and become the predominant raw material during Stage III.

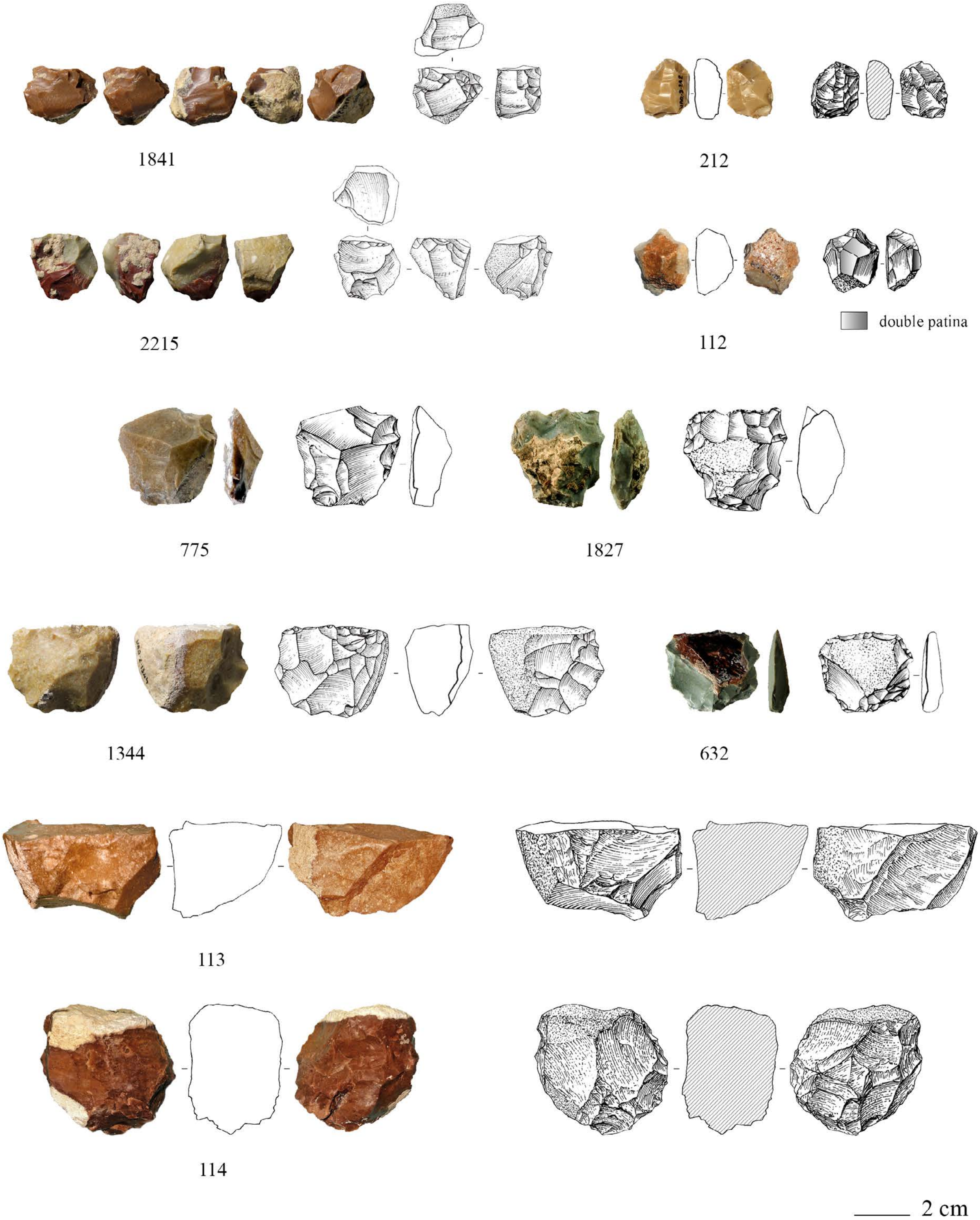


Figure 4.12. Examples of lithic cores found at UAQ2. Photos & Drawings: G. Devilder.

This change in lithic raw material may be linked to a change in the knapping tradition or to new preferences as regards the worked materials. The procurement sites of clastic resources may also have changed depending on the settlement phases, and new procurement networks may also have been established. All these issues still need to be clarified, given that the primary sources of all the lithic raw materials used at the site, as well as the intermediate exploitation sites between the primary sources and the UAQ2 site, could not be identified.

Rock crystal is particularly present in the levels attributed to Stage I, where it is associated with waste stemming from debitage activities. The desired products, the modified products as well as the raw material blocks, are absent from the UAQ2 industry, as is the case at other sites in the north-eastern part of the United Arab Emirates, i.e. Akab (Charpentier and Méry 2008). They were certainly exported, and, apart from rare flakes, only unusable waste products were abandoned in situ. These elements were evidenced in the distinct levels of UAQ2 in the form of batches or concentrations, more particularly in Levels 14-8, and occasionally in Levels 7, 6, 2, and 1. It was not possible to specify their function in the course of the study.

The study of the industry of the UAQ2 site reveals two distinct, although complementary assemblages, as regards their function. The first are mainly tools with quite standardised shapes and production types, including endscrapers on blades, and projectile points with bifacial retouch. The second is a less standardised industry, evidence of which, from the production and modification stages to their abandonment, could be identified at the site. The associated tools are mainly indicative of a toolkit made on flakes, which is less sophisticated and less work-intensive compared to the first assemblage. The production is significant in terms of quantity and is thought to correspond to short-term needs requiring the production of functional rather than technical blanks. The desired blanks were used unmodified or retouched prior to their use. Certain cores were also reused as tools and present significant scars. The tools made on flakes are not very sophisticated and include endscrapers, sidescrapers, micro-borers, and various flakes with marginal retouch. A sizeable portion of the blanks, and also several cores, testify to simple re-use or recycling in order to fully optimise the available raw material. On the other hand, the most work-intensive tools are hardly re-used and their manufacture seems to be intended for one-time use, as is the case for the bifacial projectile points.

The different techno-types of tools identified at UAQ2 may have been used for quite specific activities related to food or craft purposes. The recurrent presence of macro-use-wear – hinges, scars, crushing marks – is indicative of intense pressure on the blanks up to their complete exhaustion. The less sophisticated tools would correspond to the search for blanks that are complementary to those dedicated to specific activities. These tools were made and used at the UAQ2 site, whereas the more specialised tools that reveal significant gaps in the operational sequences had to be imported or were exploited elsewhere, not at the UAQ2 site.

The tools show a great variety of shapes and techniques as regards the used blank and whether or not they are predetermined, and in terms of their size, the exploited raw material, the shape and the extent of the added retouch, etc. Many of these exhibit significant crushing marks and scars, testifying to their use at the UAQ2 site. In some cases, modifications were subsequently added. Thus, the edges of the tools were resharpened by retouch and certain products were reused. These recoveries contributed to a variety of shapes and triggered significant morphometric changes. The discovery at the site of a large number of tools (in particular tools made on flakes) makes it possible to assume that they were used in situ and subsequently abandoned. The technical and economic representativeness of the UAQ2 industries is linked to the production methods present and to the change in status of certain pieces, e.g. from a core to a tool and vice versa, which has a strong impact on the productivity of the exploitation methods as well as on their representativeness. As a matter of fact, a debited and then retouched piece must be regarded as a core providing new blanks, and at the same time as an active tool. The successive 'lives' of a large number of pieces of the UAQ2 industry suggest a desire to use the available raw materials, in all their forms, until they are completely exhausted.

The number of more sophisticated pieces compared to all the tool types identified is not very significant. The quality of the used materials must be stressed for Stage I, with the presence of very beautiful tools made from raw materials with outstanding clastic quality. These latter are rarely associated with simple flakes or with less sophisticated tools, but appear in the form of recycled retouched products. The production stages of these tools are absent from the UAQ2 site. It can therefore be assumed that these beautiful pieces were made elsewhere and were brought to the site to be (re)used and, possibly, to be resharpened.

The overwhelming majority of the greatly varying chips, in terms of shapes, materials and sizes, indicates the significance of operations linked to the functionality of a tool and its maintenance, including resharpening of the active edge and even changes in the status of the pieces. The scarcity of cortical elements is a good indicator of the strong constraints imposed by the remoteness of the raw material sources. The human groups were forced to establish a procurement network for unmodified or already exploited raw materials. This significant constraint explains the overexploitation of almost all the pieces at the UAQ2 site.

Typological contribution

The study of certain artefacts makes it possible to infer a process of evolution, as for the endscrapers on blades and projectile points. These elements are particularly standardised and require the use of quite specific debitage

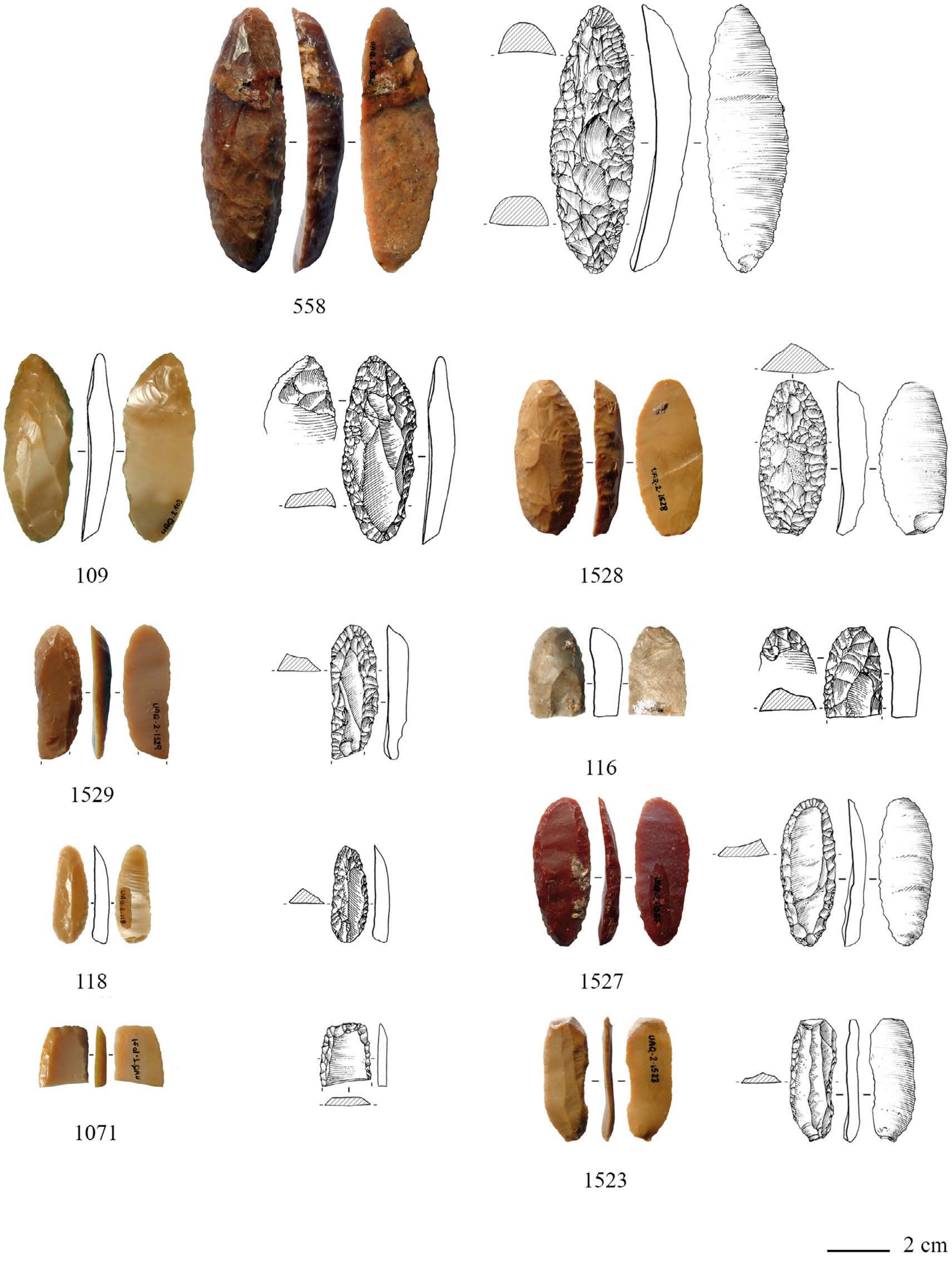


Figure 4.13. Type 1 endscrapers from UAQ2. Type 1a (UAQ2.558; UAQ2.109; UAQ2.1528; UAQ2.1529; UAQ2.116; UAQ2.118); Type 1b (UAQ2.1527; UAQ2.1071; UAQ2.1523). Note that UAQ2.1523 is made on a blade showing bladelet scars. Photos & Drawings: G. Devilder.

and retouch techniques. However, these elements change their shape and tend to disappear in the course of time.

The other tools, i.e. notches, flakes and pieces with marginal retouch, as well as sidescrapers, are much more varied as regards their types of blanks, raw materials, etc. It may be assumed that they were used for more utilitarian, even expedient, purposes and met an instant need that did not require predetermination of the blank. The greater part of the industry was subject to great

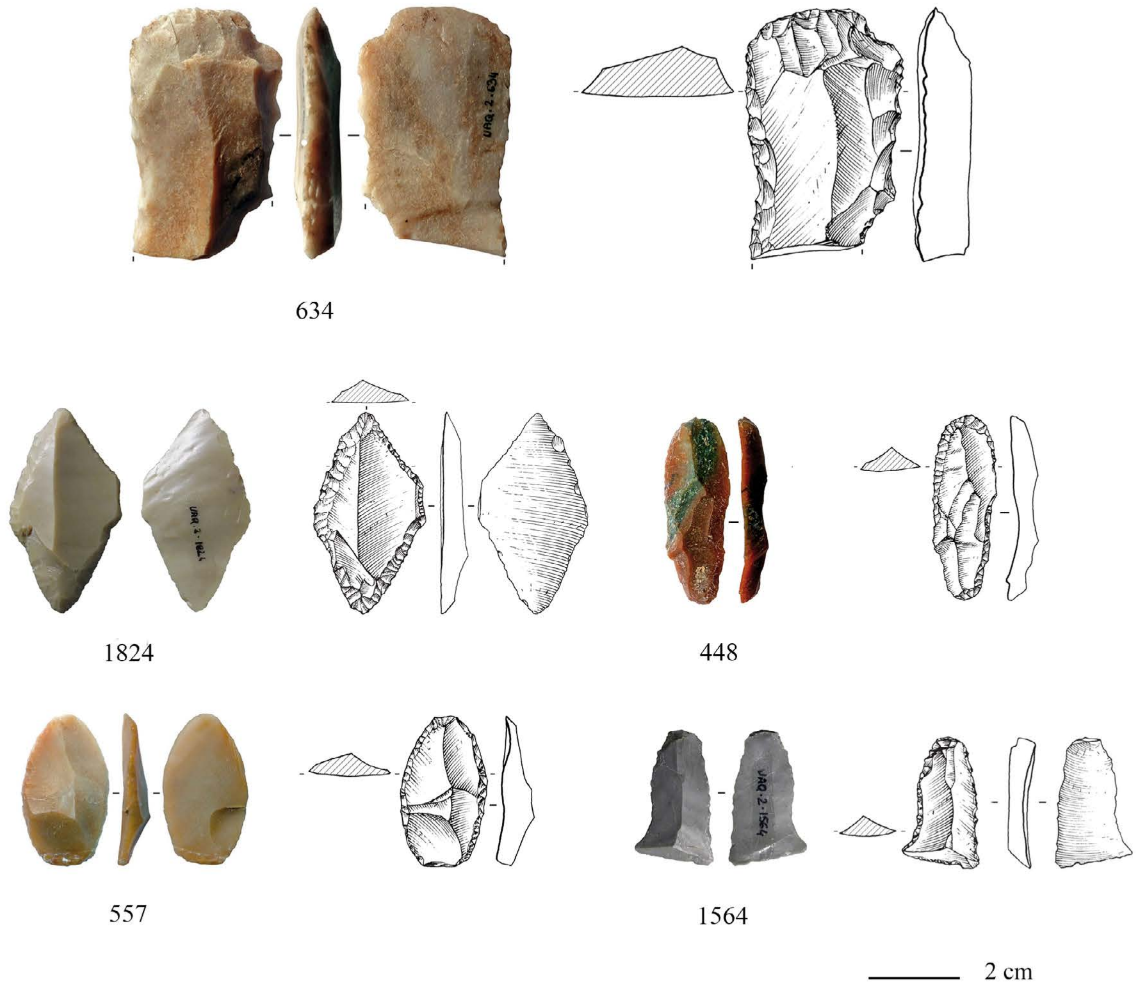


Figure 4.14. Type 2 endscrapers from UAQ2. Type 2a (UAQ2.1824; UAQ2.448 ; UAQ2.557); Type 2b (UAQ2.634; UAQ2.1564). Photos & Drawings: G. Devilder.

constraints over the entire sequence. Recycled or less sophisticated pieces predominate among the UAQ2 tools.

(Endscrapers)

Endscrapers are consistently present among the tool kit of the UAQ2 site. They are of various shapes and were made from various blanks, raw materials, etc. They are well represented during Stages I and II of UAQ2 and tend to disappear during Stage III. Distinct types of endscraper were identified, according to the blanks and the types of retouch used:

- Type 1 features elliptical endscrapers made on blades that exhibit a diversity of sizes (Figure 4.13). The blade blanks are produced with a longitudinal unipolar technique. Type 1a shows a uniface or plano-convex section. The retouch is invasive, even covering, and particularly abrupt – in most cases this is made with pressure-retouch. Type 1b shows a carenated profile with long and abrupt or semi-abrupt retouch along the edges, but not covering, and thus leaving removal scars and 'arrises' visible on the dorsal face.
- Type 2 represents endscrapers made on more irregular blanks, including laminar flakes (sometimes cortical flakes), which frequently underwent resharpening actions, leading to more irregular edges (Figure 4.14). Retouch is abrupt, denticulated, scaled, and concentrates only on the edges. Type 2a displays quite regular edges with short or long scaled retouch. Type 2b show irregular retouch, which could sometimes have resulted from multiple resharpening.

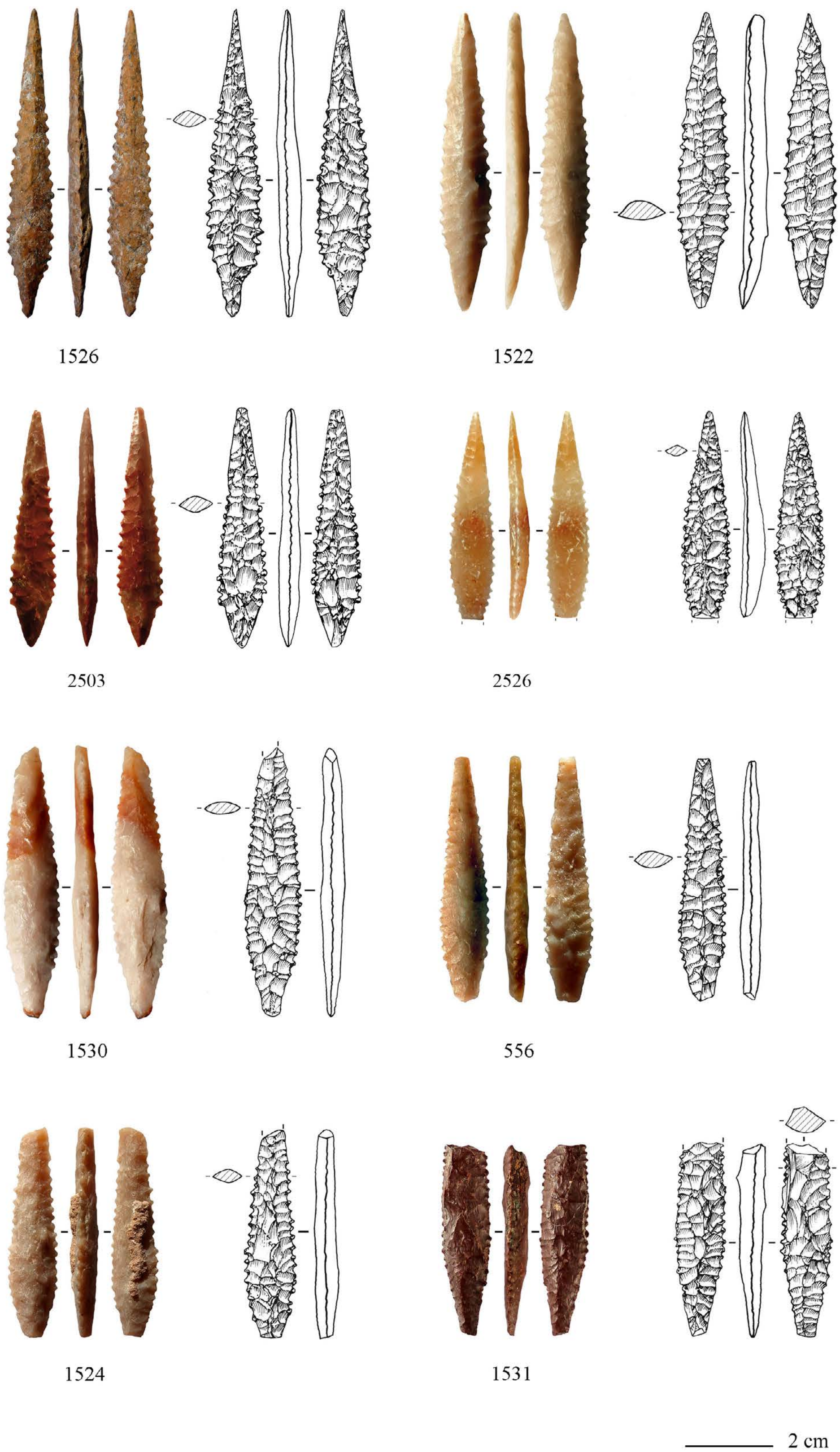


Figure 4.15. Type 1b points from UAQ2 (UAQ2.1526; UAQ2.1522; UAQ2.2503; UAQ2.2526; UAQ2.1530; UAQ2.556; UAQ2.1524; UAQ2.1531). Photos & Drawings: G. Devilder.

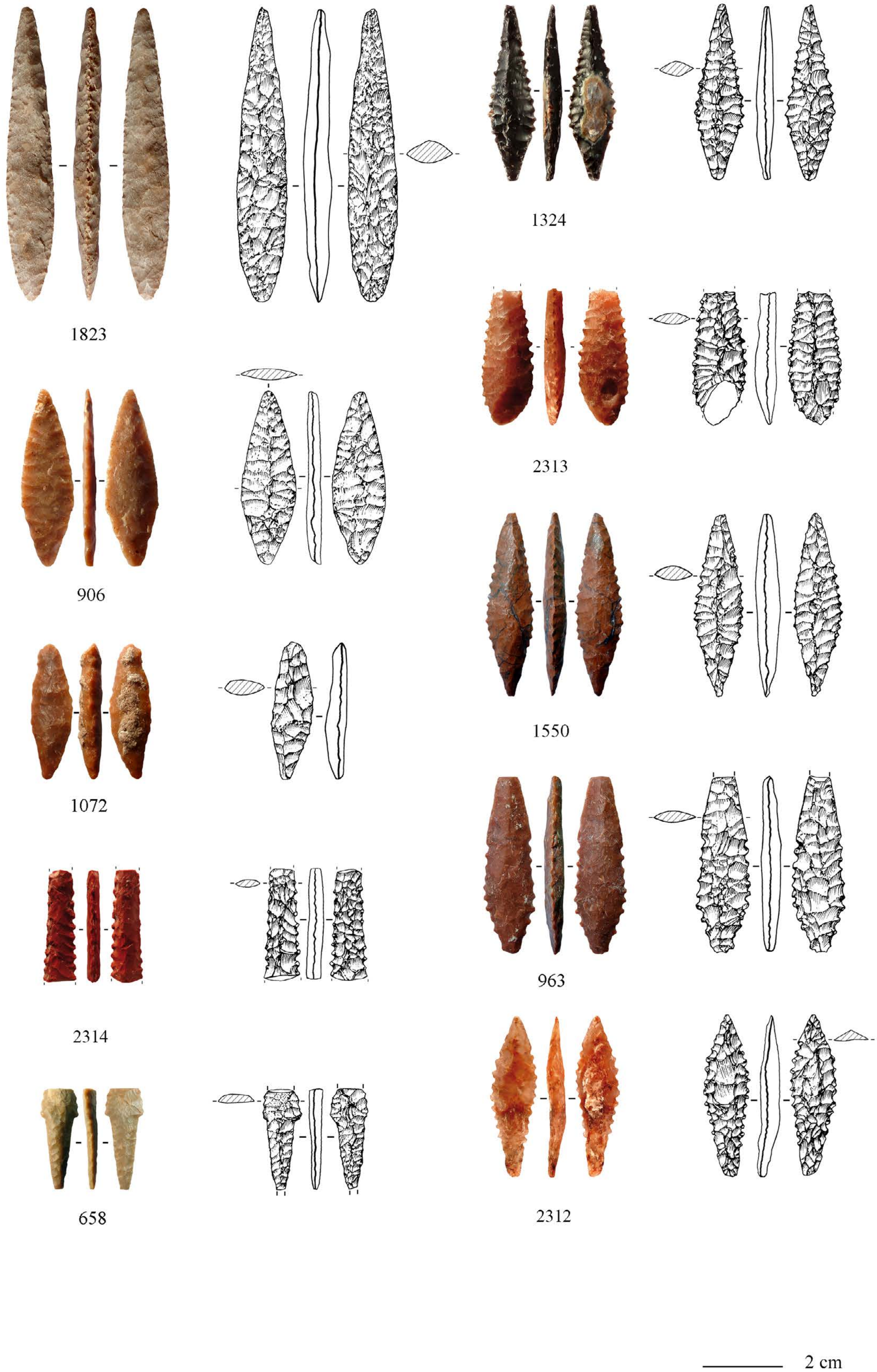


Figure 4.16. Type 2b points from UAQ2 (UAQ2.1550; UAQ2.1324; UAQ2.963; UAQ2.2313; UAQ2.2312); Type 1a (UAQ2.1823); Type 2a (UAQ2.61; UAQ2.906); Type 3 (UAQ2.1072); Type 4 (UAQ2.2314; UAQ2.658). Photos & Drawings: G. Devilder.

Figure 4.17. Type 3 point from UAQ2 (UAQ2.1223).

(Projectile points)

Most projectile points recovered from UAQ2 are fusiform, according to Charpentier (2008). They however show a diversity of sizes, blanks, and raw material. Only a few specimens could belong to trihedral points – one of these comes from Level 12. Several types of point have been identified (Figures 4.15-17):

- Type 1 includes large fusiform points, 54 mm - 71 mm in length. Retouches made by pressure flaking cover both sides. Type 1a does not show denticulated retouch on its edges. Its section is more angulated and thus has a slightly diamond-shaped profile. It is considered as a rough-out of type 1b, although it could have been used without further modifications. Type 1b exhibits denticulated retouch on its edges, concentrated on the mesial part. The retouch seems to have lessened the section, which then appears biconvex or plano-convex.
- Type 2 features shorter fusiform points, 40 mm - 43 mm in length. The edges are more or less regular, sometimes showing a carination, perhaps suggesting the distinction of sub-types potentially. Type 2a does not show denticulations, whereas type 2b does.
- Type 3 shows a biconvex section and an irregular shape, with retouches made by pressure flaking that cover both sides. No denticulations are visible. The unique specimen (Figure 4.17: UAQ2.1223) of this type measures 30 mm in length. It is possibly a type 2a point displaying a somewhat mediocre technique in knapping.
- Type 4 groups potential fragments of trihedral points with denticulations. Blanks on which this type of point are made typically show a trihedral section, but the latter appears more biconvex near the bottom. The presence of this type of point is putative at UAQ2, as only fragments have been found (Figure 4.16: UAQ2.2314, cf. UAQ2.658).

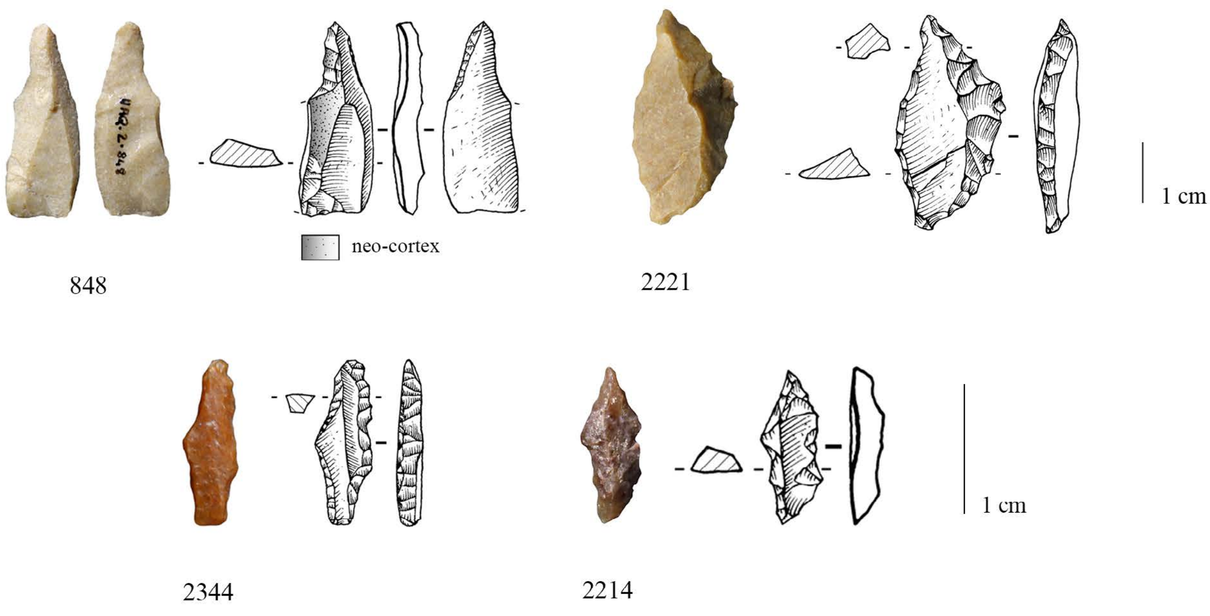


Figure 4.18. Examples of micro-borers present in the different levels of UAQ2: UAQ2.848. Micro-borer shaped by abrupt retouch (Level 5); UAQ2.2221. Double-ended micro-borer (Level 11); UAQ2.2344 & UAQ2.2214. Sub-lozenge-shaped micro-borers with abrupt retouch (respectively from Levels 11 and 8). Photos & Drawings: G. Devilder.

It is possible to state that the types evolve over time. The largest concentration was discovered during Stage I (in particular in Level 11) and groups together Types 1 and 2. Stage II yielded a single specimen assigned to Type 2a and coming from Level 6. Type 3 is associated with Stage III, accompanied by an element attributed to Type 1b, which is probably a residual piece. In stratigraphy, Type 4 is represented only in Level 12; the other specimen was collected at the site's surface.

(Micro-borers)

Large numbers of micro-borers were identified in the UAQ2 toolkit. These have various shapes and were made from several different blanks (Figure 4.18). Most appear not to have been made on predetermined blanks.

Their use is attested by a splintered active part, generally located on a bevelled end. This shape is often linked to the natural morphology of the blank used by the human groups settling at UAQ2. Nonetheless, some pieces were modified by retouch to accentuate the active part. These latter exhibit large scars and crushing on their end, possibly associated with their use. It is impossible to detail their function, bearing in mind that no use-wear analysis has as yet been carried out. These pieces were probably associated with activities related to the manufacturing of shell beads (notably made from *Spondylus spinosus*), attested as early as in Level 13 and throughout the stratigraphic sequence.

(Splintered pieces)

Splintered pieces are also present in all the UAQ2 levels. This category of tools corresponds in many cases to the last stage of the production process (Figure 4.19). As a matter of fact, the splintered pieces in most cases are highly fragmented tools, or cores no longer exploitable. Other types of these artefacts are present in the form of simple flakes, of which one or several cutting edges were used.

This tool type may have been used for various activities, including the cutting of *Spondylus spinosus* shells for the manufacture of discoid beads. However, this hypothesis still needs to be confirmed in the absence of use-wear analyses. Two types of splintered pieces were identified: the first displays one, or several, more or less randomly splintered and crushed cutting edges; the second type is characterised by two opposed parts, perhaps suggesting bipolar use of the splintered piece. This type of tool, placed as an intermediate piece between a support and a hammerstone, could very well have been used to split organic matter, bone, or shell. The splintered pieces probably attest to the latest stage of use prior to the discarding of the piece and illustrate the overexploitation of the raw material available in the assemblage of UAQ2.

Comparisons with other assemblages

The UAQ2 site is part of a settlement dynamic that is particularly interesting in terms of the transition between the regional Middle Neolithic and the Late Neolithic. UAQ2 is, indeed, one of the rare sites that cover the transition between the 6th and the 5th millennia BCE, a transition marked by a period of aridification in the region (e.g. Parker *et al.* 2004). Lithic studies are not only scarce for this area but are also mainly based on extremely specific pieces. Absolute dating is rarely available and the sites in most cases are found on the ground surface. The UAQ2 site matches perfectly the cultural background that characterises Eastern Arabia and which is defined by the production of bifacial pieces. This techno-facies is distributed over the entire region and is characterised by the debitage of opportunistic products made on retouched flakes, in addition to highly work-intensive tools such as projectile points with bifacial retouch made by pressure.

In the area of Umm al-Quwain, and in the area of Jazirat al-Hamra (Emirate of Ras al-Khaimah, UAE), which is located at its northern border, the associated human groups were fishers and herders who very likely roamed in small groups (family or clan). These groups apparently did not include skilled knappers, at least in the case of UAQ2: the knapping carried out at the site produced domestic items, whereas more sophisticated pieces, i.e. projectile points and endscrapers made on blades, were produced by more experienced knappers, as previously mentioned.

Lithic industries published from other Neolithic sites of the Arabian Gulf, e.g. from as-Sabiyah H3 (Kallweit and Davies 2010) and Dosariyah (Drechsler 2018), provide good comparison material regarding small domestic tooling, including for micro-borers, sidescrapers, and splintered pieces. However, these products differ from those documented for the UAQ2 Stage 1, regarding both their shapes and type of retouch, coarser, in the case of endscrapers (Drechsler 2018: pl.3.4 n°1). Comparisons with UAQ2 are more elusive regarding the projectile points.

Projectile points are frequently encountered among surface finds in the area of Umm al-Quwain. Several types of arrowheads are documented at UAQ69 (Boucharlat *et al.* 1991a: fig. 1) – including a barbed and tanged point (not represented at UAQ2), a trihedral point (type 4), two large fusiform points (type 1a), and a short fusiform point (type 2a). A further fusiform point shows a shaped stem (Boucharlat *et al.* 1991a: fig. 1 n°2). A comparable point has been found at Ramlah RA6 (Uerpmann and Uerpmann 1996: fig. 4), but it has no parallel in the UAQ2 assemblage. It is also worth mentioning that, in contrast to UAQ2, fusiform points from surface sites do not frequently show

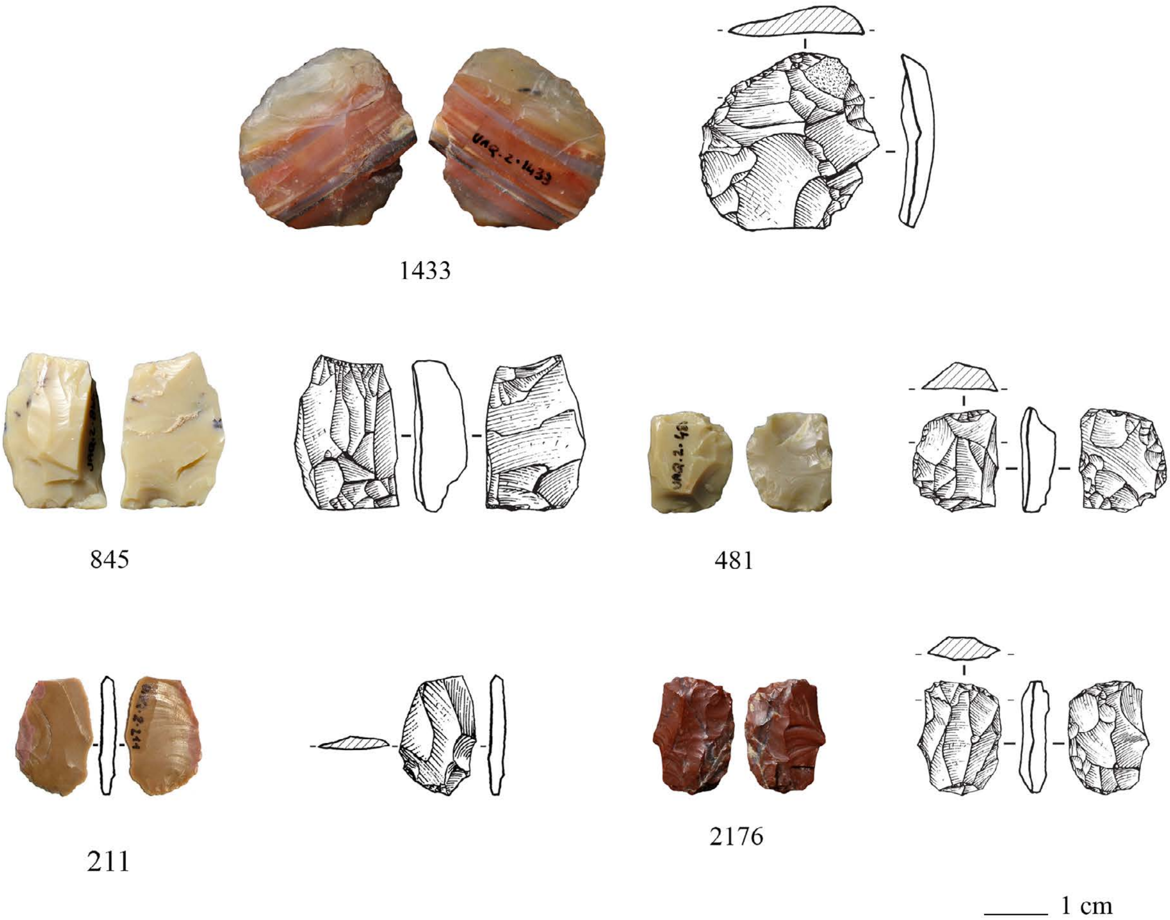


Figure 4.19. Examples of splintered pieces present in the UAQ2 industry: UAQ2.1433. Bipolar splintered piece on flake (Level 5); UAQ2.845. Bipolar splintered piece (Level 8); UAQ2.481. Bipolar splintered piece (Level 12); UAQ2.211. Bipolar splintered piece on flake (Level 13); UAQ2.2176. Bipolar splintered piece (Level 11). Photos & Drawings: G. Devilder.

denticulations in the area. A single denticulated point is mentioned by Vogt (1994: 122) at Jazirat al-Hamra (JH38, JH39 or JH40 – this is not specified). A further denticulated point (type 2b) made in carnelian was found at JH1 (survey 2010-2015 of the French archaeological mission, unpublished). Denticulated points show a broader repartition, being reported further south in the Emirate of Abu Dhabi, such as at Yahar (Hellyer 1998: 22), and, more remarkably, at MR11 on Marawah Island. Substantial quantities of barbed and tanged points and trihedral points are attested from the latter site, but it also includes specimens of large fusiform points showing small denticulations (Beech *et al.* 2022: fig. 6 n°5). Another point from the same site is close to our type 2a or type 3: it does not show denticulations, but a stem has been shaped (Beech *et al.* 2022: fig. 6 n°4). Two points from as-Sabiyah H3 in Kuwait correspond to our type 2a, suggesting a broader diffusion (Kallweit and Davies 2010: fig. 6.5 n°1 and 7).

Charpentier (2008) defined two techno-facies based on the stratified levels of Suwayh SWY1 in the Ja'alan region. The occurrence of trihedral points characterises Period I of SWY1, dated 5500-4500 BCE. The two potential fragments of trihedral point found at UAQ2 fit perfectly into this chronology since they occur in the earliest phase of occupation.

The points from Period II of SWY1 (dated *c.* 4500-3700 BCE) have a regular fusiform shape with a lozenge- or diamond-shaped section (Suwayh facies) (Charpentier 2008: figs. 5-6) – they are characterised by pressure retouch. This facies is well documented in the Ja'alan region, including at other sites of the Suwayh area (SWY2, SWY4, SWY11 and SWY20), in the area of Ras al-Jinz (RJ37 and RJ44), and further south at Ras al-Sakalah SAK1 for example (Biagi 1988: fig. 12 n°1-9). It also characterises industries from Ras al-Hamra RH5 and Saruq (Muscat district). They show a broader geographical diffusion, with specimens reported further south into the Wahiba Sands, Dhofar, and the Rub' al Khali (for more details, see Charpentier 2008).

Most of the published fusiform points of the Suwayh facies correspond to our types 1a and 2a (depending on their length), but they have no denticulated retouch. Charpentier (2008: 67) has already outlined the rare presence of 'micro-denticulations' on the edges – i.e. of fusiform points, as illustrated by a specimen from Ruwayz RWY1 in the same study (Charpentier 2008: fig. 6 n°3) – and of trihedral points as well, e.g. at Khor al-Hajar KHJ1 (Charpentier 2001: fig. 3 n°3-4). Trihedral points and, less systematically, barbed and tanged points from MR11 also show denticulations on their edges (Beech *et al.* 2022: fig. 6). It is also the case of several examples reported from Dukhan in Qatar (Nayeem 1998: figs. 57-58), Bakha (Sabkhat Khuwaysirah) in Eastern Saudi Arabia (Kapel 1973: fig. 61), as well as among the 'notched foliates' from Bahrain (Nayeem 1992: fig. 16). It thus seems that denticulations consist of an optional operation in the final stage of the production of projectile points. Although comparable, the fusiform points from UAQ2 do not fit within the SWY1 Period II chronology. At UAQ2, fusiform points are restricted to Levels 14-9 (Stage I), thus associated with an occupation dated by the second half of the 6th millennium BCE – a thousand years before their emergence in the Sultanate of Oman. One can suggest that earlier industries of fusiform points occurred in the vicinity of the Jebel al-Ma'taradh, allowing the exploitation of a variety of lithic resources (e.g. black, brown, and red flint, radiolarite, carnelian, agate) for their production. Further centres of production could have existed in the southern UAE and beyond, as suggested by the occurrence of fusiform points using another variety of flint at MR11 during the first half of the 6th millennium BCE (Beech *et al.* 2022: fig. 6 n°4-5).

Conclusion

The UAQ2 lithic industry is indicative of significant technical changes that occurred between the 6th and first half of the 5th millennium BCE, a timespan which corresponds to strong climatic aridification on a regional scale. This climatic change appears to have had some impact on the settlement dynamics and the lifestyles of the Neolithic groups, which could have become more mobile. The reorganisation of the social and environmental systems, including subsistence and the mobility strategies, resulted in profound changes as regards the exploitation methods used for lithic raw materials, as well as the choice of tool types produced.

The levels attributed to Stage I show a great variety of tools and raw materials, of reasonably high quality, including very beautiful pieces such as the endscrapers on blades and the large projectile points with denticulated retouch. This abundance can be related to various domestic or craft activities. However, during the various occupations of the UAQ2 site the initial homogeneous cultural and technical background progressively changed. High-quality tools tended to disappear, whereas non-standardised and less sophisticated tools are found over the entire occupation of the site.

The industries of Stage II (Levels 8-6) thus maintained the tradition of the earliest occupation at the site (Stage I, Levels 14-9), although their compositions diverge in an almost imperceptible manner up to Stage III (Levels 5 to 1).

The levels representative of Stage III contained much less abundant lithic materials. The industry appears less mature compared to the levels of Stage I. The change in the predominant raw material is, however, worth mentioning. All these clues suggest that the social and technical behaviours of the prehistoric inhabitants of UAQ2 progressively changed after the climatic deterioration that occurred during Stage II (Phases C, D, and E).

Groundstone implements

K. Lidour, S. Méry

Tile knives

Tile knives are thin sidescrapers made either from large flakes or from tabular flint, and are frequently attested at coastal sites from the Arabian Gulf (Edens 1982: pl. 102, B; Kapel 1967: 21, fig. 44b; Méry and Charpentier 2013: 75). Finds include specimens reported from major stratified sites, i.e. Dosariyah (Saudi Arabia) (Dreschler 2018: 247, pl. 11.11-12), Marawah MR11 (Beech *et al.* 2020: fig. 10, n°8), and Akab (Emirate of Umm al-Quwain, UAE) (Méry and Charpentier 2012: figs 16-17). Edens (1988: 21) outlined that this type of tool is absent in the interior.

Strikingly, tile knives are not particularly abundant nor varied at UAQ2 (Figure 4.20). Two specimens of made from tabular schist have been found respectively on the site's surface (UAQ2.51) and in Levels 9-12 (UAQ2.1225). They are worked all along their edges – the retouch is short and abrupt. Two further sidescrapers knapped in massive haematite have been found in the section documented in 2009 (not registered in the database) and during excavations associated with Level 12 (UAQ2.226).

Stone adzes

The excavations at UAQ2 have provided various ground stone implements, including a few stone adzes: three fully polished specimens (UAQ2.2586; UAQ2.2587; UAQ2.2945), a partially polished piece (UAQ2.770), and a potential unpolished preform (UAQ2.2305) (Figure 4.21).

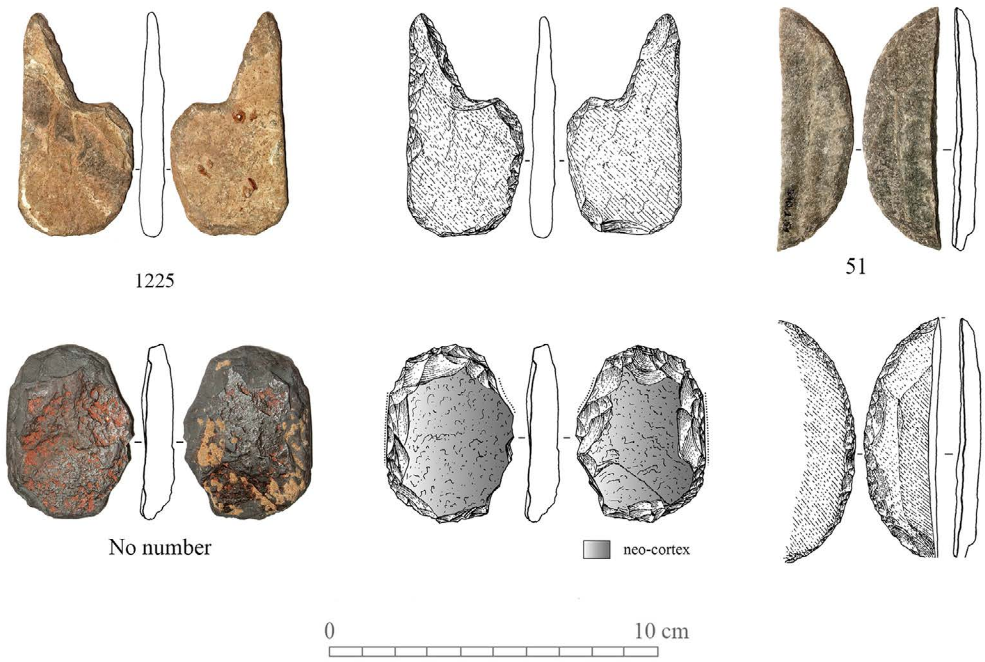


Figure 4.20. Large sidescrapers – classified as 'tile knives' – and one specimen of shaped massive haematite from UAQ2, found by V. Charpentier during the 2009 survey on the surface of the site. Photos & Drawings: G. Devilder.

Two polished adzes (UAQ2.2586; UAQ2.2587) were found in a small shallow pit inside a circular housing structure associated with Level 14 (square I4, Sector 2). The pit was *c.* 10 cm in diameter, by 15 cm in depth, and filled with pure loose sand. The two adzes had been deliberately stuck into the ground close to one another, with the cutting edges pointing upwards. Although doubts remain on the precise nature of this feature, we suppose it could have consisted of a cache left by the site's inhabitants. The lack of parallels in the region does not allow us to interpret it as a foundation deposit. Comparable features are known from Ras al-Hamra RH6 (Sector A, squares T40 and T42) (Marcucci *et al.* 2014: 237) and Ras al-Khabbah KHB1 (Cavulli and Scaruffi 2012: 407) in the Sultanate of Oman. Square T40, at RH6, contained a cluster of items in mother-of-pearl, a shell fishhook, and a few stone files and fishing sinkers. At KHB1, a pile of fishing sinkers was associated with bone needles and worked flint pieces. An important concentration of fishing sinkers was also found in a Bronze Age context at Ras al-Hadd HD6 (Room 11) (Azzarà 2015: 153). Similarly, a possible cache of fishing sinkers has been found at UAQ2, close to Tomb 1 in Sector 5 (see below).

Both adzes show convex and rounded sides. Adze UAQ2.2586, made of a pale green hardstone identified as nephrite or jadeite, is elliptical in shape and finely and entirely polished. It measures 67 mm in length, 35 mm in maximum width, and with a maximum thickness of 20 mm. Adze UAQ2.2587 is of a pyriform shape and measures 72 mm in length, 36 mm in maximum width, and 20 mm in maximum thickness. It is made of greyish granite. Another specimen of the same shape (UAQ2.2945) was found in a northern extension of the main settlement area (Sector 6, excavated in 2017). The latter is also associated with the occupation of the 6th millennium BCE, belonging as it does to Levels 9-14. This adze measures 100 mm in length, 33 mm in maximum width, and 20 mm in maximum thickness. The material is fine-grained limestone. These adzes find a good parallel with a specimen made of conglomerate from Ras al-Hamra RH6 (Level 2) (Biagi 1999: fig. 13), dated from the second half of the 5th millennium BCE (L.G. Marcucci pers. comm.).

A partially polished adze, or hand-axe, made in haematite (UAQ2.770) found in Level 3 (late 5th millennium BCE occupation) shows a more triangular shape and straight edges, measuring 59 mm in length and 54 mm in width – it is also significantly thinner than the previous specimens described, i.e. less than 10 mm in thickness. Only the bottom is polished, while retouches are visible along both long edges. These characteristics fit in Charpentier's (2020: 88) general description of haematite adzes, outlining that polishing appears to concentrate on the cutting edge, leaving the remaining surface of the tool unworked. Comparable specimens are attested in a

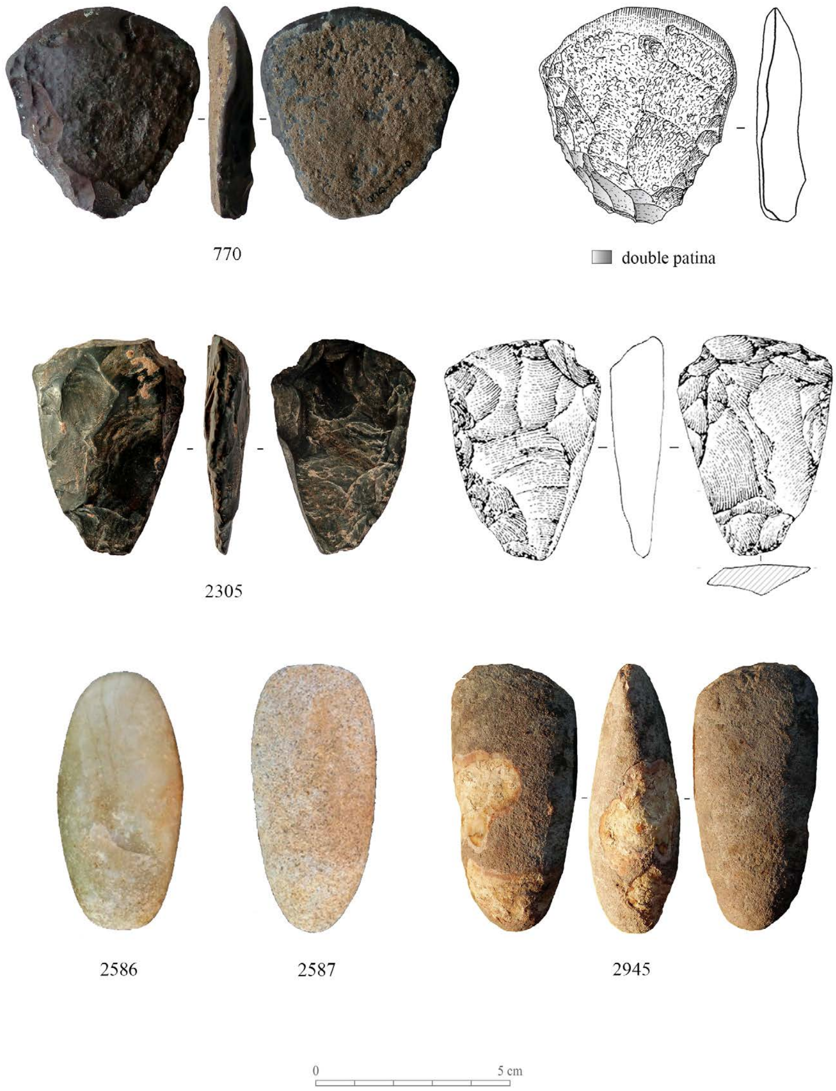


Figure 4.21. Partially polished haematite adze UAQ2.770 and possible preform UAQ2.2305. Fully polished adzes include UAQ2.2586, UAQ2.2587, and UAQ2.2945. Photos & Drawings: G. Devilder & K. Lidour.

stratified context dated from the second half of the 6th millennium BCE on Delma Island (Kallweit and Beech 2020: 126, fig. 7) – salt domes of the Abu Dhabi islands provide substantial quantities of raw haematite. A potential preform of a stone adze showing a triangular shape has been found in Level 12 (UAQ2.2305): it measures 51 mm in length, 36 mm in width, and 12 mm in thickness. Flake removals cover both sides, and no polished surfaces are visible. It is made of a black clastic rock.

Softstone files

Two softstone files have been found in Levels 11 and 12 (UAQ2.123 and UAQ2.427) (Figure 4.22). They exhibit polished and rounded surfaces with many striations oriented in various directions. Although stone files are frequently associated with the manufacturing of shell fishhooks and softstone earrings during the 5th to 4th millennia BCE in the Sultanate of Oman (Charpentier and Méry 1997; Uerpmann and Uerpmann 2003: 110, fig. 7.5; Usai 2018 – see also the experiments conducted by Cavulli *et al.* 2009), the specimens found at UAQ2 belong to levels dated from the second half of the 6th millennium BCE and cannot be related to these industries theoretically. In this sense, shell fishhooks (UAQ2.1012; UAQ2.1549) and fragments of softstone earring (e.g. UAQ2.2022-3) have been found in the upper stratigraphy at UAQ2. However, it is also worth noting the discovery of a black

Figure 4.22. Softstone files from Levels 11 and 12 (UAQ2.123 and UAQ2.427). Photos & Drawings: H. David.

earring made in hardstone (UAQ2.2450) from Level 11, evidencing earlier productions that could have involved the use of stone files. Furthermore, the files from UAQ2 could have been used to produce other types of stone or shell adornments, including polished stone spheres that concentrate in Levels 10- 13 (e.g. UAQ2.171; UAQ2.380; UAQ2.2027-30).

Grinding and milling stones

A total of 83 fragments of grindstones were found in stratigraphy at UAQ2, mainly in Sector 2. More than half are associated with Levels 9-14, and are still numerous in Levels 8 and 7, after which their numbers decrease. Most are small items with an average length of 2.2 cm (length: from 1 cm - 9.7 cm; width: 1 cm - 5 cm). They are mostly made of gabbro or diorite, as well as other rock types, such as limestone and various siliceous stones (Figure 4.23: e.g. UAQ2.793; UAQ2.3013; UAQ2.3015). Similar tools were frequently found at Akab and several surface sites at Umm al-Quwain, and it is unlikely that they all date from the Neolithic period. Similarly, it is also not possible, of course, to date poorly stratified specimens or surface finds.

Specimens made from fine-grained sandstone seem to have been used as abrading tools (Figure 4.24: e.g. UAQ2.3073; UAQ2.3074), as evidenced by polished surfaces and deep, intersecting grooves that could have been produced by the sharpening of bone points or the manufacture of shell disc beads. Two harzburgite wadi cobble stones were found set together in Level 11 (Figure 4.23: UAQ2.783-4). Macro-traces suggest that they were used as milling stones (UAQ2.783 is 11.2 cm long, 9.8 cm wide, and 5.8 cm thick; UAQ2.784 is 15 cm long, 10.1 cm wide, and 4.4 cm thick). These types of tools have no parallel in the UAE.

Both grinding and milling stones could have been used to process various foodstuffs (i.e. cereals, fruits, roots) or materials. We can also mention that several small, ochre nodules were discovered during excavations at UAQ2, but no direct evidence of the processing of this natural colourant was identified. Recent use-wear analyses undertaken by one of the present authors (K.L.) on shell tools recovered from the site suggest the exploitation of ochre for the treatment of animal skins. A few shell valves had also been used for scraping ochre (Lidour *et al.* 2024a). Further evidence of grinding ochre is reported from Shagra in Qatar, with some milling stones showing reddish traces identified as iron oxide (Inizan 1988: fig. 56 n°2), and at some other Neolithic sites, e.g. Dosariyah (Drechsler *et al.* 2018: fig. 13.3).

Figure 4.23. Selection of groundstone tools from UAQ2: grindstones (UAQ2.795, UAQ2.3013, and UAQ2.3015) and milling stones (UAQ2.783, UAQ2.784).

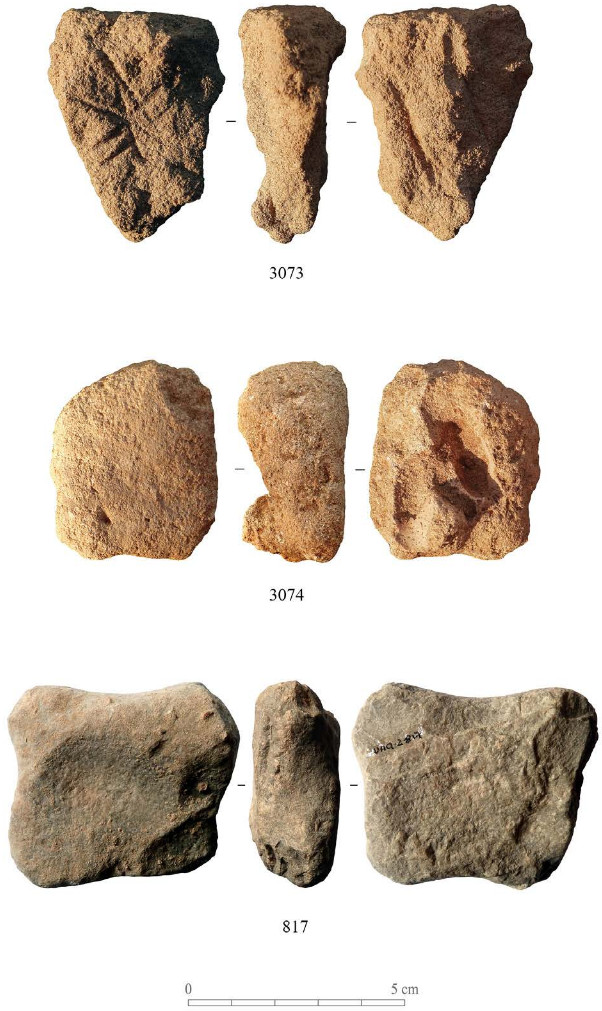


Figure 4.24. Selection of groundstone tools from UAQ2: abrading tools (UAQ2.3073, UAQ2.3074) and a crushing stone (UAQ2.817). Photos: H. David.

The use of ochre-based pigment was previously been reported by Phillips (2002: 180, fig. 11) at UAQ2. The finds consisted of a quite large ochre ball (*c.* 4 cm in diameter) and a bone applicator showing red traces. While ochre could indeed have been used as a cosmetic as early as the Neolithic in Eastern Arabia (see Salvatori 2007: 38), other activities could also have involved the use of ochre, i.e. the processing of animal skins, as suggested by recent use-wear analyses made on shell tools recovered from the site (Lidour *et al.* 2024a). Interestingly, a layer with a red colouration was found in Sector A at Ras al-Hamra RH6 (Marcucci *et al.* 2014: fig. 2.I). This might have been associated with a processing area where ochre powder was produced and/or applied. The use of ochre for (other) symbolic purposes is attested during the Neolithic in Eastern Arabia. It was reported within the *Dugong Bone Mound* at Akab, where both the bones and the sediment constituting the lower part of the monument were infiltrated with ochre (Méry *et al.* 2009: 702).

Crushing stones

There is one particular type of tool reported from several archaeological sites – the so-called ‘crushing stone’ (or, less frequently, ‘cupped stone’). This type of tool could have been used for several purposes, as suggested by the types of marks often visible on its surface; e.g. crushing stones were used as anvils on their largest surfaces (as evidenced by small grooves and wear traces) and as hammers on their sides (showing percussion impacts). It is possible, therefore, to see crushing stones as multi-purpose, everyday tools; indeed Cleuziou and Tosi (2007: fig. 49) envisage them as a kind of Neolithic ‘Swiss Army knife’! Other scholars have argued that such tools may have been specifically used to crush mangrove-snail shells (*Terebralia palustris* in particular) (Vogt 1994; Uerpmann and Uerpmann 2003: fig. 115). It is not unreasonable to think that other large marine gastropods could have been shelled in a similar way, e.g. murex (*Hexaplex kuesterianus*), which were abundantly exploited during the Neolithic in the Umm al-Quwain area, i.e. at UAQ2, al-Madar S69, al-Ramlah RA3 (Uerpmann and Uerpmann 1996), and Akab (Charpentier and Méry 2008: 131).

Crushing stones are documented during the Neolithic both in the Arabian Gulf and in the Sultanate of Oman.

Examples were found at as-Sabiyah H3 in Kuwait (Carter and Crawford 2010: fig. 6.7 n°1-2), Shagra in Qatar (Inizan 1988: fig. 55 n°2 and fig. 56 n°1), and in smaller quantities in the northern UAE, as at Akab (Charpentier and Méry 2008: fig. 8 n°8) and Jazirat al-Hamra, for which only a single drawing is published (Vogt 1994: fig. 9.5 n°12). This scarcity is probably related to the low availability of local stone supply. Conversely, a few crushing stones are reported from sites in the Sultanate of Oman, e.g. Ras al-Khabbah KHB1 (Cavulli and Scaruffi 2012: fig. 12 n°12-13), Wadi Saruq, and Khor Milkh KM1 (Uerpmann 1992: fig. 26). This last site revealed 244 specimens (Uerpmann and Uerpmann 2003: 113). We should also note that crushing stones are reported as being used during later periods, i.e. at Tell Abraq (Emirates of Umm-Quwain and Sharjah), Umm an-Nar (Emirate of Abu Dhabi), during the Bronze Age (Frifelt 1995: 309, fig. 300; Potts 2000), and at Muweilah (Emirate of Sharjah) during the Iron Age (P. Magee pers. comm. to Charpentier and Méry 2008: 127). Specimens found out of stratified contexts cannot be dated.

A small number of crushing stones were discovered at UAQ2, both from the surface of the site (n = 3) and within the stratigraphy (Levels 11, 6, 5, 4 – one in each layer) (Figure 4.24: e.g. UAQ2.817). These are made from blocks of hardstone (siliceous rocks and diorite), as well as, although more rarely, from limestone and beach rock. The examples found at UAQ2 are mainly between 7 cm - 12 cm in length, 5.5 cm - 8 cm wide, and between 3 cm - 5 cm thick.

Fishing equipment

K. Lidour, S. Méry

Stone fishing sinkers

47 fishing sinkers were found at UAQ2 (Figure 4.25), coming from the lowest layers: 31 (66%) being found in Levels 9-14, corresponding to the Middle Neolithic as defined at UAQ2. Conversely, sinkers are rarely attested in the uppermost layers, in particular above Level 8 (where only 11 specimens were found). The relative disappearance of fishing sinkers in the latest levels is linked to a shift in the mode of occupation of UAQ2 rather than a change in fishing techniques.

Considering the average occupation time at UAQ2, and the large planimetric extension of the excavation area, the number of fishing sinkers collected is quite low when compared to some other Neolithic sites from the Sultanate of Oman, e.g. Khor Milkh KM1 (n = 126) (Uerpmann and Uerpmann 2003: 111). This is also found at Akab, where only *c.* 20 examples were found in the settlement area. Fishing sinkers are rare on the surface of many of the other sites surveyed in the northern UAE.

At UAQ2, most of the fishing sinkers come from Sector 1+2 in the settlement area. A cluster of ten other sinkers was found in a small pit located *c.* 1 m from Tomb 1 in Sector 5 (necropolis), associated with Level 14, which is the oldest level of the main phase of occupation of the site (C13, see Chapter 1: Figure 1.47). A group of pebbles was previously found at Akab, close to the *Dugong Bone Mound* (4th millennium BCE) (Méry *et al.* 2009), and considered to be linked to symbolic behaviours. Although the two discoveries are not contemporaneous, these ritual deposits highlight immaterial practices linked to fishing.

The fishing sinkers from UAQ2 are all made of stone pebbles – spherical and flattish (Figure 4.25). Two main types of stone materials were selected: pebbles of sandstone and beach rock, and hardstone pebbles (frequently from siliceous rocks). The latter are more commonly found all along the occupation area of the site. A few gabbro pebbles are also present. The fishing sinkers are fairly standardised, both in shape and in size, indicating a selection process prior to bringing them to the site and then using them to make fishing nets. They usually measure *c.* 6 cm - 7.5 cm in length (min. 3.3 cm; max. 10 cm.), 4.8 cm in width (min. 2.3 cm; max. 7.5 cm), and with a thickness of 2.2 cm (min 1.3 cm; max. 3.4 cm). Their mean weight is *c.* 120 g (not exceeding 200 g). (For a more complete review of Neolithic fishing sinkers from Eastern Arabia, see Lidour 2023.)

Several categories of fishing sinkers are identified at UAQ2, based on their shape, size, and method used for attaching the line. We can highlight two types based on the shape and method for attaching the line, as well as several sub-types, depending on the size of the sinkers and the nature of the raw material used:

- Type 1: Oval to circular shape, flat. These are mostly made of sandstone and beach rock pebbles (Type 1a, Figure 4.25: e.g. UAQ2.541), which are quite common along seashores and in the fossil coastal escarpments (including hardened Pleistocene sand dunes). They are more rarely made of hardstone pebbles (Type 1b), probably gathered from wadi beds. Type 1c also corresponds to sinkers made of hardstone that have been almost entirely shaped. Generally, hand-sized and flatter than Type 2 (see below), Type 1 sinkers typically show transversal steeped notches. Specimens of Type 1 are attested from several sites in the Arabian Gulf, although only a few are known from the northern and central regions, despite the extensive surveys conducted in these regions since the 1960s, and the extended excavations conducted at Bahra 1, as-Sabiyah H3, Dosariyah, al-Markh in Bahrain, and Khor in Qatar. Examples only come from as-Sabiyah H3 (Carter and Crawford 2010: fig. 4.11), Dosariyah (Drechsler

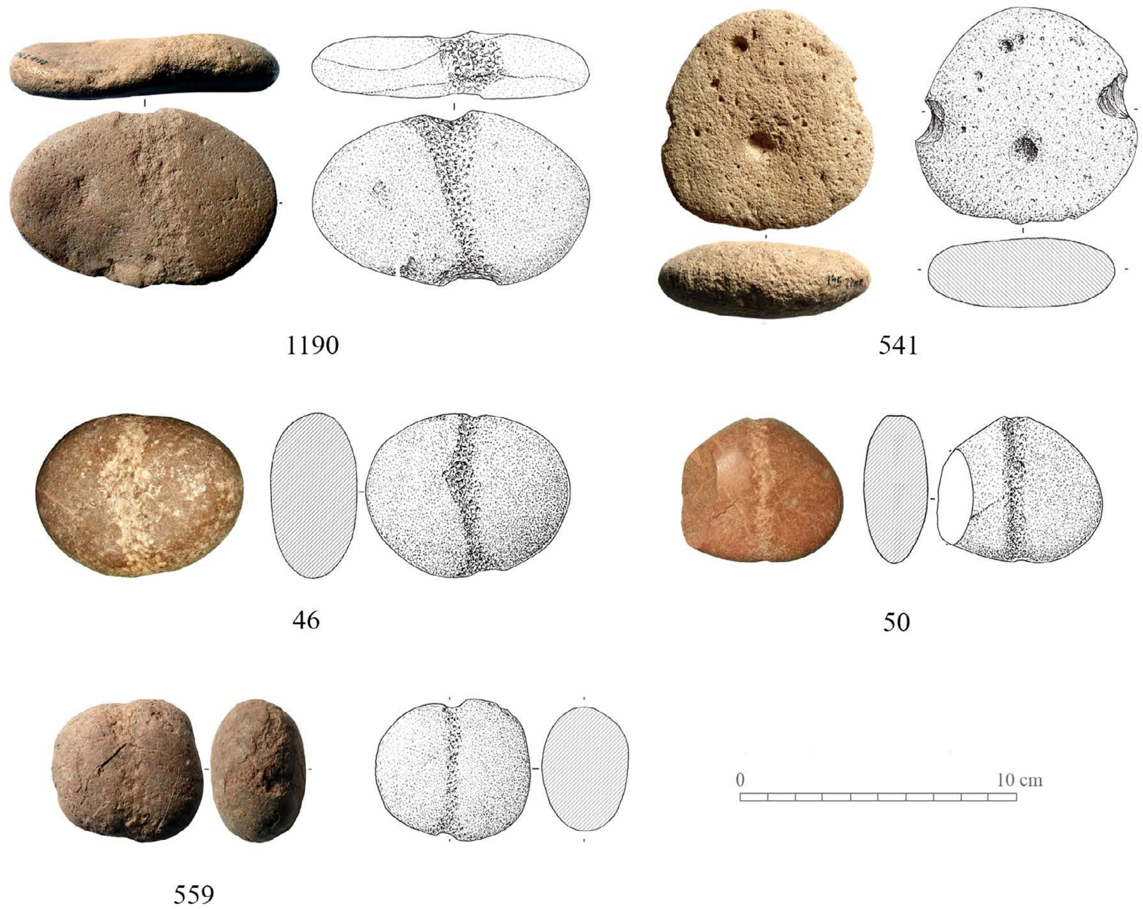


Figure 4.25. Selection of stone fishing weights from UAQ2: Type 1 with transversal notches (UAQ2.541) and Type 2 with a transversal pecked waistline (UAQ2.1190, UAQ2.46, UAQ2.559). Photos & Drawings: G. Devilder.

2018: pl. 11.22.g), as well as from the Umm al-Quwain area, at Akab (Charpentier and *Méry 2008: fig. 8 n°*4-7). Among unpublished material, a beach rock fishing weight fragment with a notch comes as a surface find from UAQ36. At UAQ38, 2 km north of UAQ2, another example showing stepped notches was found more recently (Degli Esposti *et al.* 2020). Type 1 sinkers are reported more frequently in the Sultanate of Oman, e.g. Ras al-Hamra RH6 (Biagi 1999: fig. 14 n°10-11), Khor Milkh KM1 and KM2 (Uerpmann 1992: fig. 27 b-d), Ruwayz RWY1, Suwayh SWY10 and SWY11 (Charpentier *et al.* 2000: 81; Berger *et al.* 2020: fig. 5 n°1 top left), and Masirah Island (Charpentier *et al.* 2013).

- Type 2: Circular shape, almost round or often slightly flattish. They are generally made of hardstone pebbles (e.g. harzburgite) that may have been gathered in wadi beds. Their method of attaching essentially consists in a transversal pecked line: signs of impact and crushing due to direct percussion are visible on the retouched edges, often creating stepped notches. Sinkers of Type 2a (Figure 4.25: e.g. UAQ2.46; UAQ2.50; UAQ2.559) are roughly hand-sized, just as the specimens of Type 1. We may distinguish them from Type 2b sinkers (Figure 4.25: e.g. UAQ2.1190) as they are slightly flatter and occasionally smaller. They might, however, have been used in a similar way as Type 2a sinkers. Type 2 sinkers are principally documented in the northern UAE, e.g. Hamriyah (Jasim 1996: fig. 8 n°23; fig. 9), al-Madar S69 (pers. comm. D.T. Potts to Uerpmann and Uerpmann 1996: 134, note 58), Akab settlement (Charpentier and *Méry 2008: fig. 8 n°*1-3), as well as at a number of surveyed sites of Umm al-Quwain, Jazirat al-Hamra, and areas of Ras al-Khaimah (e.g. Haerinck 1991: fig. 1-2, 6-7; Vogt 1994: fig. 9.5 n°8-11). Other Type 2 specimens (n = 5) were found during the restoration of the Umm an-Nar settlement in Abu Dhabi in 1996-1997 (Al Tikriti

2011: 27, fig. 24). Similar examples were found at a few Neolithic sites in the Sultanate of Oman. They include Wadi Saruq (Uerpmann 1992: fig. 28 a-g) and Ras al-Hamra RH6 (Biagi 1999: fig. 14 n°1-3; Marcucci 2015: fig. A1.353). Examples found at Ras al-Jinz RJ2 (Period I) differ slightly, being larger and showing a wider central groove (Azzarà 2015: pl. 218 n°1-2, maybe 3).

It is likely that hand-sized sinkers were used to weight small fishing nets, i.e. beach seines (Lidour 2018: 121; 2023). Smaller specimens of Type 2b could have been used in a similar way, although it is also possible that the latter were attached to fishing lines. However, some were found in contexts dated to the Middle Neolithic, where no conclusive evidence of shell fishhook manufacture is reported to date.

Neolithic fishing sinkers are well recorded in the Sultanate of Oman, i.e. during the 6th and 5th millennia BCE at Ras al-Hamra RH6 (Biagi 1999: 14 n°10-11), and Khor Milk KM1 and KM2 (Uerpmann and Uerpmann 2003: fig. 7.6 n°1, fig. 7.23 n°4-6). Unlike examples from UAQ2 and RH6, where notches are made by abrupt retouches along the edges, sinkers from Khor Milkh sites show 'Clactonian' notches, showing large negative flakes. Such flaking is due to tangential percussion on the edges. The grooves of Type 2 sinkers are obtained by picketing on both sides of the pebbles. Picketing was probably direct and made by hard-hammer percussion. The depth of the groove is < 2 mm, and < 3 mm in width.

At UAQ2, as at Akab and UAQ38 (Degli Esposti *et al.* 2020), non-retouched hardstone pebbles could also have been used as fishing sinkers. Lines can simply be tied around pebbles, small rocks, or rubble, as is still often the case today in Southern Arabia and Socotra Island (Jansen van Rensburg 2016: 137, fig. 86). Knowing that fishing gear deteriorates quickly and is often lost, we can also consider that non-retouched pebbles were stored at sites, prior to making new fishing equipment or for fixing existing gear. It therefore seems likely that the inhabitants of coastal Neolithic sites may have built up, here and there, some stocks of pebbles – especially as the latter are not abundant in the area close to UAQ2.

During the 4th millennium BCE in the Sultanate of Oman, new types of fishing sinkers begin to appear (e.g. Tosi and Usai 2003: fig. 8; Uerpmann and Uerpmann 2003: fig. 7.6 n°3). These present new methods for attachment: longitudinal notches or longitudinal grooved lines (or 'sawn-in' according to Uerpmann 1992). They are also made from softer stone materials than previously, i.e. limestone, and are easier to manufacture in a standardised way – in particular, the thickness of the fishing gear becomes more easy to calibrate. These new types of fishing sinkers are not found to date in the Umm al-Quwain area during the Neolithic, or in other regions of the Arabian Gulf, where sinkers mostly belong to Type 1.

It is important to note that a miniature sinker corresponding to the 'sawn-in' type mentioned above, or to Group 4 of Ras al-Khabbah KHB1 (Cavulli and Scaruffi 2011: fig. 2 n°20-25), was found in the late 4th-millennium BCE *Dugong Bone Mound* at Akab (Méry and Charpentier 2012: fig. 19-20). This small pebble clearly differs from UAQ2 Type 2b sinkers, showing a transversal grooved line recalling examples from Wadi Saruq in the Muscat area (Uerpmann 1992: fig. 28). It also differs from sinkers from KHB1, whose grooved lines are longitudinal. Miniature sinkers could have been used to weigh down fishing lines and be assembled together with shell fishhooks. If one considers that this kind of fishing gear first appears during the 4th millennium BCE, then it seems understandable that it has not been found at UAQ2, where site occupation concentrates during the 6th and 5th millennia BCE.

Shell fishhooks

Two fishhooks made of mother-of-pearl (*Pinctada persica*) have been discovered at UAQ2. Both hooks were found in settlement contexts: UAQ2.1012 in Level 7 (Sector 2), and UAQ2.1549 in Level 3 (Sector 4). They thus both date from the second half of the 5th millennium BCE, which is consistent with the dating obtained for the Akab settlement, where other specimens of shell fishhooks have already been found (Charpentier and Méry 2008).

Almost complete, UAQ2.1012 (Figure 4.26) is 2.2 cm in length, quadrangular in section, and thin. Its incurved shape finds parallels at Akab (Méry and Charpentier 2012: fig. 4) and at Ras al Khabbah KHB1 (Cavulli *et al.* 2009: fig. 1 n°23-24). The method of attaching the line relates to a series of notches at the top of the hook, and finds numerous parallels in the Sultanate of Oman at sites dated from the mid 5th to the end of the 4th millennium BCE (e.g. Biagi 1984: fig. 6 n°14-16; Uerpmann 2003: fig. 7.4 n°7; Cavulli *et al.* 2009: fig. 1 n°14, 18-19; Charpentier *et al.* 2012b: fig. 15; Marcucci *et al.* 2014: fig. 3 n°5-6). Fishhooks belonging to this type generally measure between 2.5 cm - 8 cm in length (Lidour 2018: 125; 2023).

The second fishhook, UAQ2.1549, circular in section and thin, measuring 4.3 cm in length (Figure 4.26). Its head is simply thinned. This type is less frequent in Eastern Arabia than finds of notched hooks. Nevertheless, examples are known from a number of sites, e.g. Akab (Charpentier and Méry 2008: fig. 9 n°7-8; Méry *et al.* 2008: fig. 2 n°5, 3), Ras al-Hamra RH5 (pers. comm. Salvatori in Charpentier and Méry 1997: 150), Wadi Shab GAS1 (Tosi

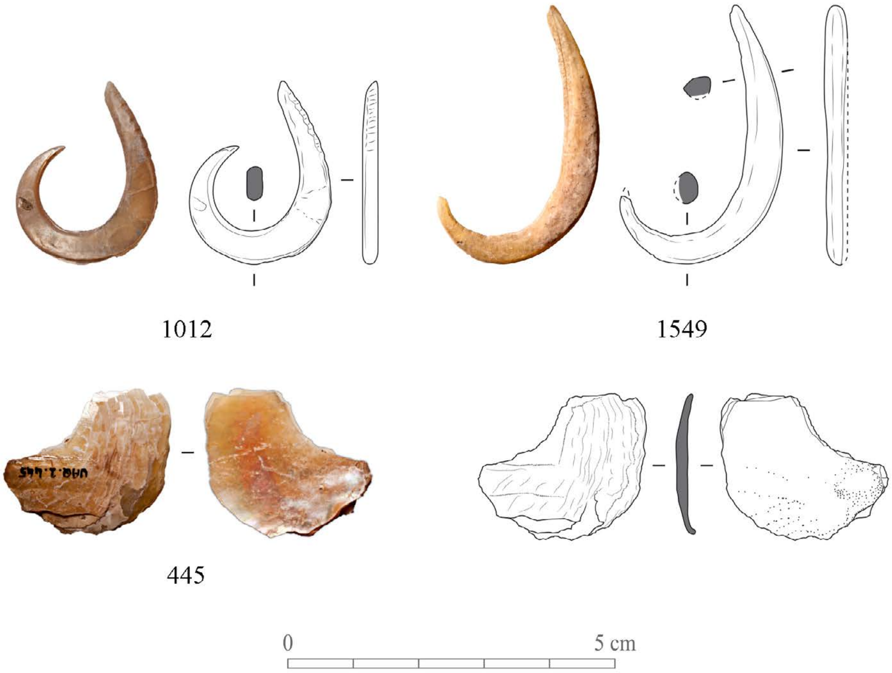


Figure 4.26. Shell fishhooks and preform from UAQ2. Photos & Drawings: H. David.

and Usai 2003: fig. 11 n°3), and Ras al-Khabbah KHB1 (Cavulli *et al.* 2009: fig. 1 n°16). They generally measure between 5 cm - 10 cm in length (Lidour 2018: 127).

Two preforms were collected (UAQ2.124, UAQ2.445) at the site's surface, indicating perhaps that shell hooks were directly produced at UAQ2. A few fragments of worked mother-of-pearl were also found during the excavations, which could be interpreted as raw material or waste products. One of the blanks, UAQ2.124 (length: 4.7 cm, width: 1.8 cm, thickness: 1.1 cm), is nearly oval-shaped, and corresponds to the first step of the manufacture of the hook (see Charpentier and Méry 1997; Cavulli *et al.* 2009; Bavutti *et al.* 2015). It is close in shape to preforms found at Ras al-Hamra (e.g. at RH6, Marcucci *et al.* 2014: fig. 3 n°1-2), Ras al-Hadd HD5 (Borgi an Maini 2018: fig. 5, top left), and Ras al-Khabbah KHB1 (Cavulli *et al.* 2009: fig. 2 n°1-3). The second blank (Figure 4.26), UAQ2.445 (length: 2.9 cm, width: 1.8 cm, thickness: 1.7 cm), evokes the second stage fishhook manufacture, i.e. reduction of the blank by knapping to obtain a 'drop-shape' preform (cf. Charpentier and Méry 1997; Cavulli *et al.* 2009: 75; for find parallels at Wadi Shab GAS1, see Tosi and Usai 2003: fig. 25, top line); for Ras al Hadd HD5, see Borgi and Maini 2018: fig. 5, top middle); for Ras al Khabbah KHB1, see Cavulli *et al.* 2009: fig. 2 n°4-9).

The discovery of shell fishhooks in the upper levels of UAQ2 was not the first in the UAE; several specimens were found previously at Akab (Charpentier and Méry 2008), and another near the Wadi Suq tomb SH105 at Shimal, i.e. out of context, in the northernmost Emirate of Ras al-Khaimah (Kästner 1991: 27, pl. 11C). Two shell hooks were also found in graves at al-Buhais BHS18, in the interior of the Emirate of Sharjah (Kiesewetter *et al.* 2000: 137-46, fig. 2. 13, 6), an important discovery and one of the proofs of the mobility of coastal Neolithic groups and their investment in fishing activities. One find shows a head with two eyelets for attaching the line, a rare case for the UAE, but attested in the 4th millennium BCE at Akab in the *Dugong Bone Mound* (Méry *et al.* 2008: fig. 2 n°6). Hooks of this type are quite frequent in the same period in the Sultanate of Oman, both in the Muscat region and along the Arabian Sea (see, e.g., Phillips and Wilkinson 1979: fig. 5, plate 44b; Uerpmann and Uerpmann 2003: fig. 7.22; Gaultier *et al.* 2005: fig. 10).

The presence of blanks at UAQ2 confirms the local production of shell fishhooks and the sharing of this developed technology in the north of the UAE, whereas it was long thought to be associated with the coastal populations of the Sultanate of Oman, from the Muscat region to the Ja'alan. In the UAE, the site of Akab has revealed to date the most numerous finds of shell fishhooks, most coming from the 5th-millennium BCE levels (i.e. at different stages of fabrication, in levels dated to *c.* 4500-3800 BCE (Charpentier and Méry 2008)). Not only the material, but also the dimensions, morphology, and the methods for attaching the hooks, are the same on both sides of the Strait of Hormuz. The

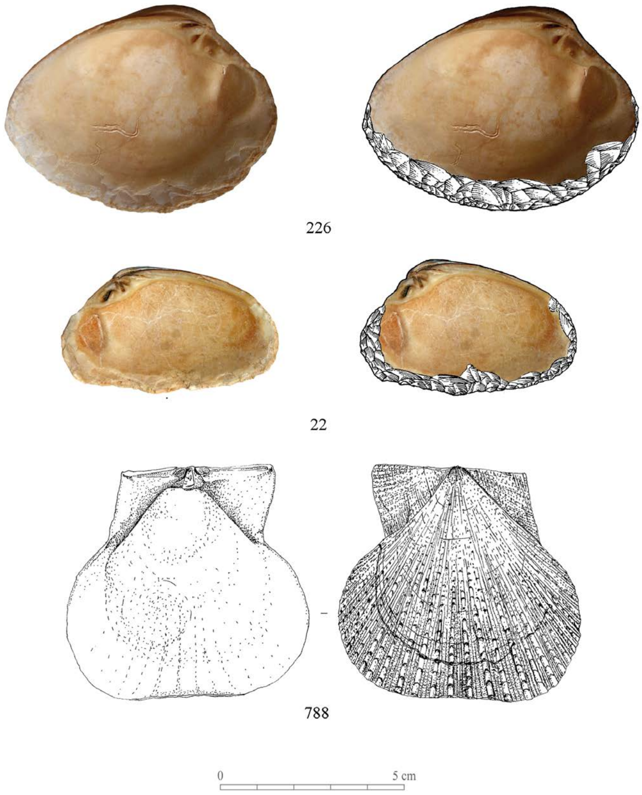


Figure 4.27. Selection of shell tools from UAQ2: retouched *Callista erycina* valves (UAQ2.226, UAQ2.22) and a *Mimachlamys* sp. (UAQ2.788) valve showing a smooth recess on its ventral margin, likely due to its use as a tool. Photos & Drawings: H. David & G. Devilder.

chaîne opératoire and knowledge involved are similar, and the process seems to have been adopted about the same time, by the mid 5th millennium BCE. In the Sultanate of Oman, most Neolithic sites dating from the 5th and 4th millennia BCE have yielded shell fishhooks. However, the earliest potential precursor of a shell hook in Eastern Arabia is reported from the site of Suwayh SWY1, dating to 5300 BCE (Méry and Charpentier 2013: fig. 2). Further potential fishhook preforms date from the end of the 6th millennium BCE at Suwayh SWY11 and Ras al-Hamra RH6 (Biagi 1999; Méry and Charpentier 2013: 75), but no complete specimens have been published so far.

It has often been suggested that the use of mother-of-pearl fishhooks during the Neolithic was linked to tuna fishing (e.g. Charpentier and Méry 1997). However, for UAQ2 there is a lack of direct evidence for this, and no finished hook has been found below Level 7. Tuna fishing remains are only attested in the oldest levels of the site (Chapter 5). Moreover, it should be mentioned that tuna are known to have been caught in large quantities as early as the 6th /beginning of the 5th millennium BCE at Delma and Dosariyah (Lidour and Beech 2019; Uerpmann and Uerpmann 2018) where no fishhooks have been found so far. Their catch is said to be linked to the use of on-board seines in open sea. Such a fishing technique was possible during the Neolithic off the Umm al-Quwain lagoon, both by the inhabitants of Akab and UAQ2. One can therefore think that the fishers from Akab perhaps used both methods – fishhooks and on-board seines (Lidour *et al.* 2020a). No mother-of-pearl fishhook has yet been found at Neolithic sites on the northern and central Arabian Gulf. This absence can be interpreted as a significant cultural feature, as it is linked to one of the most important characteristics of the Neolithic economic sphere in coastal Arabia – fishing.

Other tool kits

K. Lidour, S. Méry

Shell tools

The excavations have produced remarkable quantities of shell tools (N = 171). Initially identified by Glover (1991) at Shimal, by Charpentier *et al.* (2004) at Akab, and in the Ruwayz and Suwayh areas along the Ja'alan coast in the Sultanate of Oman, these types of artefact have been more recently reported from other Neolithic sites within the UAQ coastal area (Méry *et al.* 2019; Degli Esposti *et al.* 2020), as well as from Marawah MR11 (Beech *et al.* 2022) and Ghagha GHG63 (N. Al Hameli, pers. comm.) in the Emirate of Abu Dhabi. Further examples are reported from Ras al-Hamra RH6 (Marcucci *et al.* 2014) and Sharbithat SHA10 (M. P. Maiorano, pers. comm.) in the Sultanate of Oman. Shell tools continue to be used during the Bronze Age and Iron Age at some sites, i.e. Suwayh SWY3, Shimal, and Masafi 5 (Lidour *et al.* 2023b).

The shell tools consist of large valves that show scalar-like retouches along their ventral margin (Figure 4.27: UAQ2.22 and 226). The great majority of the retouched shell valves belong to *Callista erycina* and *Callista umbonella* (previously classified as *Amiantis umbonella*), and less frequently to *Asaphis violascens*. The valves are frequently almost complete, despite a slight reduction of the original volume due to retouch and use-wear. They measure from 5.5 cm - to 9.6 cm in length (average length: 5.9 cm). Among them, 131 were found within the stratigraphy, particularly in the occupation levels from the 6th millennium BCE (Phase B: 61 specimens). They are, however, identified in all the other levels of the site, i.e. 12 in Phase C, seven in Phase D, 13 in Phase E, 38 in Phase F. The decrease in their proportions in the upper levels of UAQ2 is more than likely due to a shift in the mode of occupation of Sectors 1+2 than to a reduction of their use by the site's inhabitants during the 5th millennium BCE. In this sense, it is the tool in hard animal material that is the most frequently encountered at Akab, where 55 specimens have been retrieved (Charpentier and Méry 2008: 127).

A great number of valves show marine erosion and evidence of parasitism of other marine organisms in the inner valve (e.g. shell-boring annelids, barnacle shells, etc.), suggesting that shell collection was mainly conducted among the washed debris in the wrack zone. The retouch is abrupt on the edge of the ventral margin and made by direct percussion (Lidour and Cuenca Solana 2023). It covers almost all the ventral margin, although the use-wear is frequently only identified on a smaller part of it. Left and right valves are almost equally used.

The present assemblage documents a variety of production activities unidentified so far at other Neolithic sites in the Arabian Peninsula. The results of functional analyses have been presented and discussed in Lidour *et al.* (2024). Use-wear analyses highlight their use for butchering tasks, the processing of animal skins, in addition to ochre, woodworking, and the cutting of vegetal fibres (possibly for basketry and making ropes). The evidence of both transversal and longitudinal actions indicates that the shell tools were either used as scrapers or knives. It is possible that shell tools had a complementary function alongside lithic tooling, but this remains to be confirmed by further use-wear analyses.

An assessment of the presence of non-retouched shell tools recovered from UAQ2 still needs to be undertaken. In this sense, *Mimachlamys* sp. valves found in Level 1 of the site show a smoothed surface in the middle of their ventral margin (Figure 4.27: UAQ2.788) – suggesting their use as scraper. Some other large shell valves have been classified as potential tools or small containers: 75 from *Vasticardium lacunosum*, 44 from *Anadara* spp., and seven from *Pecten* sp. These are associated with all the stratified levels at UAQ2. Although from edible species, most of these shells are frequently encountered washed ashore in the UAQ coastal area. Specimens often show marine erosion and do not seem to have been exploited as a source of food on site.

Bone industry

Even though bone tools have been regularly referenced at several other Neolithic sites, bone industry remains quite poorly documented in Eastern Arabia. Most of the bone artefacts consist of simple points: examples are known from as-Sabiyah H3 (Carter and Crawford 2010: fig. 4.8), al-Markh in Bahrain (Roaf 1976: 158), Akab (Charpentier and Méry 2008: 127, fig. 10-11), Ras al-Hamra RH6 (Biagi 1999: fig. 19), Khor Milk KM1 (Uerpmann and Uerpmann 2003: 111, fig. 7.4 n. 6, 10), and at Suwayh SWY2 and SWY11 (Charpentier *et al.* 1998: 30; 2000: 75, fig. 6). More recently, bone foreshafts (more than likely for spears or harpoons) made in worked human bones (ulnae and radii) have been reported from burials at Marawah MR11 Area F. A small bone 'spatula' is also reported from one of the burials – the latter is thought to have been a cosmetic applicator associated with a shell container, but other uses cannot be excluded (Al Hameli *et al.* 2023b).

Richer and more diversified assemblages of bone tools have been recovered at Dosariyah in Eastern Saudi Arabia (Dreschler 2018: chap. 14) and Ras al-Khabbah KHB1 in the Sultanate of Oman (Cavulli *et al.* 2009). The latter assemblages include needles, awls, punches, and, possibly, chisels. Bone needles were also reported at al-Khor in Qatar (Midant-Reynes 1985: fig. 5 n. 8), at Akab (K.L.), and at Ras al-Hamra RH6 (Biagi 1999: fig. 19 n. 28-31). They may have been used both for sewing and net making.

Possible gorge hooks were found at as-Sabiyah H3 (Carter and Crawford: fig. 4.8 n. 7, 10), Ras al-Hamra RH5 (both settlement and graveyard), RH6 (Biagi 1987: fig. 3; 1999: fig. 19 n. 32-41; Salvatori 2007; Marcucci *et al.* 2014: 15-17, fig. 3), Ras al-Khabbah KHB1 (Cavulli and Scaruffi 2012: fig. 11 n. 2), as well as at Ras Dah SM10 on Masirah Island (Charpentier *et al.* 2013). Salvatori (2007: 38-9) has, however, suggested that such bi-pointed tools were used as cosmetic applicators rather than as fishhooks. Biagi (1999: 66), for his part, noticed that the bi-pointed tools found in Eastern Arabia never show characteristic central grooves for attaching the line. At UAQ2, no bone needles or gorges were found, but awls (Figure 4.28). The same type of tool was found, e.g. at Akab (Charpentier and Méry 2008: fig. 9 n. 10-11) and at Dosariyah (Dreschler 2018: fig. 14.1 a-d). At UAQ2, 21 specimens were recovered, coming from Levels 14-11, and 8-5. When recognizable, they are fashioned from the tibia of small ruminants, including sheep (M. Mashkour, pers. comm.) (Figure 4.28: UAQ2.1098 and 1472). They measure from 1.9 cm - 9.5 cm in length, with an average size of 6.2 cm. At UAQ2, awls made of bone could have been used for wood- and leather working.

A unique perforated bone disc (Figure 4.29: UAQ2.555) has been found in Level 8, Sector 1. It measures 82 mm in diameter (7.3 mm thick) and has been shaped from a wild camel scapula – the central hole is *c.* 10 mm wide. The edges have been well rounded, despite some areas being slightly damaged. The inner hole also shows rounding, but extensive sand incrustations mean that we cannot conduct more detailed observations of potential use-wear of the item as a whole. As far as we know, no similar artefact has been found elsewhere in Neolithic Arabia, and many doubts remain as to its specific use. Parallels with other cultures, based on both archaeological and ethnographic data, suggest that it could have been used as a spindle-whorl.

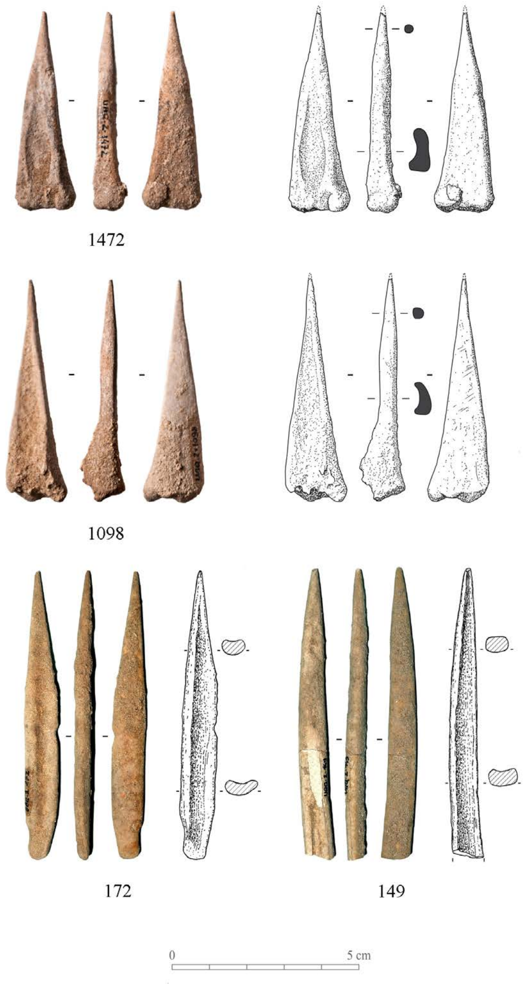


Figure 4.28. Selection of points from UAQ2 made from terrestrial mammal long bone shafts. Photos & Drawings: H. David.

Figure 4.29. Perforated bone disc UAQ2.555, found in Level 8.

Personal adornments

O. Brunet, K. Lidour, S. Méry

A total of 969 personal ornaments were found during the excavations at UAQ2 (Table 4.12). They are mainly (over 97%) composed of beads and pendants. The two latter categories are differentiated by the location of the perforation: transversal for pendants (six items), longitudinal for beads (940 items, among them ten may have been worn as pendants as well). Ornaments also include buttons (two items), earrings (four items), spheres (eight items), and a ring.

Approximately 96% of the objects are produced from marine shell, the rest from stone. Among the marine shells, 60% are made of gastropod and 25% of bivalve shells. Other items are made of segments of tusk shells (Scaphopoda: *Dentalium octangulatum*) and of mother-of-pearl from oyster shells (Pteriidae). Ornaments made of gastropod shells present a great diversity, including at least 11 families. Two families of bivalves and a single family of tusk shells are represented.

Only 32 personal ornaments made of stone were found at UAQ2. Most are classified as softstone or hardstone, the rest are made of beach rock, carnelian, and haematite.

Except for the beads found in the necropolis in the early 1990s (Phillips 2002: 176, figs. 7-8) no remains of bitumen have been found at UAQ2, This material, coming from Mesopotamia (Connan *et al.* 2005: 61), was undoubtedly rare and precious.

Within the most common category – beads and pendants – 70% of the total amounts of personal ornaments are associated with only two families of marine shell: Naticidae and Spondylidae, followed by, per quantity, Conidae/Strombidae, Pisaniidae, and Dentaliidae. The remaining shell families represent less than 5% of the assemblage.

Ornaments are presented according first to the type of object: bead/pendant, button, earring, ring, and sphere. Within this division, artefacts are presented by material: stone or marine shell, then by rock type or taxonomic rank. Some of the stone and shell beads present similar morphologies (spherical, discoidal, tubular).

Beads and pendants

Stone

(Softstone)

The category simply referred to here as softstone (a term used by archaeologists in the Oman Peninsula to describe Prehistoric and Protohistoric soapstone adornments

Table 4.12. Quantities of Neolithic ornaments per material found at UAQ2.

Object	Material	Number		
Beads and pendants	Stone	Haematite		1
		Softstone		9
		Unspecified hardstone		11
	Marine shell	Gastropoda	Pisaniidae: Engina mendicaria	43
			Columbellidae	5
			Conidae or Strombidae	89
			Cypraeidae	2
			Marginellidae: Volvarina monilis	4
			Muricidae	3
			Nassariidae: Nassarius spp.	6
			Naticidae: Polinices mammilla	402
			Neritidae: Nerita sp.	3
			Olividae: Ancilla sp.	20
			Trochidae: Umboniinae	2
			Unidentified gastropod	3
		Bivalvia	Pteriidae: Pinctada spp.	6
			Spondylidae: Spondylus spinosus	239
		Scaphopoda	Dentaliidae: Dentalium octangulatum	91
		Unidentified shell		1
Buttons	Marine shell	Gastropoda	Conidae or Strombidae	1
		Bivalvia	Pteriidae	1
Earrings	Stone	Softstone	3	
		Hardstone	1	
Ring	Marine shell	Gastropod	Unidentified	1
Spheres	Marine shell	Pearl		14
	Stone	Carnelian	1	
		Softstone	6	
		Beachrock	1	
Total				969

and vessels) includes a number of different rock types and designates at least four distinct green rock types by the geologists. Soapstones have a hardness of up to 5 on the Mohs scale and mainly comprise chloritite, steatite, and serpentinite. These rock types are petrographically and chemically different. Without specific laboratory analysis, it is not possible to distinguish between them with certainty, and this is why we prefer here – as archaeologists – to adopt the general term 'softstone'.

The raw material used for the softstone beads recovered at UAQ2 is of good to average quality, depending on the veins from which it was extracted. The colours vary from dark grey to faded green.

Nine softstone beads were found at UAQ2; all but one are discs (I.B.3 morphological type in Brunet 2014: vol. 3 table 8) (Figure 4.30: e.g. UAQ2.2446 and 2782). The outlier is a long tube (type I.D.3 from Brunet 2014) (Figure 4.31: UAQ2.441). These two morphological types gather more than 90% of the Neolithic stone beads published so far in the Oman peninsula and refer to the same predetermined designs and technological schemes: a rough-cut parallelepiped shape is transformed into a cylinder, from which beads are cut out transversally according to the desired length. The main difference between annular and disc shapes involves the sawing of the blank during the final stage of the working process.

At UAQ2, the disc beads measure from 2.8 mm - 4.5 mm in diameter and between 1.5 mm - 2.5 mm in thickness. They are well-knapped and have a regular morphology. In the Sultanate of Oman, the same type of bead is a frequent find, e.g. at al-Haddah BJD1 (Charpentier *et al.* 1997: fig. 5 n. 3-6) and Wadi Shab GAS1 (Tosi and Usai 2003: fig. 10 type B2).

The only tubular bead (UAQ2.441) found at UAQ2 measures 12.8 mm in length and 2.3 mm in diameter, but only half is preserved, and it must have measured

Figure 4.30. Selection of stone adornments from UAQ2: pendants (UAQ2.381, UAQ2.60), disc/circular beads, and a possible preform for disc bead manufacturing (UAQ2.900).

c. 25 mm in length. It is broken in half transversally, where the two drill holes meet. This enables us to see several regular striations, indicating rotary drilling. The softstone tubular beads are numerous at al-Buhais BHS18, where they may form elements of bracelets of long tubular beads, alternating softstone and shell (de Beauclair 2008a: fig. 29). The length of UAQ2.441 is in the range of those from BHS18, but its diameter is smaller than most of them (Kutterer and de Beauclair 2008: 140, fig. 12). Items similar to UAQ2.441 belong to the largest softstone beads found at Wadi Shab GAS1 (Tosi and Usai 2003: fig. 10 type B 1A) and Suwayh SWY2 (Charpentier *et al.* 1998: fig. 10 n. 1-2).

From a stratigraphic point of view, all softstone beads are found in layers from the second half of the 6th millennium BCE and the 5th millennium BCE.

Several softstone objects found at UAQ2 might indicate a local production. UAQ2.827 (Level 8) could be a preform of a pendant, judging from its dimensions (18.5 mm long, 10.7 mm wide, and 6 mm thick) and general shape (oblong form and two flat sides) (Figure 4.31: UAQ2.827). The raw material is of an average quality with a few impurities, and the object shows many knapping traces on its flat surfaces, which are non-abraded. No comparable item has been found at the site. UAQ2.900, found unstratified, is a worked piece (Figure 4.30: UAQ2.900). It has a rough, irregular shape (17.1 mm long, 7.7 mm in width, and 4.1 mm thick), with three intentional perforations (2 mm - 3 mm in diameter). The two perforations visible on the periphery of the object are possibly related to the process of cutting the blank, or to the perforation stage of bead production (this stage frequently causes breakage). The function of a third artefact, UAQ2.1500 (6.8 mm long, 5.5 mm wide, and 4 mm thick), from Level 8, is unknown – could it be a preform? It is difficult to say. It has a rectangular shape with rounded corners, two flattish sides, one of which shows a hollow, and reveals evidence of much knapping and many abrasion traces. Once again, no other object with this same morphology was found on site.

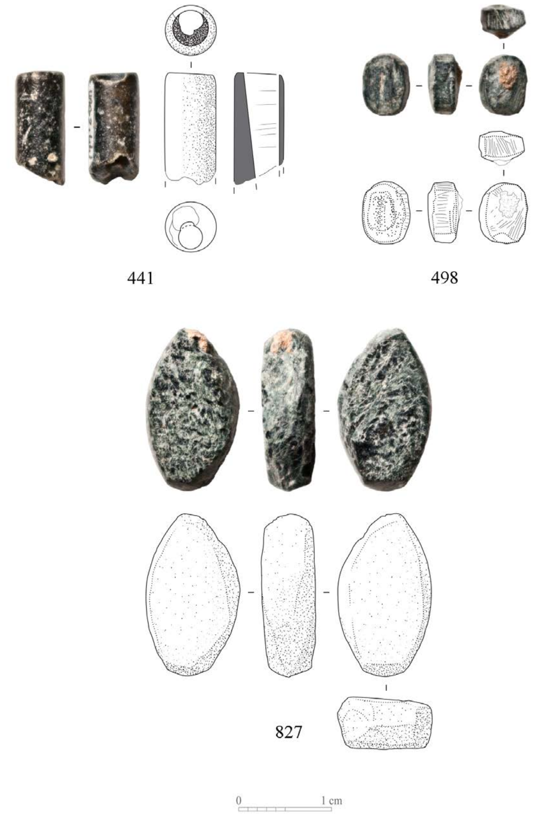


Figure 4.31. Selection of stone adornments (tubular bead and various preforms) from UAQ2. Photos & Drawings: H. David.

Figure 4.32. Massive haematite pendant (UAQ2.2451) and possible preform (UAQ2.2452) from UAQ2. Photos: H. David.

Whatever the function of these objects, their occurrence demonstrates a local softstone production at UAQ2 after the end of the 6th millennium BCE.

(Haematite)

Haematite is a form of mineral iron oxide, black to steely grey; once crushed or abraded into powder it is generally used as a red pigment.

A massive haematite pendant was found in a layer dating from the second half of the 6th millennium BCE (Level 11) (Figure 4.32: UAQ2.2451). It measures 12.8 mm long, 10.4 mm wide, and 2.9 mm thick. It has a rough, flat, elongated rectangular shape with a pointed and a straight extremity. This last extremity shows a rotary drilling perforation. It is the only haematite ornament found at the site. A small fragment of unworked haematite was also found in the same level (Figure 4.32: UAQ2.2452).

(Carnelian)

Carnelian is a microcrystalline quartz rock-type with a hardness of 6.5 to 7 on the Mohs scale. It is a red-orange gemmological (rather than mineralogical) variety of chalcedony that gets its colour from iron oxides. The only carnelian bead (UAQ2.60, barrel-shaped, 10 mm long, and 7 mm in diameter) was found on the surface of the site (Figure 4.30: UAQ2.60). It is not a Neolithic type and has no technological Bronze Age features either, according to O. Brunet, which is why it is not included in Table 4.12.

However, a carnelian sphere was found stratified in Level 11 (UAQ2.171). It is described later with the other spheres found at the site (see below).

(Unspecified hardstone)

Ten disc beads come from a variety of hardstone types and correspond, almost exclusively, to two morphological types – types I.B.1 and I.B.3 – based on the typology of O. Brunet (2014: vol. 3, Table 8), although one example belongs to the type I.B.8. They measure from 3 mm - 4.5 mm in width, and from 0.5 mm - 2 mm thick. Three different materials have been distinguished:

- Two beads were produced from a green and translucent material that is harder than softstone

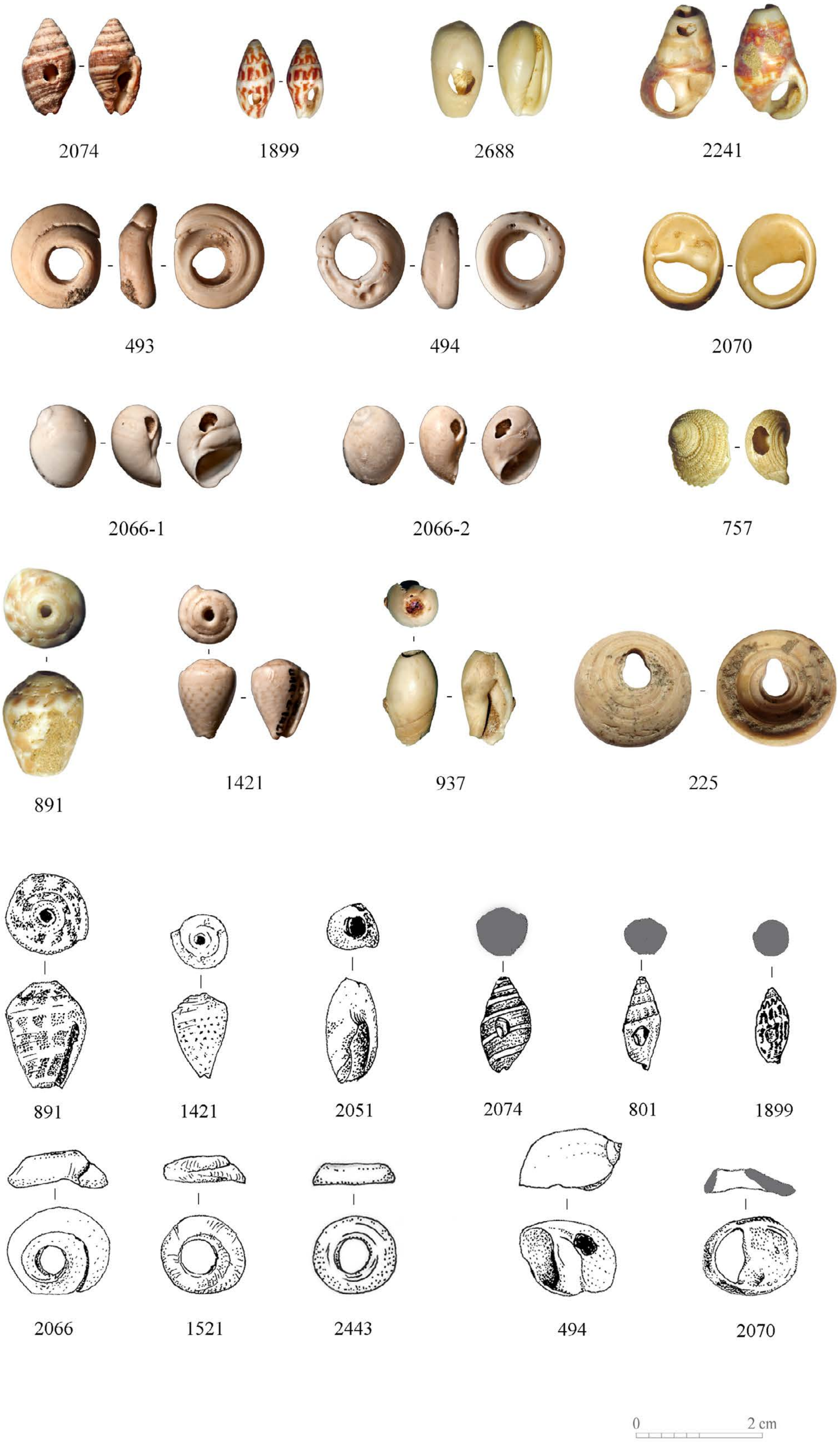


Figure 4.33. Selection of marine shell adornments from UAQ2. Photos: H. David; Drawings: D. Zaros.

(5-6 hardness on the Mohs scale) (Figure 4.30: UAQ2.2446 and 2675). They are regular in shape, well abraded, with a shoulder (or bend) in the perforation indicating bipolar drilling (made from two opposite ends that meet in the middle of the length).

- One bead was produced in good-quality stone, opaque, light brownish-red with dots (Figure 4.30: UAQ2.2664). The stone is macroscopically identical to a material used for beads found at Hili M, from Umm an-Nar period contexts (Early Bronze Age). The UAQ2 bead measures 7.7 mm in diameter and 3.8 mm in thickness. Its unique morphology, type I.B.8, is due to the fact that it is a re-shaped bead which must have measured *c.* 8 mm in length originally, if one considers that the shoulder is located transversally at the middle of the bead. A large perforation (3.5 mm in diameter) is visible on one side; the other side has a larger and flattish truncation, showing a smaller diameter for the perforation (1.7 mm). The shoulder can be observed near the flat truncation.
- The other beads were made from a brown to grey raw material with white veins or black dots on the surface; it is an opaque material, harder than softstone (5-6 hardness on the Mohs scale as well), and showing some impurities. These finds are less well made than the other stone beads; nevertheless, their morphology is generally regular (Figure 4.30: UAQ2.2731 and 2747). Several show an oval transversal profile due to excessive abrasion, the result of knapping accidents or impurities in the stone. A bend is present in the holes, indicating bipolar perforation. Furthermore, concentric striations suggest rotary drilling. The diameters of the perforations vary from 1 mm - 1.5 mm.

One small pendant from Level 13 is made from a light-brown stone with no impurities in the raw material (Figure 4.30: UAQ2.381). The stone is not of good quality, probably coming from a small beach pebble. It is 15.8 long, 12 mm wide, and 4.6 mm thick, with a unipolar perforation of 4.9 mm. It shows several knapping traces due to insufficient abrasion. Two other stone pendants recovered in the UAE have been published so far. The first is a long, oval example recovered by Phillips (2002: fig. 10) during excavations in the 1990s at UAQ2; it shares parallels with finds from the Sultanate of Oman, i.e. the elongated, flat objects interpreted as rhombs (possible musical instruments) by Cleuziou and Tosi (2007: fig. 54). The second is an engraved oval find from Faya FAY-NE15 (Emirate of Sharjah, UAE) (Uerpmann *et al.* 2012: fig. 11 n°10677).

In the stratigraphy, all these items occurred only in layers dated from the second half of the 6th millennium BCE (Levels 11 to 14). Considering the low number of beads produced in these materials, their inferior quality, and the fact that they occur at UAQ2 only during the Neolithic, it is possible that the stones used for the beads, and our pendant UAQ2.381, have a local origin.

Shell

Ornaments made from shell of marine mollusc species were first divided by class (gastropod, bivalve, scaphopod), then by family, and by the lower taxonomic rank, when possible. Determination of genus or species was not always possible (Table 4.12).

(Pisaniidae)

At UAQ2, this family only comprises the bumblebee snail *Engina mendicaria* (Figure 4.33: e.g. UAQ2.2074). When alive, this small gastropod has a yellow and black shell with an elongated whorl. The natural ornamental features of this shell (bicoloured and with a striped pattern) most probably played a major role in its selection. Due to physico-chemical alteration, archaeological *Engina mendicaria* beads found at UAQ2 show alternate white and brown stripes.

43 beads were found in Levels 3 and 5-14, thus covering almost all the stratigraphy, but more than half come from layers associated with the second half of the 6th millennium BCE (Levels 9-14). Only one unperforated *Engina mendicaria* was recovered, in Level 14, suggesting possible bead manufacture at the site.

The beads are made using the whole shell; their lengths vary from 7.1 mm - 16.8 mm and their diameters from 6 mm - 10.1 mm, with no preferential size observed. Only the last whorl of the shells has a pecked perforation opposed to its aperture. Perforation diameters vary from 1.2 mm - 3.3 mm, with shapes more oval than circular. Perforation by picketing is not usually followed by an abrasion of the edge. One bead (UAQ2.893) has two perforations; another shows the beginning of a perforation, confirming local production on site (Figure 4.34: UAQ2.2079).

A number of examples have been previously recorded in 5th-millennium BCE contexts at Akab (Charpentier and Méry 2008: fig. 9 n. 5) and in contexts dated from the 6th millennium BCE at UAQ38 (Degli Esposti *et al.* 2020: fig. 11.b). Further specimens are reported at Faya FAY-NE15 (Uerpmann *et al.* 2012: fig. 10), and al-Buhais BHS18 (de Beauclair 2008a: tab. 1). The beads reported from Delma DLM19 (previously DA11) (Beech *et al.* 2016: 14) are likely belonging to *Cerithium caeruleum* (K.L.). At BHS18, the *Engina mendicaria* beads represent 10% of the total of the 5116 pierced gastropods, whereas at FAY-NE15 they represent 4.8% of a total of 272 (based on the data published by de Beauclair 2008a: tab. 1 and by Kutterer and de Beauclair 2008: tab. 1). At Buhais BHS18, two sizes

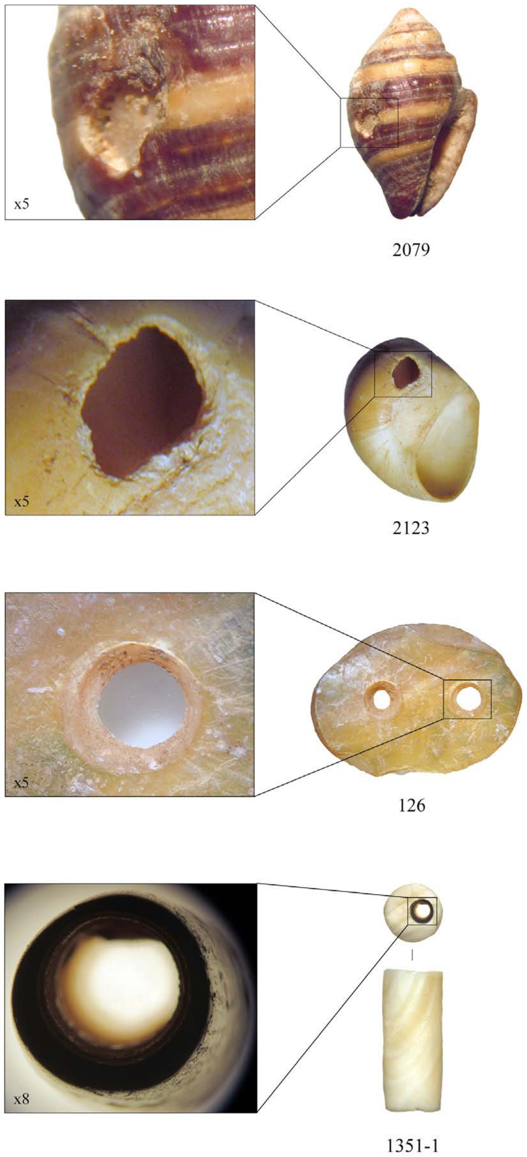


Figure 4.34. Details of marine shell ornament manufacturing (by O. Brunet).

were noticed, *c.* 6.5 and 9.7 mm, indicating a selection of natural shells (de Beauclair 2005: 14).

In the Sultanate of Oman, they represent half of all the ornaments of al-Haddah BJD1 (Charpentier *et al.* 1997: fig. 5 n. 19-23) and dominate at Suwayh SWY1 (Charpentier *et al.* 2003: 17). They are attested at Suwayh SWY2 (Charpentier *et al.* 1998: 31), Suwayh SWY11 in Levels 1, 4, 5, and 7 (Charpentier *et al.* 2000: 75), Suwayh SWY20 (Charpentier *et al.* 2012b: 60), Ras Jibsh Trench 2 (Charpentier *et al.* 2012b: 65), Ras Dah on Masirah Island (Charpentier *et al.* 2013: fig. 4 n. 6), and Ras al-Hamra RH6 during the periods 3, 5, and 6 (Marcucci *et al.* 2014). They are also found at Dosariyah, and considered there as revealing contacts with Southeast Arabia (Drechsler 2018: 323, fig. 15.5 c-d).

The precise geographical repartition of *Engina mendicaria* southwest of the Strait of Hormuz has probably yet to be completed, despite the huge contribution of Bosch *et al.* (1995: 23, 128 n. 522), in which they are mentioned as being associated with the Gulf of Oman, not the Arabian Gulf. It would seem that they are not currently found in the UAQ coastal area. Their recurrent presence at UAQ2, assuming that *Engina mendicaria* was not available locally during the Neolithic, could have been the result of gatherings during distant expeditions, or exchange with other coastal communities.

(Columbellidae)

Five ornaments made of Columbellidae shells were discovered at UAQ2 (Figure 4.33: e.g. UAQ2.801 and 1899). They measure from 5.4 mm - 15.8 mm in length, with widths between 5 mm - 6.4 mm. The working process simply consists of making a hole by picketing in the larger part of body whorl of the shell; the object was probably worn as a pendant. Examples were found in layers dated from the 5th millennium BCE (Levels 3-8).

(Conidae or Strombidae)

Conidae and Strombidae are two families of gastropods, featuring a trunconic cone shape with a large aperture. Strombidae shells (especially *Conomurex persicus* shells) are distinguished by a longer apex. Both are treated together here, because they are similar both in their general spiral shape and in the potential working processes used to transform them into ornaments (Figure 4.33: e.g. UAQ2.493, 494, 2066, 1521, 2443 are made in *Conomurex persicus* apexes – UAQ2.225 is made in a Conidae apex). At UAQ2, Strombidae were mainly discovered in Levels 9-13, including 33 beads found together as a necklace (Level 11). Another whorl bead from a large Conidae, with a natural smooth apex, has been recovered in Level 12 (Sector 1). It shows a trace likely left by a thread (Figure 4.33: UAQ2.225).

A total of 82 whorl beads of the same type were found at UAQ2: one was recovered on the surface, the others were stratified within the settlement. An adornment (bracelet or necklace) comprising 34 of these beads was found in Level 11 (square A2). They are oval in shape, rarely circular, and slightly truncated cone-shaped; they measure from 4 mm - 24 mm in diameter, with thicknesses between 1.2 mm - 13.8 mm. However, over 90% of them have a more standard size with lengths ranging between 10 mm - 20 mm and thicknesses between 2 mm - 7 mm. Although the apex is frequently found detached from the remaining

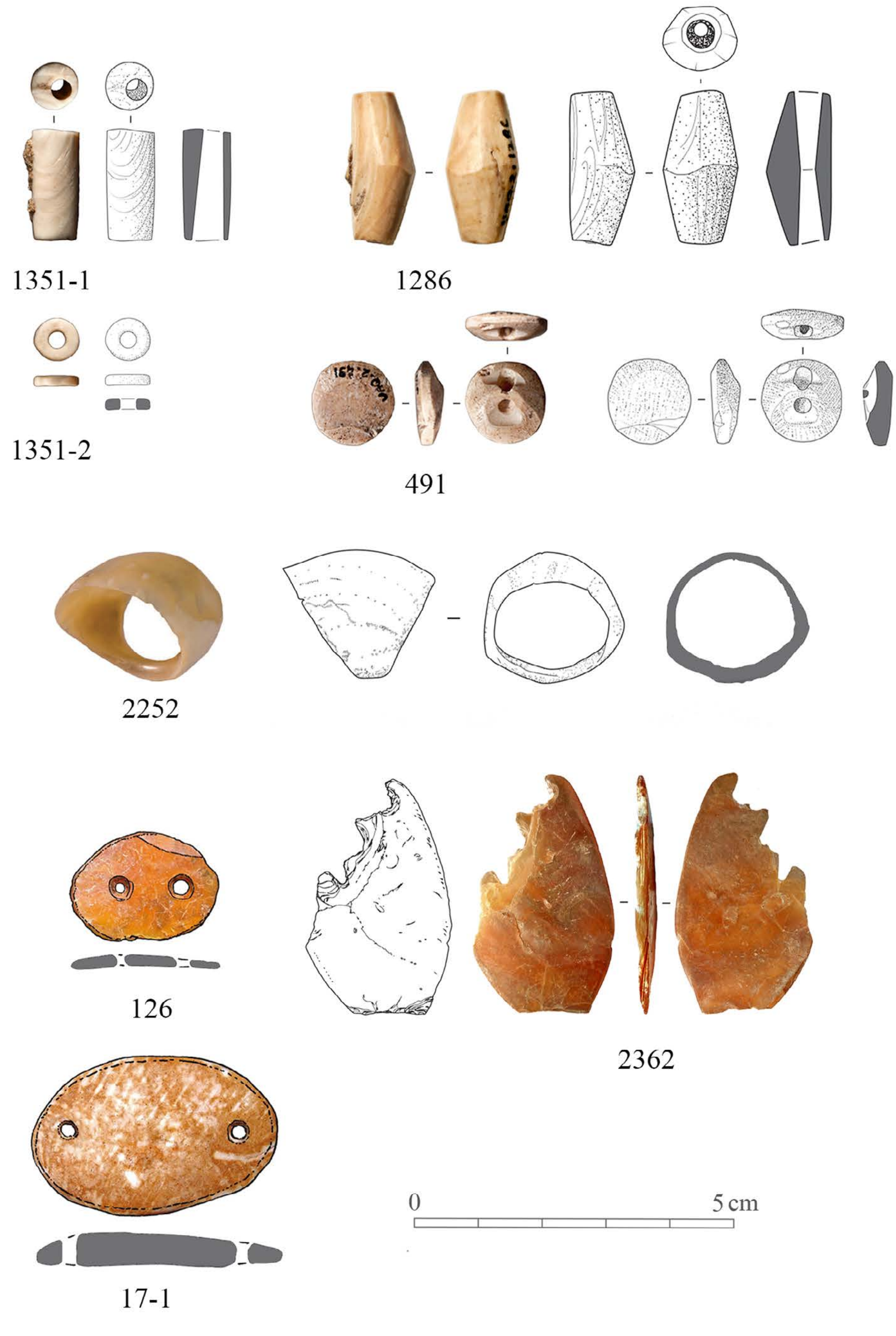


Figure 4.35. Selection of marine shell adornments from UAQ2. Photos & Drawings: H. David.

part of the shell on material found washed up on the shore, the potential working process of this category of bead would comprise sawing the spire and taking off the apex. The final product could thus have been worn as part of a necklace, but several beads, such as UAQ2.2055, show additional perforations on the side, perhaps to be worn differently or sewn on a textile.

The same type of bead occurs, for example, at Bahra 1 in Kuwait (Reiche 2015) and at al-Haddah BJD1 in the Sultanate of Oman (Charpentier *et al.* 1997: fig. 5 n. 12-13). Further specimens have been reported at the neighbouring 6th-millennium BCE site of UAQ38 (Degli Esposti *et al.* 2020: fig. 11.a).

Two other beads are large and made of the whole shell, their apexes being only perforated. One is a *Conus ebraeus*

(Figure 4.33: UAQ2.891), a species not reported as living in the Arabian Gulf (Coomans *et al.* 1986: 94), but only encountered in the Masirah vicinity and in the Gulf of Oman, according to Bosch *et al.* (1995: 159 n. 697). This implies it was obtained from a region located several hundreds of kilometres away. Thus, it was the result of a series of exchanges. The other specimen is a *Conus betulinus* (Figure 4.33: UAQ2.1421). As with UAQ2.891, only the summit of its apex is perforated, by picking, leaving small marks. This species is reported by Bosch *et al.* (1995: 158 n. 691) in the Arabian Gulf.

Four other beads, in the shape of small discs, complete this assemblage (UAQ2.68, UAQ2.2400, UAQ2.2665, UAQ2.2968). Diameters range from between 3.4 mm - 4 mm and thicknesses between 1 mm - 1.2 mm. This type of bead is recorded at al-Haddah BJD1, for example (Charpentier *et al.* 1997: fig. 5 n. 8-11), where their diameters measure from 4.5 mm - 6 mm. Comparable beads have been recorded from Marawah MR11 (Beech *et al.* 2022: fig. 8 n. 4).

(Cypraeidae)

Two ornaments from cowry shells (Cypraeidae) were found at UAQ2, dating from the second half of the 6th millennium BCE (Levels 11 and 14). Cowry shells are rounded with no visible spire on their apical side. On the ventral face, their aperture is elongated, narrow, and lined with small denticulations. To transform them into an ornament, craftsmen sawed the shells transversally, removing the apical part. They were worn as pendants.

These artefacts are among the largest ornaments found since 2011 at the site (UAQ2.1024 is 43 mm long and 25 mm wide, UAQ2.1718 is 44.7 mm by 28.6 mm), but another pendant, *c.* 65 mm long, and a further fragment (> 40 mm) of a shell bracelet (not a Conidae or Strombidae but a bivalve, based on the photo) were recovered at the beginning of the 1990s by Phillips (2002: fig. 9-10).

A single pierced Cypraeidae is recorded at FAY-NE15 (Uerpmann *et al.* 2012: 396) and two pendants, identified as *Naria turdus* were recovered at Dosariyah (Drechsler 2018: 322, fig. 15.5 m-n).

(Marginellidae)

Four *Volvarina monilis* finished pendants have been found (Figure 4.33: UAQ2.2688) in the same area and layer (Sector 2, Level 12), except for one. They measure from 11 mm - 12.9 mm long, with diameters between 5.6 mm - 8.7 mm. This gastropod can be found in the Gulf of Oman (Bosch *et al.* 1995: 147). The shell is typically pierced on the body whorl, allowing it to be worn as a pendant. Considering its aspect, the perforation was probably the result of picketing rather than rotary drilling.

Marginellidae beads are known at al-Buhais BHS18 (de Beauclair 2008b: tab. 2) and in the Sultanate of Oman (Charpentier *et al.* 2003: 17), however, in the absence of published photos, we are uncertain whether *Volvarina monilis* are attested.

(Muricidae)

Three beads from Muricidae shells were found at UAQ2, but unstratified (Figure 4.35: UAQ2.1286, 1351.1-2). The gastropods belonging to this family generally have spiral shells, showing a large aperture and prominent sculptures. One is a disc (UAQ2.1351.2), another is tubular (UAQ2.1351.1), and the third is biconical (UAQ2.1286). They were all well knapped and abraded, showing a very regular morphology.

The tubular bead (I.D.3 shape based on Brunet 2014: vol. 3, Table 8), is large: 15 mm long and 6.6 mm in width. It was probably broken during its knapping and shows a large perforation (4.4 mm) on one side, and on the other a narrower perforation (2.7 mm) with a non-straight/flat extremity. The bead was drilled by bipolar rotary drilling, as shown by the concentric striations (Figure 4.34: UAQ2.1351.1). It was found on the surface of the site, as was the disc bead, but it is highly probable that both belong to the Neolithic, considering the preferential use of Muricidae shells during this period.

The biconical bead was associated with Levels 9-12 and measures 21 mm long, with a diameter of 9 mm. It also shows bipolar rotary drilling, and its morphology, biconical, required more advanced skills and know-how than is required to produce the Muricidae tubular beads. In the Oman Peninsula, it is the oldest and, so far, only bead of morphological type I.D.4, using Brunet's typology (2014: vol. 3, Table 8). Biconical beads were previously unreported before the Bronze Age (Hafit period), such as several hard stone beads of agate and carnelian from Tawi Silaim I and Jebel al-Emalah (de Cardi *et al.* 1977: fig. 4.5; Brunet 2014: vol. 3, pl. 41 fig. 14, pl. 43 fig. 11).

No tubular shell beads of the very frequent type at al-Buhais BHS18 and Faya FAY-NE15 (de Beauclair *et al.* 2006; fig. 7; Uerpmann *et al.* 2012: fig. 10), or the Akab tubular type (Charpentier and Méry 2008: 130, fig. 16.1), have been recovered at UAQ2.

(Nassariidae)

Six ornaments were produced from Nassariidae shells, which have an elongated spire showing prominent sculptures and frequently colourful patterns (e.g. purple, yellow). The items measure from 18 mm - 22 mm long, with diameters of 9.7 mm - 13.2 mm. They come from Levels 8-13. *Nassarius* spp. beads are known at other sites in the Oman Peninsula, e.g. al-Haddah BJD1, where they are represented in limited quantities (Charpentier *et al.* 1997: fig. 5 n. 8).

Artefacts UAQ2.1567, 2240, and 2241 were worn as pendants. The working process includes first taking off the apex, thus forming the first hole. A second hole is then pierced by picketing into the larger part of the body whorl of the shell (and was not abraded in the case of UAQ2.2241).

(Naticidae)

At UAQ2, Naticidae are only represented by *Polinices mammilla*, a globular gastropod shell with a wide, semi-lunar aperture (Figure 4.33: e.g. UAQ2.494, 2066.1-2).

A total of 402 beads, made of the whole shell, makes this species by far the one most selected for ornaments at the site. To wear the shell as a bead, the only working process required is the picketing of the apex. Considering the shape of the shell, and the location of its piercing, the perforation is bent. The picketing is quite sloppy, and undertaken not always successfully: it is not abraded and often shows an irregular shape (Figure 4.34: UAQ2.2123).

A great diversity in bead size is noticed (bead length: 4.7 m - 26 mm, bead diameter:3.8 mm - 16.8 mm, perforation diameter: 0.8 mm - 3.7 mm), pointing to a lack of selection during gathering. The diameter of pecked holes is proportional to the size of the shells.

The beads come from all the levels, except Level 3, but are rare in the earliest levels (8 beads in Levels 1-5), and they are very abundant in the oldest levels (Levels 9-14 produced 65% of the finds). They were all found isolated except for ten, these latter forming the elements of a hip adornment on skeleton E (Tomb 2), from the graveyard (Sector 5) associated with Level 14.

Polinices mammilla beads are found at other sites in the UAE, i.e. al-Buhais BHS18 (where more than 40 unpierced shells were found, see de Beauclair 2005: 14) and Faya FAY-NE15 (Uerpmann 2003: fig. 3; Kutterer and de Beauclair 2008: fig. 10), and represent the main species among beads at Suwayh SWY1 (Charpentier *et al.* 2003: 17). They represent 8% of the 5116 pierced gastropods at al-Buhais BHS18 and 4.8% of the 272 from Faya FAY-NE15 (based on the quantities published in de Beauclair 2008a: tab. 1 and Uerpmann *et al.* 2012: fig. 10). Specimens have also been found at the neighbouring site of UAQ38 (Degli Esposti *et al.* 2020: fig. 11.c).

(Neritidae)

Only three *Nerita* spp. shells have been found at UAQ2, two transformed into ornaments. These gastropod shells are a semi-lunar globular type, quite large. The aperture is slightly serrated, and also semi-lunar. The perforation pecked through the apex allows the passing of a thread transversally so the ornament can be worn as a pendant (Figure 4.33: e.g. UAQ2.2070). The abrasion of UAQ2.2069 perforation is incomplete; but the whole globular body whorl of UAQ2.2070 was sawed and abraded so that only the internal wall was selected, indicating more developed skills. The abrasion phase was executed perfectly, so as to obtain a flat oval pendant. Found in a layer dated from the end of the 6th millennium BCE (Level 10), the two beads measure 14.8 mm and 16.9 mm diameter, with thicknesses of 12.8 mm and 13.6 mm respectively.

According to Bosch *et al.* (1995: 43), the distribution of the Neritidae is vast, being mainly intertidal on rocks. Does their rarity at UAQ2 reveal that they were not local, or at least difficult to find locally? It is not possible to answer at this stage. An unworked complete shell (UAQ2.958) was discovered in a more recent layer (Level 6) than the two beads.

A small quantity of Nerita spp. was also found at al-Buhais BHS18, among them some unpierced shells (de Beauclair 2005: 15). Neritidae were identified at Dosariyah (Drechsler 2018: fig. 15.5 o-p), although the perforation is located differently on the apex of the shell.

(Olividae)

20 beads made of *Ancilla* spp. shells were found at UAQ2. These gastropods have an elongated, olive-shape shell (close to Brunet's (2014) I.D.1 shape), with a short and smooth apex. UAQ2 specimens have white and brown stripes on their spire. Their working process implies taking off the apex (Figure 4.33: e.g. UAQ2.937 and 2051). In this way a tiny, 1 mm - 1.5 mm, diameter perforation is obtained, and the hole is then usually slightly abraded. Only one example shows a perforation on its spire (UAQ2.2688). An intact *Ancilla* sp. has been also found unworked, suggesting the possible close origin of the shell and a local production of ornaments.

Beads are 6.4 mm - 18.2 mm in length and 3.2 mm - 9.8 mm wide. The sizes of shells selected for the UAQ2 beads are similar to beads we know from al-Buhais BHS18, and larger than those from Faya FAY-NE15 (Kutterer and de Beauclair 2008: fig. 9).

At UAQ2, the Olividae beads are associated with the main part of the stratigraphy (Levels 6-12). They are clearly under-represented at UAQ2 compared to BHS18, where they make up 75% of the shell assemblage (3902 *Ancilla* cf. *farsania* from a total of 5245 shell beads, de Beauclair 2008a: table 1), or to FAY-NE15 (Uerpmann *et al.* 2012: 395, fig. 10). The discovery of *Ancilla* sp. beads is cited at the Akab settlement (Charpentier and Méry 2008: 127), as well as at UAQ38 (Degli Esposti *et al.* 2020: fig. 11.d).

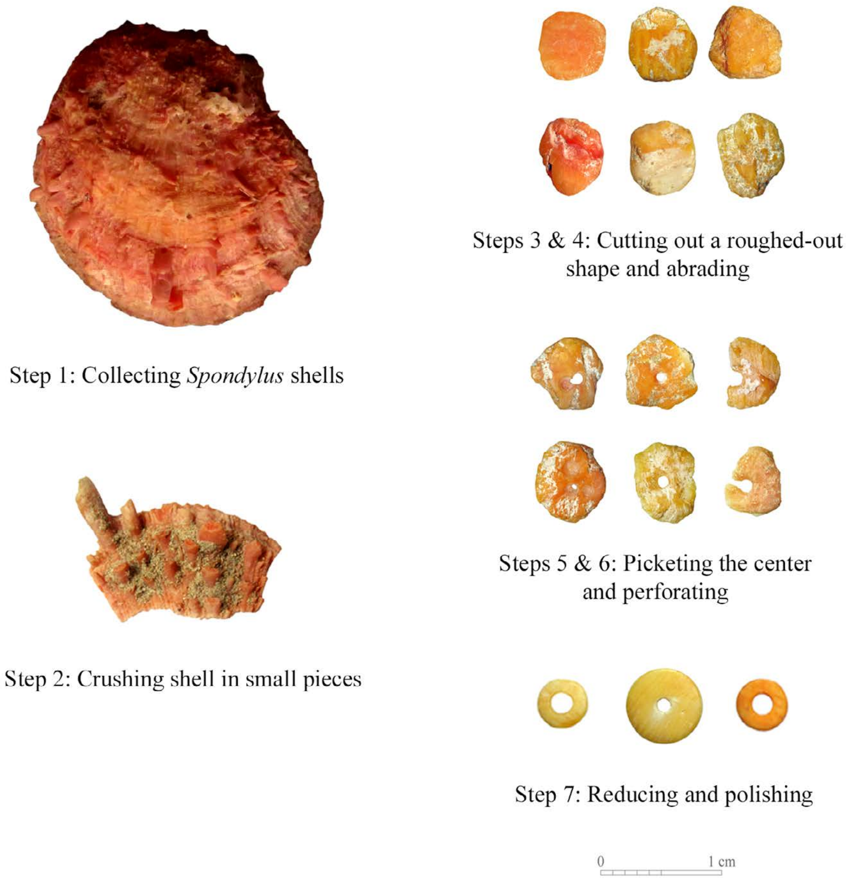


Figure 4.36. 'Chaîne opératoire' of the manufacture of *Spondylus spinosus* shell disc beads.

(Trochidae)

Only two ornaments made of Umboniinae shells were found. Umboniinae have a globular body whorl, showing several deep sutures on its spire. These beads measure, respectively, 11.4 mm and 12 mm wide, with thicknesses of *c.* 8 mm. The working process consists of picketing the body whorl to make a hole (Figure 4.33: e.g. UAQ2.757). This operation was carried out relatively well for one of the beads, but less successfully done for UAQ2.1175, i.e. the piercing is very wide compared to the body size (2.9 mm diameter). One of the ornaments was found in a layer dating back to the 5th millennium BCE (Level 7).

(Pteriidae)

Five beads and a pendant made of *Pinctada* spp. shells were found at UAQ2. It is worth noting that these shells are not only used to produce ornament but also fishhooks, with known examples at UAQ2. Today, pearl oysters occur in large amounts in the Arabian Gulf (Bosch *et al.* 2008: 220) and the procurement of *Pinctada* shells does not seem to have been difficult during the Neolithic, i.e. they are found used at several sites from Kuwait to the UAE.

The beads have diameters from 4.2 mm - 6 mm and vary in thickness from 0.3 mm to 1 mm. They are translucent, of a regular I.B.3 form (Brunet 2014), well executed, with a circular perforation. One of the beads was found on the surface, whereas all the others come from layers dating from the second half of the 6th (Levels 11-14) to the 5th millennium BCE (Levels 5, 7, and 8). Remains from every stage of the working process of *Pinctada* beads have been also found, allowing its reconstitution. Following their collection, the fresh shells were emptied and crushed into pieces. Fragments were most probably pierced by rotary drilling, then abraded, as suggested by the finding of a perforated, non-abraded pierced bead (UAQ2.125). Further disc beads made from *Pinctada* shells have been found at Akab (Charpentier and Méry 2008: 127) and UAQ38 (Degli Esposti *et al.* 2020: fig. 12.g-k).

Pendant UAQ2.2362 was found at the foot of a skeleton (E) in the necropolis (Figure 4.35: UAQ2.2362). Its working

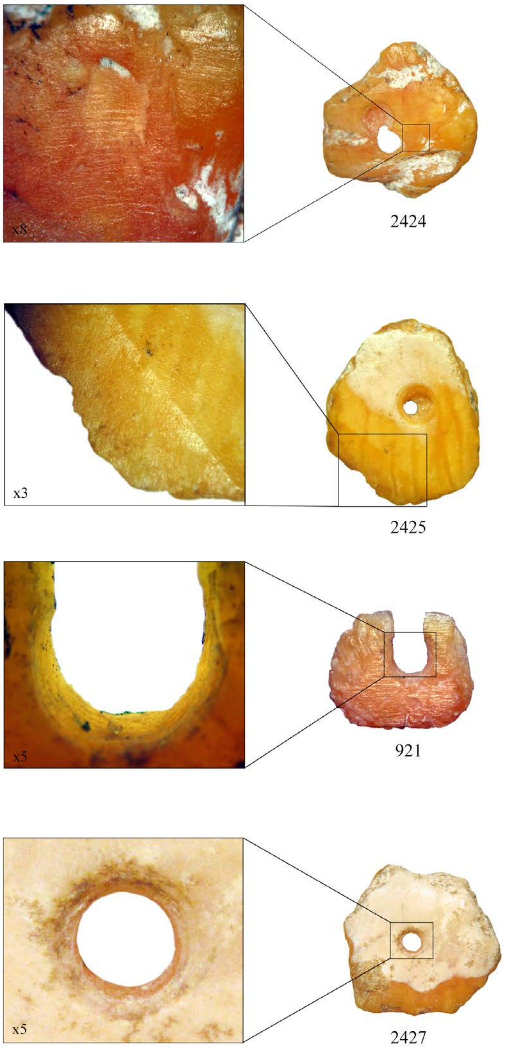


Figure 4.37. Details of the spondyle disc bead manufacturing process (by O. Brunet).

process is similar to that adopted for beads. With a length of 41.2 mm and a width of 23.7 mm, this artefact has a flat, ellipsoidal shape. One of its extremities is straight and abraded, the other is missing, thus denoting its value to UAQ2 inhabitants, who selected a broken artefact to accompany the deceased in the grave. It is one of the oldest specimens of mother-of-pearl pendant found so far in Arabia, together with those of UAQ38 (Degli Esposti 2020: fig. 10) and al-Buhais BHS18 (de Beauclair *et al.* 2006: fig. 6).

(Spondylidae)

239 *Spondylus* beads have been found, slightly less than the total number of *Polinices mammilla* beads. As many were burnt, or had lost their natural colour, their identification was sometimes difficult. *Spondylus spinosus* shells are easily found washed up on the shores of the Arabian Gulf (Bosch *et al.* 1995: 233), and broken shells are frequently found in the area of Umm al-Quwain (on exposed sandy shores). The shell of this species is orange, red, or purple in colour on the external sides. The valves have long and spiny tubercles which are frequently broken or smoothed down by marine erosion after the molluscs have died.

Approximately 50 blanks and unfinished beads (abraded or non-abraded discs with a beginning of perforation, non-abraded perforated items, perforation accidents, polishing accidents) have been found at UAQ2. In all but one instance, no specialised area to produce the beads was identified, although small concentrations of both unfinished and finished artefacts were observed here and there. The concentration of ten abraded discs found together in one of the oldest layers of the site (Concentration C27, in Level 13, step 4 of the working process, see below) suggests the only area where a bead workshop might be hypothesised (Figure 1.56).

Every stage of the working process is represented on the site (Figure 4.36), permitting its full restitution:

1. Collecting natural *Spondylus* shells.
2. Crushing shells into small pieces.
3. Cutting out a roughed-out shape/blank.
4. Creating blanks (abraded discs).
5. Picketing the centre of the discs with a stone or bone tool to prepare the drilling and avoid the slipping of the drill tip. It creates a concave surface with traces of micro-impacts (still partly visible after stage 6 around the perforation).
6. Perforating the discs with a stone tool, perhaps the most delicate step, during which many breakages happen (Figure 4.36: Steps 5 and 6; Figure 4.37: UAQ2.921). Usually bipolar, the perforation diameters vary from 0.5 mm - 1.8 mm. Concentric striations are present inside, indicating rotary drilling, probably mechanical when considering the regularity of the striations (Figure 4.37: UAQ2.2427). Many specimens are broken during this stage (e.g. at Akab, see Charpentier and Méry 2008).
7. Polishing the edges of the beads.

In between all these steps, the shell is regularly abraded (Figure 4.37: UAQ2.2424-5). The beads have a standardised size, with over 90% of them having diameters between 2.5 mm - 5 mm, and thicknesses of between 0.5 mm - 2 mm. The largest bead is 8.5 mm in diameter.

The UAQ2 beads were thus produced according to the technique identified at Akab (Charpentier and Méry 2008: fig. 14) and as-Sabiyah H3 (Carter and Crawford 2010: 70-71): by cutting a piece ('contour'), dot-hammering, perforation, and then abrasion. Compared to this site, the amount of waste produced by the working of *Spondylus* shell is rather low at UAQ2. It reinforces the hypothesis of a specialised production site at Akab (Charpentier and Méry 2008: 129). Evidence of bead production is also documented at UAQ38 (Degli Esposti *et al.* 2020: fig. 12. a-e), Dosariyah (Drechsler 2018: fig. 15.4 g and 15.10).

(Dentaliidae)

41 beads of Dentaliidae were found at UAQ2, and 50 tiny, barrel-shaped beads, identified as also belonging to the same taxa.

As other Scaphopoda, Dentaliidae have very distinctive tusk-like shells which are conical and more or less curved. They can be found both in the Arabian and Oman gulfs (Bosch *et al.* 2008: 186-7) and are commonly encountered on exposed sandy beaches in the Umm al-Quwain area. In the assemblage of UAQ2, only the *Dentalium octangulatum* beads are easily recognisable due to their octagonal section. Some other examples (e.g. UAQ2.1920 or UAQ2.774) show a natural transversal groove.

The surface of some beads – often the smallest ones – is naturally eroded (smoothed edge), indicating that the shells were exposed for longer on the beach before being collected.

The shells were broken or sawed (Figure 4.38). The sawing of each extremity was well executed, with a few exceptions (e.g. UAQ2.806 and UAQ2.1131). At UAQ2, there is a wide range among the 41 beads of Dentaliidae, from 1.5 mm - 26.1 mm long, but a majority (60%) measure less than 5 mm, indicating a size standardisation. The (natural) diameters are between 2.2 mm and 4.4 mm. The 50 tiny, barrel-shaped beads are also standardised in shape: with a natural diameter between 3 mm - 7.1 mm, they are from 3 mm - 5.5 mm long.

Dentaliidae beads were found in almost all layers (Levels 2-14), in more or less equal quantities per layer (three on average). They are found at other Neolithic sites in the Oman Peninsula, for example at UAQ38 (Degli Esposti *et al.* 2020: fig. 12.f), Suwayh SWY1 (Charpentier *et al.* 2003: 17), and al-Haddah BJD1 (Charpentier *et al.* 1997: fig. 5 n. 17). They are the most numerous shell bead type at Khor in Qatar (Midant-Reynes 1985: tab. 3). Interestingly, they are absent at al-Buhais BHS18 and Faya FAY-NE15 (Uerpmann *et al.* 2012: 396).

Shell buttons

Three buttons of different morphological types, but all in shell, were found in the oldest layers. These artefacts are generally interpreted as potentially sewn on textile.

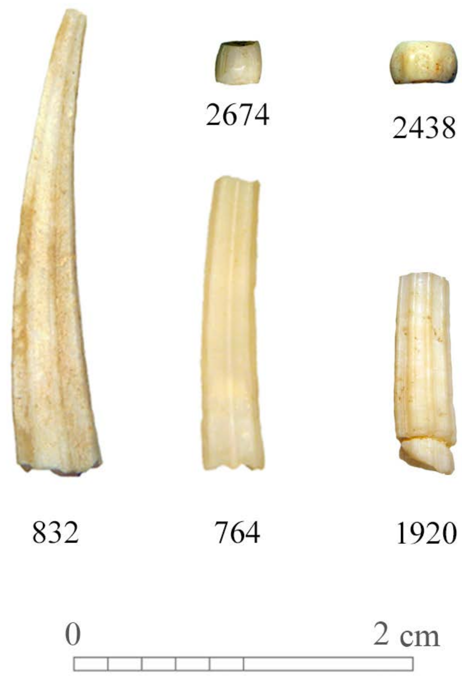


Figure 4.38. Selection of tusk shell (*Dentalium octangulatum*) beads from UAQ2. UAQ2.2674 and UAQ2.2438 are smoothed.

The first specimen (UAQ2.0126), made of *Pinctada persica* shell, was well knapped and abraded. It has a quite regular morphology, flat and oval (24 mm long, 18 mm wide, and 1 mm thick). Two unipolar perforations are in the middle of the surface: one is of 2.5 mm diameter while the other is of 2.2 mm (Figure 4.34: UAQ2.126). The second button UAQ2.17-1 is almost twice the size. Comparable artefacts were found at contemporaneous sites, e.g. Marawah MR11 Area A (MR11.228, MR11.119, MR11.1730) (Beech *et al.* 2005: 49, fig. 12; 2022: fig. 8 n.1), at al-Buhais BHS18 (de Beauclair 2005: 39), Khor in Qatar (Midant-Reynes 1985: pl. II.5-6; Nayeem 1998: 215), and at as-Sabiyah H3 in Kuwait (Carter and Crawford 2010: fig. 4.3).

Another type was found at UAQ2 (Figure 4.35: UAQ2.491), made from Conidae shell. It measures 11.8 mm wide and 3.8 mm thick and has a circular shape, with a flat side and a concave opposite side which shows a bent perforation. Its morphology is not very regular and displays several knapping traces.

Stone earrings

Four stone earrings were found, three in softstone (Figure 4.39: UAQ2.979, UAQ2.2022, UAQ2.2023), and one in a harder unknown stone material that was polished

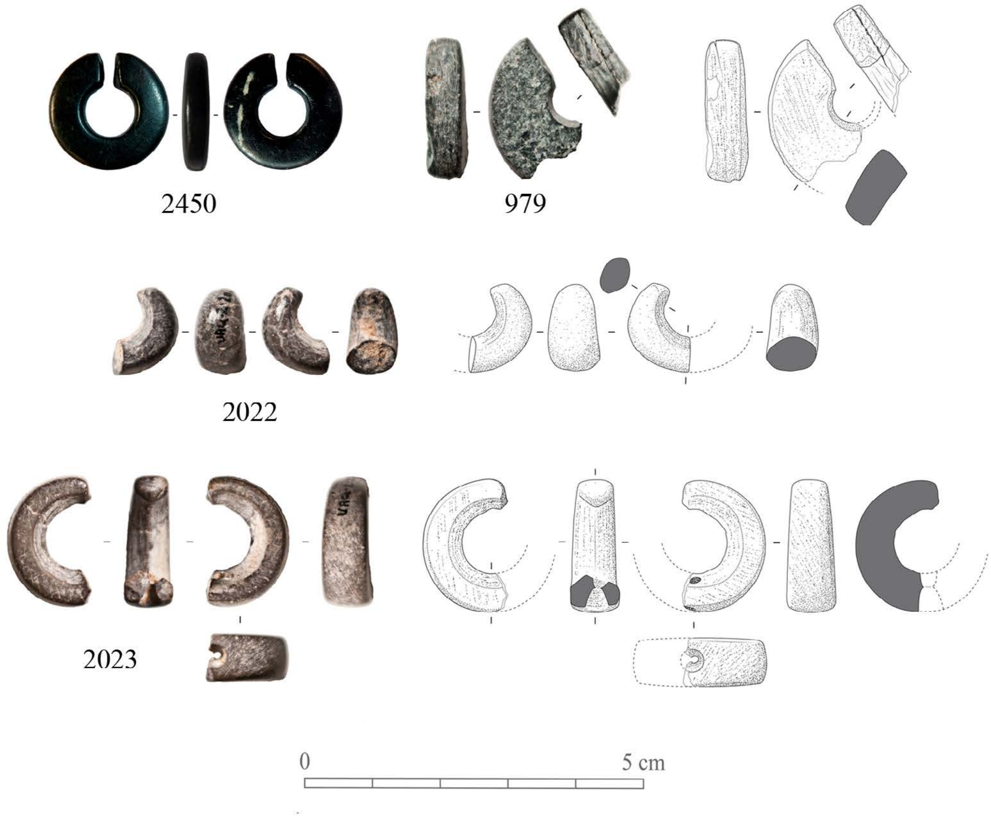


Figure 4.39. Stone earrings from UAQ2: UAQ2.2450 (Level 14), UAQ2.979 (Level 7), UAQ2.2022, and UAQ2.2023 (Levels 4–5). Photos & Drawings: H. David.

(Figure 4.39: UAQ2.2450). They are ring-shaped with a gap to go through the earlobe. All have a different width and except for UAQ2.2450 they are broken. Two examples (UAQ2.2022 and UAQ2.2023) have a bipolar perforation and it was probably also the case for UAQ2.979. The earrings have a rectangular transversal profile, sometimes plano-convex, except UAQ2.2022, which has a rounded shape. Thicknesses are between 5.5 mm - 6.1 mm. The examples found at UAQ2 are undecorated, except for UAQ2.2023, which shows a small, bipolar perforation the purpose of which appears to have been aesthetic rather than functional. Being perfectly aligned with the general shape of the object, and considering the position of the perforation, it was made with a maximum 9 mm-long tool, the use of which requires some skill. UAQ2.2450 was found in a layer dated from the 6th millennium BCE (Level 11) and UAQ2.979 comes from a layer from the 5th millennium BCE (Level 7). UAQ2.2022 and 2023 are both dated from earlier occupations of the site (Levels 4 and 5). UAQ2.2450 is perfectly shaped and polished, has a black, shiny colour, and a small opening, considering its diameter. Its shape is, so far, unique, and differs from specimens known from the 5th and 4th millennia.

This is not the first time that stone earrings of this type have been found in the UAE: two fragments of a rectangular-section, grey earring were found at al-Buhais BHS18, near the surface of the site but not in a grave (de Beauclair 2005: 36, fig. 2.60). At BHS18, in the graveyard, the earrings found are of a quite different type, e.g. in the shape of oval semi-perforated beads, and mostly in carnelian (de Beauclair 2008b: 147). This type of adornment is, up to know, restricted to the northern UAE in the Arabian Gulf – being totally absent from sites like Marawah, Delma, Dosariyah, or as-Sabiyah H3.

However, in the Sultanate of Oman, this type of ornament is frequent, i.e. at Ras al-Hamra RH5 (Biagi and Salvatori 1986: fig. 5 n. 1-3; Isetti and Biagi 1989: 11; Salvatori 2007), and RH10 (Santini 1987: fig. 8 n. 5). At RH-5 most were found in the settlement (Isetti and Biagi 1989: 12). They have also been found, among other sites, at Wadi Shab GAS1 (Tosi and Usai 2003: fig. 9), Khor Milkh KM1 (Uerpmann 1992: fig. 33), al-Haddah BJD1 (Charpentier *et al.* 1997: fig. 5 n. 2), Suwayh SWY1 (Charpentier *et al.* 2003: 17), Suwayh SWY2 (Charpentier *et al.* 1998: fig. 9 n.

Table 4.13. Sizes of stone earrings found at UAQ2.

UAQ2 ID	Presumed diameter (mm)	Thickness (mm)
UAQ2.979	25	5.9
UAQ2.2022	18	5.5
UAQ2.2023	23	6.1
UAQ2.2450	24.4	4.9

1, undecorated), as well as at Ras Dah SM10 on Masirah Island (Charpentier *et al.* 2013: fig. 4 n. 1-3).

According to Usai (2018), the working process for stone earring production could be as follows: extracting raw material; breaking/crushing or cutting/sawing the raw material to obtain smaller pieces; rounding/abrading the tablets/blanks edges and the two opposed surfaces (i.e. on a grinding stone); perforating the rounded tablets in the middle through 'punches'; abrading/modelling the external and internal surface of the earring with a file, giving it its external shape, enlarging the hole with a file again, and decorating the earring (optional). This working process appears plausible for our finds, except for UAQ2.2450 which is of a harder material. The actual or estimated (when broken) diameter of the UAQ2 earrings (Table 4.13) is comparable to those found, e.g., at GAS1, RH5, BJD1, and SWY2.

Except for Ras Dah SM10, where the oldest layers are from the first half of the 6th millennium BCE, the Omani sites that have delivered stone earrings are all dated from the 5th, and mostly the 4th millennium BCE. The only ones so far that have produced evidence of softstone earring production are Ras al-Hamra RH5, Bimmah, and Wadi Shab GAS1, even though no workshops were precisely located at either RH5 or GAS1 (Usai 2005). At UAQ2, many stone tools have been discovered, some of which could have been used in the manufacture of personal ornaments, e.g. a file in Level 11 (UAQ2.2450). There is, however, no direct evidence to suggest local production.

Shell ring

A surface find of a shell ring at UAQ2 (Figure 4.35: UAQ2.2252) seems to have been made from a gastropod (probably a large Trochoidea). It measures 20 mm in diameter, with a width of 22 mm. At al-Buhais BHS18, concave fragments of mollusc shell were discovered near a metacarpus, which might suggest a ring (de Beauclair 2005: 39, 60, fig. 2.63). It has the same diameter as the UAQ2 example.

Stone spheres

Eight globular or oval stones were found at UAQ2: one in carnelian, one in beach rock, and six in grey-black softstone (Figure 4.40). These objects do not show any perforation or start of perforation, except for the carnelian sphere (UAQ2.171, 18.7 mm in diameter, Méry and Charpentier 2013: fig. 4), which shows series of small intentional impacts (rather than drilled depressions) on the opposite sides. It has a very regular rounded shape; its material is of good quality, orange-red with red dots. This artefact, which is of a harder material than softstone, required much more technical skill compared to that required for the manufacture of the other spheres. The latter have a less regular shape and are smaller (i.e. diameters between 8.9 mm - 12.4 mm). Some have a more oval profile (UAQ2.2037 and 2039).

Six of the seven UAQ2 spheres are from the oldest layers of the site: one from Level 13, two from Level 11 (including the carnelian sphere), and three from Level 10.

These spheres could have been used as ornaments. They are finished artefacts, not preforms (whose perforation would not have been completed). The same type of object (spheres or oval shapes) is found in other Neolithic settlement contexts of Eastern Arabia, e.g. a chalcedony sphere at UAQ38 (Degli Esposti *et al.* 2020: fig. 8 bottom) and at as-Sabiyah H3 in Kuwait (Carter and Crawford 2010: 82, fig. 4.10). Spheres are more often found in graves than in settlements, such as in the graveyards at Ras al-Hamra RH6 (Biagi and Nisbet 1999: 39), al-Buhais BHS18, Faya FAY-NE15, and Yarmuk (Biagi 1999: 63, fig. 15 n. 6-10; de Beauclair 2005: 33-34, fig. 2.54; de Beauclair *et al.* 2006: 177; Kutterer and de Beauclair 2008: table 1; Méry and Charpentier 2013: 76; Uerpmann *et al.* 2012: fig. 10-11). At BHS18, the carnelian beads usually show a beginning of perforation with two shallow depressions from 0.5 mm - 1 mm deep, diametrically opposed (Brunet 2014: 248, pl. 21 n. 1). They have a similar diameter to finds from UAQ2 (between 11.4 mm - 18.6 mm), and most may have been elements of earrings, being found near the external acoustic opening (*porus acusticus externus*), the maxillary or the mastoid of the skeletons. No attachment system, probably made from a perishable material, has been preserved for the spheres (de Beauclair 2005: 55; de Beauclair *et al.* 2006: 179). In other cases, the spheres were placed on the upper jaw of the deceased at BHS18, between the upper lips and nose.

Another interpretation of these small stone spheres as tokens has been proposed by Carter and Crawford (2010: 83, fig. 4.10). Similar small stone spheres, measuring 1.45-1.7 cm in diameter, have been discovered inside two of the stone-built chambers at as-Sabiyah H3. Surprisingly, similar objects are widely documented in Mesopotamia, including at sites such as Ur and Eridu (Schmandt-Besserat 1992). The possibility of their exchange between Arabian groups and Mesopotamian societies would support the hypothesis of formalised connections between these two cultural spheres.

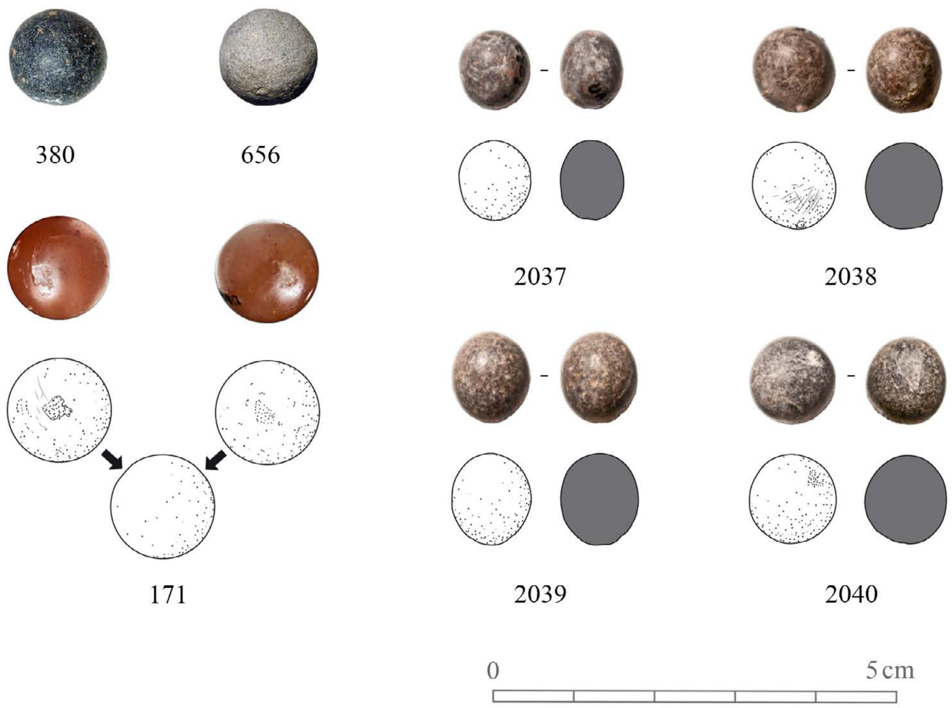


Figure 4.40. Stone spheres from Phase B at UAQ2 (Levels 13 to 10). Photos & Drawings: H. David.

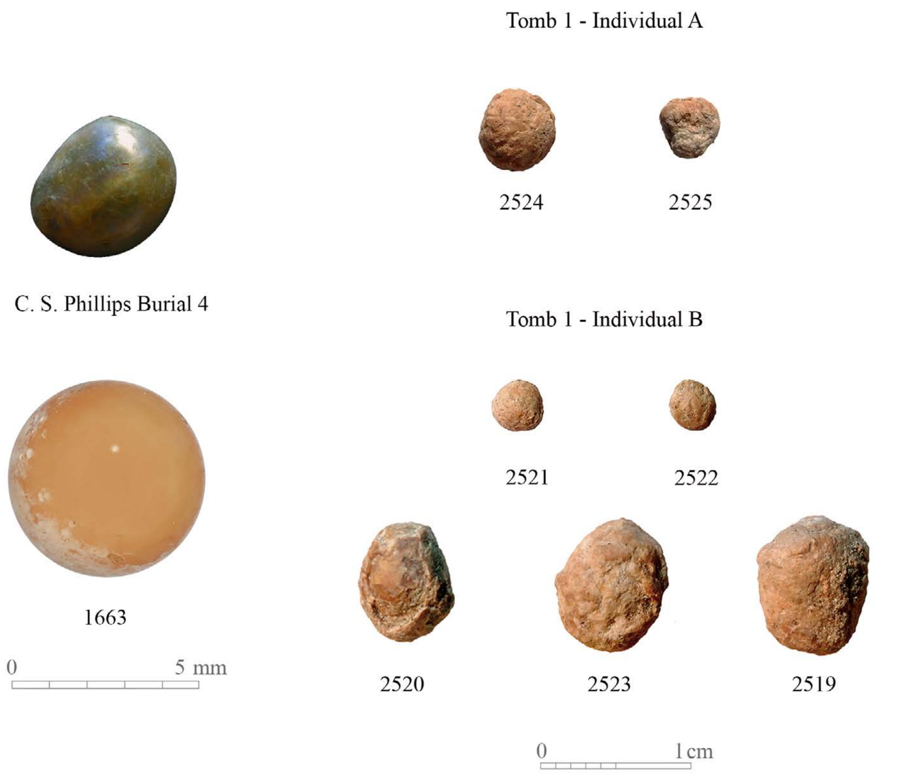


Figure 4.41. Selection of pearls from UAQ2; UAQ2.1663 was associated with Level 10 in Sector 1+2. Photos: K. Walton & H. David.

Pearls

The first pearl recovered at UAQ2 was found by Phillips (2002) in the graveyard – very close to a human skull – and recently dated from the second half of 6th millennium BCE (LOCEAN 164: 6741±30 BP [5471-5112 cal. BCE]), according to the 2009 section (Charpentier *et al.* 2012a) and stratigraphical relation between the necropolis and the settlement levels. From 2011, 14 further pearls have been discovered at UAQ2, including nine in the graveyard and five in the settlement areas. In the graveyard, seven pearls have been found associated with Tomb 1 (Figure 4.41), stratigraphically linked to Level 14. The specimens recovered from the settlement (mainly from Sector 2) are associated with Levels 9-14, thus all belonging to the 6th-millennium BCE occupation at the site.

The UAQ2 pearls are often altered, with a colour ranging from whitish to pale beige. Two thirds of them have regular, globular shapes; the others have a more oval morphology. They measure from 3 mm - 7.2 mm in diameter (the largest being found in the oldest layers) and have similar diameters to pearls found al-Buhais BHS18 (de Beauclair 2005: 20). Only one shows the beginning of a perforation (UAQ2.1664). This comes from the necropolis area, but was not directly associated with a skeleton – it belongs to Level 11.

Over 100 pearls have been discovered in more than a dozen sites of the 6th-4th millennia BCE, including settlements and necropolises, in Kuwait, Saudi Arabia, UAE, and the Sultanate of Oman (see Charpentier *et al.* 2012a for a detailed review, and Drechsler 2018: 325, fig. 15.8 for the most recent publications of well-preserved pearls) (Table 4.14), outlining the longevity of the history of pearling in the region, indeed it remained one of the main economic resources in the Arabian Gulf in the 19th century CE and the beginning of the 20th (Carter 2005). Until now, the most ancient pearls in Arabia come from the MR11 site from the Emirate of Abu Dhabi (UAE) and date back to *c.* 5600 BCE (Beech *et al.* 2019: fig. 9), thus slightly older than the specimens found at UAQ2. One of the MR11 pearls was recovered from Context 507 (Area C), which also provided a trihedral point.

Most pearls found at Eastern Arabian Neolithic sites are from *Pinctada persica* or *Pinctada radiata* oysters. Natural pearls are generally of an irregular shape, sometimes found unformed, but the archaeological pearls are often regular in shape, spherical or oval, showing that the selection of the shape was practised by the Neolithic populations. Pearling is a perilous activity (drowning, decompression accidents, shark attacks, jellyfish stings, etc.) when diving is involved, sometimes to considerable depths. The risks taken by Neolithic divers indicate how important pearls were for communities, i.e. within the spiritual sphere, as they have been associated to funeral rites at sites such as al-Buhais BHS18, Faya FAY-NE15, and Ras al-Hamra RH5 and RH10 (Kutterer and de Beauclair 2008; Salvatori 2007; Santini 1987: 184). Additionally, many pearl-oyster banks are to be found in shallow, subtidal, rocky areas, making them easy to collect by hand, without the need for diving.

Although much smaller, Neolithic pearls are similar in appearance to stone spheres. Like carnelian spheres, some of the pearls were perforated and worn as beads, others were unpierced, or have only the start of one

Table 4.14. Quantities of pierced pearls per Neolithic site in Eastern Arabia (adapted from Charpentier et al. 2012b, tab. 1; Salvatori 2007: 86, 148, 157; Uerpmann and Uerpmann 2003: 150-151; Beech et al. 2020: 7-8, fig. 9).

Site	Graveyard	Settlement	Pierced pearl
As-Sabiyah H3		1	1
Dosariyah		10	
Marawah MR11.C		2	
Yarmuk		1	
Al-Buhais BHS18	62		61
Faya FAY-NE15	3		
Akab		18	
Umm al-Quwain UAQ2	9	5	1
Ras al-Hamra RH5	5		5
Ras al-Hamra RH10	2		
Khor Milkh KM1		1	1
Ras al-Khabbah		4	
Suwayh SWY1	1	2	
Suwayh SWY2		1	
Ruwayz RWY1		1	

Table 4.15. Proportions of stone and shell ornaments per Neolithic site (data after Brunet 2014: vol. 1 tab. 2, and vol. 2).

Site	% Stone ornaments	% Shell ornaments
Al-Haddah BJD1	2	98
Umm al Quwain UAQ2	3	97
Hamriyah	5	95
Marawah MR11.A	5	95
Al-Buhais BHS18	5.5	94.5
Akab	8	92
Ras al-Hamra RH5	44	56
Ras al-Hamra RH10	45	55
Ras al-Hamra RH4	49	51

or more perforations, i.e. finds from Suwayh SWY1 (Charpentier *et al.* 2003: 14). Pearls without perforations, or indications of them, could have had the same link system as described above. At al-Buhais BHS18, the pearl discoveries show a particular pattern for use in funeral rites. A pearl with indications of two perforations was placed between the upper lip and nose of deceased males, and a perforated pearl was positioned in the same place for women (de Beauclair 2005: 71). At Ras al-Hamra RH5, all pearls were pierced and set in bracelets, or placed in the hands of the interred (Salvatori 2007: 86, 148, 157). In the UAQ2 graveyard, the pearls were grouped in clusters near the pelvis of two individuals within Tomb 1 (two for individual A; four individual B), suggesting that the pearls were contained in small bags or wrapped in a perishable material attached to the hip, or deposited close by.

Discussion

Perfectly adapted to their natural environment, the UAQ2 inhabitants had a vast expertise regarding marine shells and made specific choices in selecting them for their ornaments: only a dozen taxa were selected among the hundreds from the Arabian and Oman Gulf seashores. This selection could, of course, be related to acquisition constraints (some shells are hard to find, e.g. *Engina mendicaria*), or to technical difficulties (some shells are hard to work, others too fragile), but choices were also linked to cultural and aesthetic purposes. As at other Neolithic sites of the UAE, but only quantified at al-Buhais BHS18 and Faya FAY-NE15, seashells were of particularly important significance to the UAQ2 communities in terms of the chosen shapes, sizes, and colours.

It is not possible yet to say if all the taxa found in the settlement were associated to the UAQ2 graves as the shell articles from the previous excavations have not been published (Phillips 2002: 176), except for a bracelet fragment (Phillips 2002: fig. 9). In the tombs excavated in 2012 and 2013, *Polinices mammilla* and *Pinctada* were the only identified shells.

The proportions of stone and shell ornaments at UAQ2 as a whole correspond to average rates from the majority of other Neolithic sites within the UAE and the Sultanate of Oman, as shown in Table 4.15, except for the Ras al-Hamra sites, where there are almost as many stone ornaments as shell ornaments.

Stone ornaments

Lithic activity at UAQ2 was common. Hundreds of rock crystal, flint, and radiolarite fragments or debitage have been found coming from all layers, although chalcedony remains are evidenced in all layers (predominantly in Levels 9-14). The colour and nature of these chalcedony remains display great diversity: opaque brown-orange, translucent orange-red, translucent light green, translucent brown-green-black, and opaque brown with white veins. A large ice-blue agate tabular boulder (UAQ2.796), extracted directly from a vein, along with some flakes, were also found on the surface. Carnelian was used to make one sphere (UAQ2.171), but there was no evidence of its manufacture at UAQ2. As with the chalcedonies identified at the site, this carnelian is macroscopically similar to a source found in the Jebel al-Ma'taradh, Ras al-Khaimah, located *c.* 30 km southeast of UAQ2 (Charpentier *et al.* 2017), and exploited since Neolithic times, at least, to produce tools and ornaments.

The only haematite ornaments found in the Oman Peninsula during the Neolithic and Bronze Age periods are the UAQ2 pendant (UAQ2.2451) and a bead found in a Hafit period grave in the Jebel Hafit (Cleuziou 1977: 16, fig. 17 n. 9). Nothing indicates that the UAQ2 pendant was produced at UAQ2, and the closest known source for haematite today is near Wadi Jizzi, at Lasail (Sultanate of Oman) (Tosi 1975: 198), i.e. more than 150 km from the site.

As previously mentioned, the several softstone objects found at UAQ2 might indicate local production (UAQ2.827, UAQ.900, and UAQ2.1500, see their descriptions above).

Table 4.16. Production techniques for shell beads.

Shell	Technique		
	Picking	Drilling	Sawing
GASTROPODA			
Pisaniidae	X		
Columbellidae	X		
Conidae or Strombidae	X		X
Cypraeidae	X		X
Marginellidae	X		
Muricidae		X	X
Nassariidae	X		
Naticidae	X		
Neritidae	X		
Olividae	X		
Trochidae	X		
BIVALVIA			
Pteriidae		X	X
Spondylidae	X	X	X
SCAPHOPODA			
Dentaliidae			X

Availability and access to softstone sources did not present significant challenges, as many softstone locations are known in the Oman Peninsula, with the closest source *c.* 50 km from UAQ2 (David *et al.* 1990: fig. 3). The raw material could also have been obtained through exchange, or perhaps even by the men and women of UAQ2 themselves, either during specific searches or seasonal migrations.

Shell ornaments

(Manufacture)

Transforming shells into ornaments of the types found at UAQ2 usually implied simpler working processes than those required for soft- and hardstone items. The shell species that appear throughout the whole stratigraphy were systematically worked in the same way, and the technical processes used were homogeneous and continuous, involving serial work (Table 4.16). In most cases, the production of gastropod shell beads only required perforation by picketing holes, which were then abraded. The apex of Conidae/Strombidae was sometimes removed by sawing. Tusk shells required transversal sawing, depending on the length of bead required. Other marine shells, e.g. Conidae/Strombidae, Muricidae, Pteriidae, and Spondylidae, were associated with more complex working processes. These included: fragmentation and fashioning/shaping by sawing (using an anvil); picketing to prepare the perforation (possibly using a bone tool); perforation (using a flint or chalcedony borer); abrasion between all these phases, and at the end. Regarding tools, picketing was probably done using a bone tool, and perforation with a clastic stone borer; sawing and shaping involved splintered pieces from clastic stones; anvils, grinding stones, and stone files could be used to polish the edges of the bead. All these types of objects are attested at UAQ2.

(Distribution of species)

At UAQ2, Naticidae, Conidae/Strombidae, and Spondylidae are among the most common species associated to ornaments. Most of them appear in Levels 8 and 9 to 14, which gather almost 90% of the total amount of shell ornaments (Table 4.17).

With regards to the stratigraphy, we observed that several of the 12 species found related to the second part of the 6th millennium BCE diminish or disappear during the 5th, after Level 7. This diminution in terms of both the quantities of ornaments and the represented shell taxa is related to the decrease in variety and intensity of domestic activities, and is presumably related to a different mobility pattern, based on briefer installations on the site.

(Origin of the shells)

All marine shell species except three can be found today on the western UAE coast, e.g. *Pinctada* spp., *Spondylus spinosus*, and *Dentalium octangulatum*. Considering the large amount of *Polinices mammilla* beads found at UAQ2, it is also probable that they could be found in the vicinity of the site.

The presence of unfinished/unworked fragments of *Spondylus spinosus* and *Pinctada* spp. at the site would confirm the manufacture of finished items in these materials at the site (and probably also the manufacture of items in *Ancilla* spp. and *Nerita* spp. as well).

Based on Bosch *et al.* (2008), three species are not reported today along the seashore of the UAE, although they appear in the Gulf of Oman, i.e. *Engina mendicaria*, *Conus ebraeus*, and *Volvarina monilis*. At UAQ2, these represent no more than 45 beads and, in the current state of the research, they likely demonstrate, as at other coastal or inland sites of the western coast of the UAE, links with other groups – who could help UAQ2 obtain these beads (or shells) via distance trade.

(Use)

Only one adornment (bracelet) was found in the settlement (Level 11, Sector 1). This was made of 34 Conidae or Strombidae whorl beads, two *Polinices mammilla* beads, and one from an unrecognised shell. Its composition thus shows little diversity in shell choice,

Table 4.17. Shell adornments per strata (n = 819 stratified beads).

	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**	**Level 8**	**Level 9**	**Level 10**	**Level 11**	**Level 12**	**Level 13**	**Level 14**	**Total**
Naticidae	1	4		2	2	15	15	48	29	45	82	33	30	56	362
Spondylidae					1	2	5	22	25	25	42	47	34	8	211
Pisaniidae			1		1	5	1	5	3	4	9	2	4	4	39
Dentaliidae				1	3	7		1	4	5	3	6	2	1	33
Olividae						8	1	3			1	1			14
Pearl		1							1	1	2			7	12
Nassariidae						1		1	1	2			1		6
Columbellidae			1			1		3							5
Marginellidae					1							3			4
Neritidae										2	1				3
Cypraeidae								1			1				2
Pteriidae											1			1	2
Total	1	6	2	3	8	42	26	101	68	92	207	103	81	79	819

Table 4.18. Ornaments per individual, Tombs 1 and 2.

<table>
<tr><th></th><th>Tomb</th><th>Indiv.</th><th>Gender</th><th>Age</th><th>Ornament</th><th>Quantity</th><th>Localisation</th></tr>
<tr><td rowspan="4">2013</td><td>1</td><td>A</td><td>Male</td><td>Young adult</td><td>Pearl</td><td>2</td><td>Pelvis</td></tr>
<tr><td>1</td><td>B</td><td>Male</td><td>Mature adult</td><td>Pearl</td><td>5</td><td>Pelvis</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">E</td><td rowspan="2">Male</td><td rowspan="2">Adult</td><td>Naticidae beads</td><td>10</td><td>Pelvis</td></tr>
<tr><td>Mother-of-pearl pendant</td><td>1</td><td>Foot</td></tr>
<tr><td rowspan="5">1992-1993</td><td>?</td><td>?</td><td></td><td></td><td>Bitumen beads</td><td>?</td><td>Neck</td></tr>
<tr><td rowspan="2">?</td><td rowspan="2">Burial 4</td><td rowspan="2">Male</td><td rowspan="2">Adult</td><td>Pearl</td><td>1</td><td>Near the skull</td></tr>
<tr><td>Bitumen bead</td><td>1</td><td>Near the shoulder</td></tr>
<tr><td rowspan="2">?</td><td rowspan="2">?</td><td rowspan="2"></td><td rowspan="2"></td><td>Shell bracelet plaque</td><td>1</td><td rowspan="2">In the graveyard, no relationship with any individual</td></tr>
<tr><td>Stone pendant</td><td>1</td></tr>
</table>

and the taxa used are among the most common found at UAQ2.

Polinices mammilla is the third most represented gastropod shell at al-Buhais BHS18 and Faya FAY-NE15, but it is the most frequent at BHS18 beyond the graveyard, which has been interpreted as indicating its use in everyday life, rather than being limited exclusively to funerary use (de Beauclair *et al.* 2006: 183). The UAQ2 finds fully confirm this hypothesis, as by far the majority of the ornaments found come from the settlement areas, with some still showing use traces that the beads and other ornaments were made to be worn. Some ornaments were also found in the necropolis, which is an important shared feature with other Neolithic graveyards in the UAE and the Sultanate of Oman.

The finds in the UAQ2 necropolis (MNI: 48 individuals) add evidence regarding funerary practices, i.e. the pearls and shell adornments in particular, as described above (Table 4.18). During the 1990s, two individuals, at least, were also found with associated ornaments: one had a pearl found near his skull and a bitumen bead near the shoulder (Charpentier *et al.* 2012b: 3), the other had a necklace of bitumen beads (Phillips 2002: fig. 7-8). As previously mentioned, a hip belt of *Polinices mammilla* beads was associated with Ind. E in Tomb 2.

(Comparisons between neighbouring sites)

The small number of Muricidae beads found to date at UAQ2 (three) stands out, as this shell is very frequently found at other sites on Oman Peninsula (*c.* 1000 were found at al-Buhais BHS18 (de Beauclair 2008a), more than 200 at the Akab *Dugong Bone Mound*, which is only a few km from UAQ2 (Méry and Charpentier 2009: 74), and more than 50 km from Faya FAY-NE15 (de Beauclair and Kutterer 2008: 139). At UAQ2, the scarcity of Muricidae beads seems to be cultural rather than down to difficulties in procurement (Muricidae species are abundant in the shallow waters of the UAQ lagoon, in particular *Hexaplex kuesterianus*), or technical issues (similar, and difficult, shell shapes were worked at UAQ2).

Again, while among gastropods beads *Ancilla* spp. finds constitute < 4% at UAQ2, they are the most represented beads at al-Buhais BHS18 and Faya FAY-NE15 (76% and 83% respectively, based on the quantities given in de Beauclair 2008b: tab. 2, and Kutterer and de Beauclair 2008: tab. 1). This may be another indication of the singularity of UAQ2.

Another difference is the fact that there is a complete absence of Dentaliidae among the ornaments from al-Buhais BHS18 and FAY-NE15 (Uerpmann *et al.* 2012: fig. 10, 396), while their number is not negligible at UAQ2.

The proportion of *Spondylus* beads is also much higher at al-Buhais BHS18 than at UAQ2, with over 16,600 items found, i.e. *c.* 70% of the ornaments (de Beauclair 2008b: tab. 2). As already mentioned, at UAQ2 the *Spondylus* beads found to date are smaller than those identified at Akab, where 95% of the finished beads are > 5 mm in diameter (between 2.3 mm - 7.9 mm). Does this suggest a cultural difference, indicating that distinct population groups may have inhabited UAQ2 and Akab during the 5th millennium BCE? This hypothesis is supported by the absence of elongated cylindrical beads with elbow perforations at UAQ2, while this type is well-represented at Akab—primarily in levels from the mid 4th millennium BCE associated with the dugong monument, but also in smaller quantities in settlement levels dating to the second half of the 5th millennium BCE.

Animal economy and subsistence strategies at UAQ2

K. Lidour, S. Méry, M.J. Beech, L. Yeomans, M. Mashkour, K. Debue, S. Bréhard, C. Dupont, J. Martin

Introduction

K. Lidour, S. Méry

The Umm al-Quwain lagoon (Khor al-Beidah) is a large, semi-enclosed basin (*c.* 80 km²) located *c.* 100 km southwest of the Strait of Hormuz. Despite its shallowness (*c.* 3 m - 4 m in non-dredged areas), the lagoon offers suitable habitats in the form of white mangrove (*Avicennia marina*) forests (Figure 5.1.C-D), seagrass beds, and sparse corals for many fish, mollusc (shellfish and cephalopods), and crustacean species of economical interest (Department of Fisheries 1984: 6-8). Wide bare areas appear at low tide (Figure 5.1.A), facilitating extensive shellfish collection, crabbing, as well as fishing on foot (including with traditional fish trapping devices). Off the lagoon, deeper waters allow the passage of large, pelagic fish shoals, e.g. tuna (Scombridae: e.g. *Euthynnus affinis* and *Thunnus tonggol*), and trevallies (Carangidae: *Platycaranx* spp.). Furthermore, important coral reefs are accessible by boat, where fishing essentially focuses on the capture of groupers (Serranidae/Epinephelidae), snappers (Lutjanidae), and large seabreams (Sparidae: e.g. *Argyrops spinifer* and *Sparidentex* spp.). Large colonies of Socotra cormorants (*Phalacrocorax nigrogularis*) have become established on some of the main islands inside the lagoon, in particular on Siniya Island (the largest colony in the UAE with *c.* 26,000-41,000 breeding pairs during 2011-2016) (Muzaffar *et al.* 2017). Such large marine birds (up to 80 cm in height), as well as their eggs, could have been exploited by humans anciently settled on the coast.

The presence and exploitation of a mangrove ecosystem during the Neolithic at Umm al-Quwain is confirmed by the abundance of *Saccostrea cuccullata* shells at UAQ2 and other sites of the area, e.g. Akab, Ramlah RA3, al-Madar UAQ69, UAQ36, and UAQ38 (Charpentier and *Méry 2008*: 119; Uerpmann and Uerpmann 1996: tab. 2; Méry *et al.* 2019; Degli Esposti *et al.* 2019), which often show traces of mangrove pneumatophores and aerial roots to which they were attached (Plaziat 1995: fig. 8). The discovery of giant mangrove whelk (*Terebralia palustris*) shells in several well-stratified archaeological levels at UAQ2 also testifies higher moisture conditions within the UAQ mangrove during the Neolithic.

Nowadays, the UAQ mangrove ecosystem is structured on the development of a unique species of mangrove tree: *Avicennia marina* (Garcia Anton and Sainz Ollero 1999). However, a recent palynological analysis conducted by D. Aoustan and C. Leroyer (Méry *et al.* 2019: 231, figs. 8-9) has confirmed the presence of a second species of mangrove tree alongside *A. marina* in the UAQ lagoon at the end of the 5th millennium BCE: *Rhizophora* cf. *mucronata*. Similarly, both *A. marina* and *R.* cf. *mucronata* charcoals have been identified at more recent sites in the UAQ lagoon: Tell Abraq (Bronze Age/Iron Age) and ed-Dur (Pre-Islamic period) (Tengberg 1998: 212-14; 2005: 42).

R. mucronata is reported to be less tolerant to salinity than *A. marina* (Khan and Aziz 2001). Therefore, *R. mucronata* requires freshwater from both abundant rainfall and rivers (Spalding *et al.* 1997; Lézine *et al.* 2010: 422). The ancient presence of *R.* cf. *mucronata* at UAQ highlights that higher moisture conditions occurred along the northern UAE coast until the last stage of the Holocene (Parker *et al.* 2004; Preston *et al.* 2015). Further data indicates that *A. marina* and *R.* cf. *mucronata* still co-existed within the Ras al-Khaimah mangrove (*c.* 35 km north of UAQ) until the 13th century CE, since charcoals have also been found at Kush (Emirate of Fujairah, UAE) (Tengberg 2005: 42). Nevertheless, the progressive aridification and the subsequent degradation of mangrove ecosystems during the Holocene in the northern UAE is also confirmed by the reduction of the *R.* cf. *mucronata* population between the 2nd millennium BCE and the end of the Iron Age, according to the charcoal analysis conducted on the Tell Abraq site by M. Tengberg (2005: 42).

Human groups anciently established in the periphery of the UAQ lagoon had access to a variety of key resources in the form of seafood, as well as raw materials, e.g. seashells, which could have been used for the production of both personal adornments and tools. As a result of their long-term presence in the area, the human groups who succeeded each other during the past eight millennia have left behind the remains of their foraging activities in the form of large shell middens.

In the light of the massive accumulations of mollusc and fish remains composing the UAQ2 shell midden, it is quite obvious that the site economy was based mainly on the exploitation of marine resources. However, UAQ2 has also provided a significant number of terrestrial mammal remains in comparison to other Neolithic coastal sites of the UAE (e.g. Delma, Marawah, Akab). This allows detailed

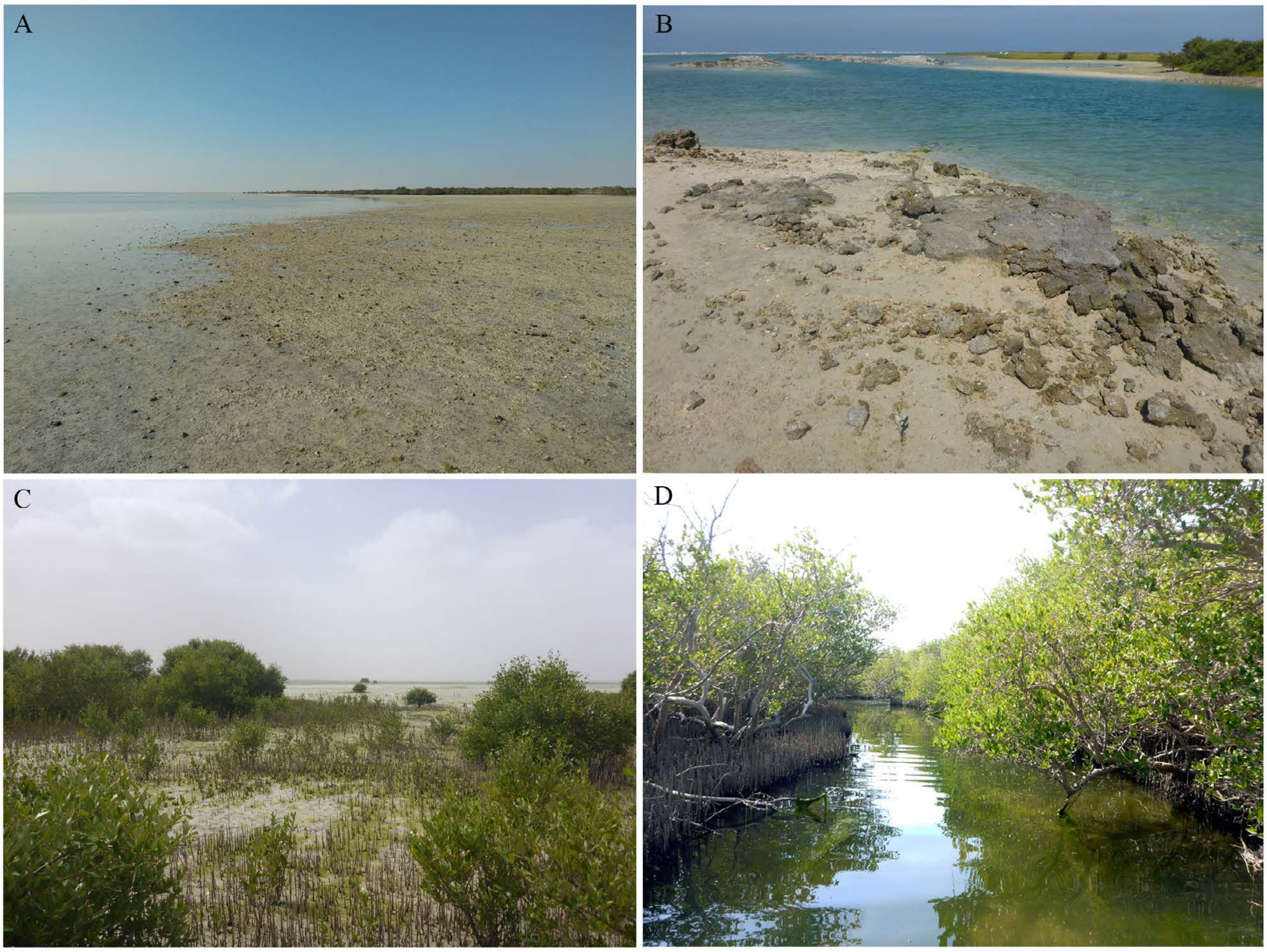


Figure 5.1. A. Sand and mud flats at mid-tide, below the mangrove (Khor al-Beidah, Emirate of Umm al-Quwain); B. Rocks on the coast of UAQ (Khor al-Beidah, Emirate of Umm al-Quwain); C. Sparse mangrove of *Avicennia marina* in UAQ (Khor al-Beidah, Emirate of Umm al-Quwain); D. A small shallow channel crossing through the UAQ mangrove. White mangrove (*Avicennia marina*) stands cover the banks (Khor al-Beidah, Emirate of Umm al-Quwain); Credits: K. Lidour.

insights into the importance of ancient husbandry and hunting within coastal subsistence patterns during the Neolithic.

Vertebrates

K. Lidour, S. Méry

Introduction

According to the preliminary results by Beech (in Mashkour *et al.* 2016: 202-5), the UAQ2 fish assemblage is dominated by species usually encountered in the lagoon, but the fact that some tuna remains have been identified in the earliest occupational levels of the site (i.e. Levels 13 and 14) also indicates that fishing could have been carried out in the open sea from the beginning of the occupation of the site. In this sense, the exploitation of both coastal and open waters is consistent with the use of stone net sinkers and shellfish hooks (but exclusively in the upper levels of the settlement) in the fishing equipment (Chapter 4): small nets, such as beach seines, could have been used along the shallow shore and the mangrove fringes for the capture of small coastal fish, whereas tuna fishing was more than likely carried out in the open sea using nets and lines from boats.

The composition of the present fish assemblage appears similar to that of Phillips' excavations in 1992-1993 (Beech 2004a: 143-150): seabreams (Sparidae) are prevalent, in particular small *Rhabdosargus* sp. and *Acanthopagrus* sp. These fish are mostly caught in shallow and sheltered coastal waters, like those found in the UAQ lagoon. Similarly, al-Madar UAQ69 (probably 5th millennium BCE), located near the modern city of Umm al-Quwain, is characterised by a great number of small seabreams and emperors (Lethrinidae) (Uerpmann and Uerpmann 1996). More recently, the excavations undertaken at UAQ36 (second half of the 5th millennium BCE) (Méry *et al.* 2019) have also revealed a substantial amount of small coastal fish remains, mostly belonging to seabreams, emperors, and rabbitfish (Siganidae) (Lidour *et al.* 2020b). At the Akab settlement (second half of the 5th millennium BCE), the fishing economy is significantly different: although small coastal fish are also present, fishing was carried out mainly in open waters, as it is shown by an assemblage dominated by large trevallies and tunas (Lidour *et al.* 2020a). This shows the diversity of subsistence strategies and ways of life within the different groups inhabiting the UAQ lagoon in the Neolithic, especially during the 5th millennium BCE.

Significant quantities of seabreams and emperors have also been observed at the Neolithic sites of Delma DLM19 (DA11) (Beech and Elders 1999; Beech 2004a: 97-109; Beech and Glover 2005; Lidour and Beech 2019) and Marawah MR11 (Lidour and Beech 2020; Lidour et al. 2024b), in the Abu Dhabi Emirate. These assemblages are comparable to those known from other Arabian Gulf sites, e.g. as-Sabiyah H3 in Kuwait (Beech 2010), Dosariyah in Saudi Arabia (Uerpmann and Uerpmann 2018), al-Markh in Bahrain (von den Driesch and Manhart 2000), and Khor P in Qatar (Desse 1988).

According to Mashkour *et al.* (2016: figs 3-4), the mammal assemblage is largely dominated by small ruminants in all the levels at UAQ2: the presence of both domestic sheep (*Ovis* sp.) and goat (*Capra* sp.) is attested on the site. Furthermore, a few remains belong to domestic cattle (*Bos* sp.). Nevertheless, the presence of wild cattle (*Bos* cf. *primigenius*) cannot be excluded on the site and will have to be examined through osteometric analyses and comparison with other sites of the Arabian Peninsula: two remains have been identified as belonging to *B. primigenius* at Buhais BHS18 (Emirate of Sharjah, UAE) (Uerpmann and Uerpmann 2008: tab. 1). Wild mammals represented at UAQ2 also include gazella (*Gazella* sp.) and oryx (*Oryx leucoryx*).

Marine fish

M.J. Beech, L. Yeomans

Introduction

Fishing forms an activity in many societies throughout the world today and played a significant role in the life and subsistence of many prehistoric societies. Here a detailed investigation of the fish bones retrieved from the archaeological site of UAQ2, located in the Emirate of Umm al-Quwain in the UAE, provides a detailed insight into the life of a community located on the southern coastline of the Arabian Gulf *c.* 7,000 years ago.

The aim of the investigation of the fish bones retrieved from archaeological excavations at UAQ2 was to determine what kind of fishing was carried out. Was offshore fishing practised in boats on the open seas? Was fishing carried out in nearby shallow coastal waters? Was fishing carried out in the adjacent lagoon at Umm al-Quwain? What kinds of fishing equipment were utilised to catch the types of fish identified? Was there any evidence for seasonal fishing activities at the site, or could occupation there have been all year round?

It should be noted that the fish bones from the earlier excavations at UAQ1 and UAQ2, carried out in 1992-93 by Phillips and Treveil (Phillips 2002), were previously analysed by the first author during the course of his PhD at the University of York – later published within the British Archaeological Reports International Series (Beech 2004a: 143-50).

Thanks go to French Archaeological Mission in the UAE for providing financial assistance for our study of the UAQ2 fish bones. We would like to thank Hannah Russ for her assistance with sorting some of the UAQ2 fish bones. Photographs were mostly taken by LY, with the exception of the tiger shark tooth, which was taken by MJB. Information and publications pertaining to the fisheries of the UAQ lagoon was kindly provided to the first author by Ahmed Abdul Rehman Al-Janahi, Head of the Fishery Extension Section, and by Mohamed Al Zarouni, Researcher, at the Ministry of Agriculture and Fisheries Marine Resources Research Centre, Umm al-Quwain.

Methods

The sediment at UAQ2 was predominantly sandy, meaning that dry sieving could easily be carried out at the site. The standard type of sieves utilised on the excavation were 3 mm - 4 mm mesh rocking sieves. Some smaller fish bones were also retrieved from the processing of bulk samples, where 1 mm - 2 mm mesh sieves were utilised to sort material resulting from flotation residues.

The UAQ2 fish bones were identified using the first author's (MJB) comparative osteological collection of Arabian Gulf fishes, located in Abu Dhabi in the UAE. Details of this collection are provided in Beech (2004a: Appendix 3). The second author, LY, assisted with the identification, recording and databasing of the UAQ2 fish bone assemblage. Analysis of the data was carried out by the first author, then the writing of the report was jointly undertaken.

In this present study a modification of the recording systems adopted by Leach (1986) and Wing and Scudder (1983) was utilised. The principle diagnostic elements recorded were the vomer, articular, dentary, maxilla, premaxilla, quadrate, cleithrum, and post-temporal. Secondary elements recorded included the basioccipital, hyomandibular, and operculum. A number of other special elements were also recorded, i.e. those characteristic of certain families, genera or species. Loose teeth were counted and these largely tended to belong to seabreams (Sparidae). Amongst these teeth, large oval molars from the posterior of the dentary and premaxilla, could be identified as belonging to the goldstriped or Haffara seabream (Sparidae: *Rhabdosargus* sp.). The diagnostic teeth belonging to requiem sharks (Carcharhinidae: *Carcharhinus* sp.) and tiger sharks (Carcharhinidae: *Galeocerdo cuvier*) could easily be recognised. Upper and lower pharyngeal were only recorded in the case of parrotfish (Scaridae). Other special elements included otoliths from sea catfish (Ariidae), groupers (Serranidae/ Epinephelidae) and, in particular, from emperors (Lethrinidae). In the case of vertebrae, where possible they were divided into one of the following categories: first vertebra, abdominal vertebra, caudal vertebra, penultimate caudal vertebra, ultimate caudal vertebra, or indeterminate vertebra. All fragments not belonging to any of the above categories were classified as 'unknown Perciformes' or 'unknown fish'. Such remains largely consisted of spine fragments and poorly preserved fragments of other elements.

Fragments were only counted if more than 50% of one of the diagnostic zones was present following Beech (2004a: 76, fig. 56) (Figure 5.2). The level of identification of fish bone fragments varies according to the morphology of the particular family, genus, or species. In the case of western Indian Ocean fish bone assemblages it is evident that it is often not possible to identify material beyond the level of family or genus because of the anatomical similarity between different species within the same family or genus. In the case of the primary elements, it was often possible to identify these to family or genus, and occasionally to species level. In the case of secondary elements and special elements, their level of identification depended primarily on the particular taxa being dealt with. Vertebrae were generally not identified below the level of family.

The following fields were recorded within the database of UAQ2 fish bones. First, relevant archaeological information: 'Sitecode', 'Sector', 'Level' and 'Area', 'Sample number', and 'Period'. Then, information about the particular bone specimen: 'Element', 'Species', 'Side', and 'Count'. The fish bones were quantified using a simple count or NISP method, fragments only being counted if they were amongst the diagnostic elements previously described. The physical condition of the specimen was noted if it was 'Burnt', and its state of 'Preservation' was also recorded. If any 'Butchery' was present it was noted. Other comments were added to 'Notes'.

Some measurements could be taken on more complete diagnostic elements (e.g. on the emperor otoliths), but in most cases there was an insufficient sample size to make this worthwhile. It was, however, possible to allocate many of the primary diagnostic elements to a particular 'Size estimate' class. These were as follows: Size category 1 (0 cm - 9.99 cm), 2 (10 cm - 19.99 cm), 3 (20 cm - 29.99 cm), 4 (30 cm - 39.99 cm), 5 (40 cm - 49.99 cm), 6 (50 cm - 59.99 cm), 7 (60 cm - 69.99 cm), 8 (70 cm - 79.99 cm), 9 (80 cm - 89.99 cm), 10 (90 cm - 99.99 cm). In the case of all vertebrae (including those in the 'unknown Perciformes' and 'unknown fish' category) which were complete enough, the maximum width of the centrum was recorded to the nearest millimetre using digital calipers. The numbers of small fish recovered on archaeological sites in this region are probably grossly underestimated due to a combination of factors, e.g. poor preservation and insufficient recovery techniques (lack of fine sieving). There is also the inherent difficulty in identifying small perciform vertebrae. It was therefore felt that such an approach would at least give an idea of the proportion of the assemblage comprising small unidentified fish, even if these could not be precisely identified.

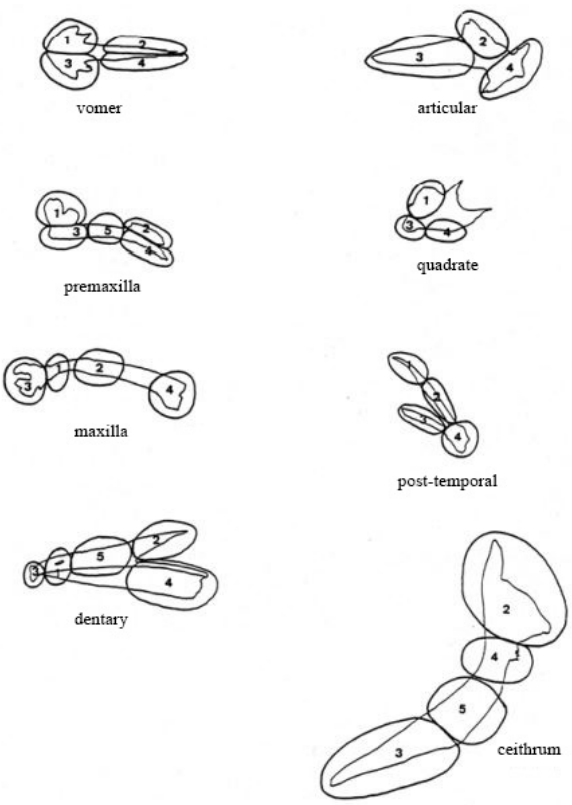


Figure 5.2. Recording zones utilised for diagnostic elements (Beech 2004: fig. 56 after Barrett 1995).

All the above data were recorded onto a relational database using Microsoft Access 2010, with Microsoft Excel 2010 also being used to analyse the data and generate pivot table queries.

Table 5.1. Fish species quantification (in NISP) by sectors.

Family	Species	Sect. 1+2	Sect.3	Sect.4	Sect.5	Total
Carcharhinidae	Galeocerdo cuvier	1				1
	Carcharhinus sp.	14			1	15
Chanidae	Chanos chanos	9				9
Ariidae		3			1	4
Mugilidae		25	2		3	30
Belonidae		52	2	2	2	58
Platycephalidae	*Platycephalus* sp.	31	3	3	4	41
Ser./ Epinephelidae	*Epinepehelus* sp.	40	2			42
		136	5	3	20	164
Echeneidae	Echeneis naucrates	6			1	7
Carangidae	Atule mate	1				1
	Platycaranx sp.	44	2			46
	Elagatis bipinnulata	2				2
	Gnathanodon speciosus	45	14		8	67
	Scomberoides sp.	11			7	18
		57	14	2	7	80
Lutjanidae	*Lutjanus* sp.	10	1			11
Gerreidae	*Gerres* sp.	4		4	2	10
Haemulidae		1				1
Lethrinidae	*Lethrinus* sp.	2474	58	13	233	2778
Sparidae	*Acanthopagrus* sp.	367	41	8	41	457
	Argyrops spinifer	126	5	2	9	142
	Rhabdosargus sp.	1609	61	33	187	1890
		1222	45	39	93	1399
Scaridae		11			2	13
Sphyraenidae	*Sphyraena* sp.	157	3	3	23	186
Scombridae	Euthynnus affinis	3				3
	Thunnini	133	1	2	6	142
		16				16
Paralichthyidae	*Pseudorhombus* sp.	2				2
Triacanthidae		3		9		12
Tetraodontidae		3				3
Unknown Perciformes		543				543
Unknown Fish		1068	46	45	246	1405
Total identified (NISP)		6618	259	123	650	7650
Grand total (NISP)		8229	305	168	896	9598

Results

A total of 9,598 fish bones fragments were recorded, of which 7,650 could be identified to the level of family, genus and/or species (Table 5.1). Fish bones were recovered in all the sectors on the excavation. Most material came from Sector 1+2, followed by Sectors 5, then 3 and 4. The majority of the fish bones came from Phases B and C, with lesser quantities attributed to Phases F, E, D, G, and A in descending order (Table 5.2).

A total of 20 fish families are represented at UAQ2 (Figure 3), including at least 27 genera or species (Figure 4). Numerically the most frequent fishes were seabream (Sparidae), followed by emperors (Lethrinidae), followed by jacks and trevallies (Carangidae), groupers

Table 5.2. Fish species quantification (in NISP) by phases.

Family	Species	A	B	C	D	E	F	Total
Carcharhinidae	Galeocerdo cuvier		1					1
	Carcharhinus sp.		14	1				15
Chanidae	Chanos chanos		9					9
Ariidae			3	1				4
Mugilidae			22	2	1	1	4	30
Belonidae			9	2		32	15	58
Platycephalidae	*Platycephalus* sp.		10	4		15	12	41
Ser./Epineph-elidae	*Epinepehelus* sp.		16	15		2	9	42
			110	26	3	9	16	164
Echeneidae	Echeneis naucrates		7					7
Carangidae	Atule mate					1		1
	Platycaranx sp.		9	5		27	5	46
	Elagatis bipinnulata			2				2
	Gnathanodon spe-ciosus		35	3	2	14	13	67
	Scomberoides sp.			2	2	13	1	18
			31	7	5	29	8	80
Lutjanidae	*Lutjanus* sp.		4			4	3	11
Gerreidae	*Gerres* sp.		1	1	1	1	6	10
Haemulidae				1				1
Lethrinidae	*Lethrinus* sp.	3	1685	910	109	33	38	2778
Sparidae	*Acanthopagrus* sp.		227	79	8	29	114	457
	Argyrops spinifer		107	22	1	4	8	142
	Rhabdosargus sp.		1016	331	43	278	222	1890
			878	193	29	158	141	1399
Scaridae			12	1				13
Sphyraenidae	*Sphyraena* sp.		123	22	1	26	14	186
Scombridae	Euthynnus affinis		2			1	1	4
	Thunnini		133	3			2	138
			8	8	3			19
Paralichthyidae	*Pseudorhombus* sp.		2					2
Triacanthidae			3				9	12
Tetraodontidae			3					3
Unknown Perciformes			259	284				543
Unknown Fish		3	1110	55	24	83	130	1405
Total identified (NISP)		3	4480	1641	208	677	641	7650
Grand total (NISP)		6	5849	1980	232	760	771	9598

(Serranidae/Epinephelidae), barracudas (Sphyraenidae), tuna and mackerels (Scombridae), needlefish (Belonidae), flatheads (Platycephalidae), mullets (Mugilidae), requiem sharks (Carcharhinidae), parrotfish (Scaridae), tripodfish (Triacanthidae), snappers (Lutjanidae), mojarras (Gerreidae), milkfish (Chanidae), sharksuckers (Echeneidae), sea catfish (Ariidae), pufferfish (Tetraodontidae), shortfin flounders (Paralichthyidae), and grunts (Haemulidae).

Bones from seabreams and emperors, however, dominated the entire assemblage. This was true in the case of by Sector, by Phase and by Level. Fish bones were found in all 14 recorded levels at the site (Table 5.9). However, Levels 1 and 14 contain < 10 remains each. Levels 2, 4, and 7 contain modest quantities (50-350 fragments). Levels 6, 8-14 contain large quantities (> 800 fragments).

Figure 5.3. Tiger shark (*Galeocerdo cuvier*) tooth (UAQ2.648) found at UAQ2, Level 10; Scale: 5 mm; Credits: M. J. Beech (photo) and K. Lidour (editing).

Figure 5.4. Sample of otoliths retrieved from UAQ2. Credits: L. Yeomans; Scale in mm.

Table 5.3. Fish families quantification (in NISP) by phases.

Family	Common name	A	B	C	D	E	F	Total
Carcharhinidae	Requiem sharks		15	1				16
Chanidae	Milkfish		9					9
Ariidae	Sea catfish		3	1				4
Mugilidae	Mullets		22	2	1	1	4	30
Belonidae	Needlefish		9	2		32	15	58
Platycephalidae	Flatheads		10	4		15	12	41
Ser./Epineph-elidae	Groupers		126	41	3	11	25	206
Echeneidae	Sharksuckers		7					7
Carangidae	Jacks/ Trevallies		75	19	9	84	28	214
Lutjanidae	Snappers		4			4	3	11
Gerreidae	Mojarras		1	1	1	1	6	10
Haemulidae	Grunts			1				1
Lethrinidae	Emperors	3	1685	910	109	33	37	2778
Sparidae	Seabreams		2228	625	81	469	485	3888
Scaridae	Parrotfish		12	1				13
Sphyraenidae	Barracudas		123	22	1	26	14	186
Scombridae	Tuna/ Mackerels		143	11	3	1	3	161
Paralichthyidae	Shortfin Flounders		2					2
Triacanthidae	Tripodfish		3				9	12
Tetraodontidae	Pufferfish		3					3
Unknown Fish		3	1369	339	24	83	130	1948
Total identified (NISP)		3	4480	1641	208	677	641	7650
Grand total (NISP)		6	5849	1980	232	760	771	9598

All major anatomical elements were represented for the major fish species, including cranial, vertebral and appendicular items (Table 5.8). This means that fish were brought to the site in a relatively complete form. Cranial elements, e.g. premaxilla and dentary, were the most common anatomical elements recorded, and there were a considerable number of otoliths (calcified structure within the ears of the fish). These elements have preferentially survived, however, because of their hard and compact nature, and their ability to be easily recognised and quantified. Most commonly represented were: seabreams (50.8%), followed by emperors (36.3%), jacks and trevallies (2.8%), groupers (2.7%), barracudas (2.4%), tuna and mackerels (2.1%) (other taxa 1% or less).

Table 5.4. Fish families quantification (in %NISP) by phases.

Family	Common name	B	C	D	E	F
Belonidae	Needlefish				4.7%	2.3%
Platycephalidae	Flatheads				2.2%	1.9%
Ser./Epinephelidae	Groupers	2.8%	2.5%	1.4%	1.6%	3.9%
Carangidae	Jacks/Trevallies	1.7%	1.2%	4.3%	12.4%	4.2%
Lethrinidae	Emperors	37.6%	55.5%	52.4%	4.9%	5.8%
Sparidae	Seabreams	49.7%	38.1%	38.9%	69.3%	75.8%
Sphyraenidae	Barracudas	2.7%	1.3%		3.8%	2.2%
Scombridae	Tuna/Mackerels	3.2%		1.4%		
Triacanthidae	Tripodfish					1.4%
Other		2.2%	1.5%	1.4%	1.0%	2.5%
Total identified (NISP)		4480	1641	208	677	641
Grand total (NISP)		5849	1980	232	760	771

Table 5.5. Diameter of the fish vertebrae diameter (in NISP) by phases.

Diameter (in mm)	A	B	C	D	E	F	Total
1		1					1
2		27	4			1	32
3		90	8	3	31	35	167
4	3	816	84	16	64	97	1080
5		618	105	6	32	43	804
6		239	60	3	20	8	330
7		114	16	2	20	4	156
8		64	13	2	11	4	94
9		35	5	1	7	1	49
10		32	3		5	2	42
11		28	7	3	2	3	43
12		22	2		4	4	32
13		19	6	1	4	3	33
14		17	5	1	4	2	29
15		9	2		8	5	24
16		1		2	3	1	7
17		15	1		3		19
18		4		1	1		6
19		1				1	2
20							
21		1		1			2
22							
23							
24							
25		1					1
26							
27							
28							
29						3	3

Table 5.6. Fish size categories (in NISP) by phases.

Size category	B	C	D	E	F	Total
00 cm - 09.99 cm	3	1	1			5
10 cm - 19.99 cm	739	105	32	173	138	1187
20 cm - 29.99 cm	1065	397	28	219	313	2022
30 cm - 39.99 cm	143	34	3	32	29	241
40 cm - 49.99 cm	34	6		22	12	74
50 cm - 59.99 cm	7	4	1	11	6	29
60 cm - 69.99 cm	4	1		4		9
70 cm - 79.99 cm	1					1
80 cm - 89.99 cm	1					1
90 cm - 99.99 cm		1				1

Fishing for tuna seems to have taken place mostly during Phase B, the earliest period of occupation at the site (Tables 5.3-4). More tuna was present in Levels 11-13 (Table 5.9) at the site than in the upper levels of the site. The apparent increase in the proportion of seabreams in the later phase of occupation at the site (Phases E and F) suggests that fishing became even more focussed on local exploitation of the shallow waters of the neighbouring lagoon, as well as nearby shallow coastal waters.

One exceptional find was a complete tooth of a tiger shark (*Galeocerdo cuvier*) (UAQ2.648) (Figure 5.3). This was found in the earliest levels at the site (Level 10, in Phase B). Such teeth have been previously identified in Bronze Age levels at Umm an-Nar, as well as from the Sultanate of Oman (as reported by Charpentier *et al.* 2009), where it has been suggested they were used as weapons. A perforated tiger shark tooth has been found at Marawah MR11 (Area C) (Lidour et al. 2024b: fig. 1.4) where it was likely used as a pendant (KL). Whether the inhabitants of UAQ2 caught the tiger shark, or simply collected the

Table 5.7. Quantification in NISP (data sources: present study; Beech 2010; Uerpmann and Uerpmann 2018; von den Driesch and Manhart 2000; Desse 1988; Lidour and Beech 2019; Lidour and Beech 2020; Lidour *et al.* 2020a; Lidour *et al.* 2020b. Data editing: K. Lidour).

	UAQ2	H3	DOS	ALM-J19	Khor P	DA11	MR11.A	Akab	UAQ36
NISP identified	7650	3498	1554	16293	843	17354	2786	12550	607
Carcharhiniformes		6%	3%			15%	10%		
Rhinopristiformes			19%				4%		
Myliobatiformes		3%							
Clupeidae				9%					
Ariidae		7%	2%					5%	
Mugilidae								5%	5%
Atherinidae					21%				
Belonidae						22%		5%	
Ser./Epinephelidae	3%	20%	11%	4%		11%	5%		
Carangidae	3%	12%	13%			2%		38%	
Lutjanidae									7%
Gerreidae				2%					7%
Haemulidae							23%		
Lethrinidae	37%			2%		7%	17%	6%	8%
Sparidae	51%	45%	28%	83%	79%	18%	18%	14%	40%
Siganidae									15%
Sphyraenidae	2%						4%		4%
Scombridae	2%		21%			13%		20%	
Other	3%	7%	3%			4%	12%		15%

tooth from a stranded individual and used it as an amulet is not clear.

Tiger sharks can be extremely large and dangerous to handle. They commonly attain a length of 3 m - 4 m, and can weigh from 385 kg - 635 kg. Male tiger sharks can grow up to 4.5 m and females up to 5.5 m. Tiger sharks are common worldwide and are often found close to the coast, mainly in tropical and subtropical waters. They often visit shallow reefs, harbours and canals, creating the potential for encounters with humans.

A modern study of the marine biology of the adjacent UAQ lagoon identified the presence of more than 110 species of fish (Department of Fisheries 1984: 36). Almost all the taxa identified at the archaeological site at UAQ2 were noted as being medium to abundant in quantity in the modern fisheries study of the lagoon. The only taxa discovered in the archaeological samples from UAQ2 that cannot be found in the lagoon at the present day (Table 5.10) are:

- The tiger shark (*G. cuvier*), a common wide-ranging coastal pelagic shark occurring in a wide range of habitats throughout the area.
- The king soldierbream (*Argyrops spinifer*), which is found in inshore waters at moderate depths on muddy, sandy bottoms, to offshore habitats.
- The kawakawa (*Euthynnus affinis*), which is an epipelagic species (i.e. relating or inhabiting the uppermost layer of the water column of the open ocean, into which enough sunlight enters for photosynthesis to take place, extending in clear waters to a depth of *c.* 200 m).

So, it may be that these fish were caught by fishermen venturing in the open seas and coastal areas outside the confines of the local UAQ lagoon.

Size of fish and fishing strategies

Most of the fish caught at UAQ2 are emperors and seabream, sized between 10 cm - 30 cm in length (Table 5.6). This is clear if one reconstructs the size classes for all the fish remains based on key diagnostic elements (vomer, premaxilla, dentary, articular, maxilla, quadrate, hyomandibular, lower pharyngeal, cleithrum, and post-temporal).

A similar pattern can be seen if one examines the size distribution of fish using diagnostic elements throughout

Table 5.8. Quantification of anatomical elements (in NISP).

Family	Species	NEU	BAS	OTO	VOM	UPH	LPH	TOO	AR	DE	MA	PM	QU	HY	OP	CL	PT	SC	PE	FV	AV	CV	CVP	CVU	V	Total
Carcharhinidae	*Galeocerdo cuvier*							1																		1
	Carcharhinus sp.							11														1			3	15
Chanidae	*Chanos chanos*																				3	6				9
Ariidae				4																						4
Mugilidae																					7	22	1			30
Belonidae										25		18									13	2				58
Platycephalidae	*Platycephalus* sp.				1				20	11	1	2								1	5					41
Ser./Epinephelidae	*Epinepehelus* sp.			9	1				1	8	6	10	5							1	1					42
			2	23	3				12	8	16	21	6	3			3			11	48	5			3	164
Echeneidae	*Echeneis naucrates*																			2		5				7
Carangidae	*Atule mate*																					1				1
	Platycaranx sp.				4				3	3	1	4		4		1				3		16	4	3		46
	Elagatis bipinnulata																					2				2
	Gnathanodon speciosus								1	10	7	2	4	3	2					8	6	23	1			67
	Scomberoides sp.								1	2	2	3									2	8				18
			1		2				4			2	3	1		1		7			4	38	17			80
Lutjanidae	*Lutjanus* sp.									11																11
Gerreidae	*Gerres* sp.								2			8														10
Haemulidae																						1				1
Lethrinidae	*Lethrinus* sp.		4	2354	5				12	47	31	129	8	10	4					67	87	18		1	1	2778
Sparidae	*Acanthopagrus* sp.			1					3	141	16	296														457
	Argyrops spinifer	1		2					5	130	2											2				142
	Rhabdosargus sp.			45				116	3	912	41	768		2			1		1	1						1890
					1			128	26	250	36	409	2	2			1			45	121	355	1		22	1399
Scaridae						4	4			1		3										1				13
Sphyraenidae	*Sphyraena* sp.					8			5	37		3								15	60	55			3	186
Scombridae	*Euthynnus affinis*									3																3
	Thunninae										1	2									7	122	4	3	3	142
																					1	8	7			16
Paralichthyidae	*Pseudorhombus* sp.																					2				2
Triacanthidae											1	4										7				12
Tetraodontidae										3																3
Total		1	7	2438	17	12	4	256	98	1602	161	1684	28	25	6	2	5	7	1	154	365	700	35	7	35	7650

Table 5.9. Fish species quantification (in NISP) by levels.

Family	**Species**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Carcharhinidae	Galeocerdo cuvier										1						1
	Carcharhinus sp.								1	1		1	10	2			15
Chanidae	Chanos chanos												5	4			9
Ariidae									1	2		1					4
Mugilidae					4		1	1	2	8	7	2		3	2		30
Belonidae			1	3	11		32		2		5	2	2				58
Platycephal-idae	*Platycephalus* sp.		1	7	4		15		4	1	2	2		2	3		41
Ser./Epinephel-idae	*Epinepehelus* sp.		1	4	4		2		15		5	7		1	3		42
				7	8	1	9	3	26	8	23	26	13	12	28		164
Echeneidae	Echeneis naucrates											2	5				7
Carangidae	Atule mate						1										1
	Platycaranx sp.				5		27		5	3	4		1		1		46
	Elagatis bipinnu-lata								2								2
	Gnathanodon speciosus		7	5	1		14	2	3	2	3	8	9	9	4		67
	Scomberoides sp.				1		13	2	2								18
				6	2		29	5	7	1	3	8	8		11		80
Lutjanidae	*Lutjanus* sp.			2	1		4				1	1	1		1		11
Gerreidae	*Gerres* sp.			5	1		1	1	1						1		10
Haemulidae									1								1
Lethrinidae	*Lethrinus* sp.	1		14	16	7	33	109	910	389	460	386	122	64	264	3	2778
Sparidae	*Acanthopagrus* sp.		29	29	52	4	29	8	79	29	36	108	16	19	19		457
	Argyrops spinifer		1	3	4		4	1	22	11	33	40	9	4	10		142
	Rhabdosargus sp.		30	68	116	8	278	43	331	138	192	241	131	142	172		1890
			17	47	70	7	158	29	193	94	192	151	161	138	142		1399
Scaridae									1	1	2	2	3		4		13
Sphyraenidae	*Sphyraena* sp.		1	5	6	2	26	1	22	10	24	28	30	10	21		186
Scombridae	Euthynnus affinis				1								2				3
	Thunninae			2			1	3	3	9	7	20	80	10	7		142
									8		4	3			1		16
Paralichthyidae	*Pseudorhombus* sp.											2					2
Triacanthidae				9							2	1					12
Tetraodontidae												2	1				3
Unknown Perciformes									284	6	64	14		21	154		543
Unknown Fish		5	6	60	54	5	83	24	55	114	185	150	229	230	202	3	1405
Total identified (NISP)		1	88	216	307	29	677	208	1641	707	1006	1044	609	420	694	3	7650
Grand total (NISP)		6	94	276	361	34	760	232	1980	827	1255	1208	838	671	1050	6	9598

the different levels of the site. An examination of the relative size of all the fish vertebrae recovered by Sector, Phase and Level also confirms that the majority were small fish, with the maximum width of the vertebrae normally being between 3 mm - 7 mm in diameter (Table 5.5).

Most of the remainder of other species caught were medium-sized individuals from 30 cm - 50 cm in length (Table 5.6). The only larger fish to be caught were some larger members of the Carangidae family, e.g. as trevallies (*Platycaranx* sp.) and golden trevally (*Gnathanodon speciosus*), which were 60 cm - 70 cm in length, and in the case of tuna species, i.e. kawakawa (*E. affinis*), between 70 cm - 80 cm in length.

A considerable number of fish otoliths were recovered from the excavations carried out at UAQ2 (Figure 5.4). Thanks to the adoption of sieving at the excavation site and careful retrieval practices, this has helped to recover

Table 5.10. Table of abundance and main fishing techniques for the fish taxa identified at UAQ2 (data source: Department of Fisheries 1984).

Family	Species	UAQ lagoon	Abundance	Gill net	Beach seine	Set net	Cage trap	Handline
Carcharhinidae	*Galeocerdo cuvier*	Not reported	Not reported					
	Carcharhinus sp.	X	++	X				
Chanidae	*Chanos chanos*	X	++	X				
Ariidae		X	++		X	X		
Mugilidae		X	+++	X	X	X		
Belonidae		X	+++	X				
Platycephalidae	*Platycephalus* sp.	X	++		X			X
Ser./Epinepheli-dae	*Epinepehelus* sp.	X	+++				X	X
Echeneidae	*Echeneis naucrates*	X	+	X	X			X
Carangidae	*Atule mate*	X	+++	X	X			X
	Platycaranx sp.	X	++	X	X			
	Elagatis bipinnulata	Not reported	Not reported					
	Gnathanodon speciosus	X	+++	X	X			
	Scomberoides sp.	X	++	X	X			
		X	++	X	X			
Lutjanidae	*Lutjanus* sp.	X	++	X	X		X	X
Gerreidae	*Gerres* sp.	X	+++	X		X		X
Haemulidae		X	++		X		X	X
Lethrinidae	*Lethrinus* sp.	X	+++	X	X		X	X
Sparidae	*Acanthopagrus* sp.	X	+++	X	X		X	X
	Argyrops spinifer	Not reported	Not reported					
	Rhabdosargus sp.	X	+++	X	X	X		X
Scaridae		X	+++	X	X		X	
Sphyraenidae	*Sphyraena* sp.	X	+++	X	X	X		X
Scombridae	*Euthynnus affinis*	Not reported	Not reported					
	Thunninae	Not reported	Not reported					
Paralichthyidae	*Pseudorhombus* sp.	X	++		X			
Triacanthidae		X	++	X	X			X
Tetraodontidae		X	++	X	X			X

a rich sample of finds. These otoliths primarily belonged to emperors. They were extremely consistent in size throughout all the periods represented, being usually between 5 mm - 9 mm in length across the longest axis, versus 4 mm - 7 mm in height. This suggests the regular targeting of a particular size and age class of emperors within the UAQ lagoon.

An earlier investigation carried out on a sample of these otoliths suggested that they were primarily caught between the late spring/early summer (April to June) to early autumn months (late September to early October) (Beech 2004a: 198-207; Beech 2004b). A modern study concerning the growth and maturity of the pink-ear emperor (*Lethrinus lentjan*) in the Arabian Gulf revealed that these two periods correspond to the two main spawning seasons in the year for the species (Ali *et al.* 1984). The ancient inhabitants of UAQ2 were well aware of the importance of the lagoon for fishery nursery grounds and deliberately targeted aggregations of key species spawning there.

Fishing Methods

A modern study of fish present in the UAQ lagoon also noted their abundance and the fishing methods used at the present day to catch them (Department of Fisheries 1984). Judging from the species represented in the archaeological samples, the majority of fishing could have taken place in the nearby lagoon using techniques such as beach seine nets, gill nets, cage traps, set nets, and hand lines (Table 5.10).

Traditional fishing methods utilised in the region include various forms of basket traps known as *gargur* (large ones sometimes being referred to as *dubaya*). Traditionally these were cylindrical in shape with a cone-like entrance, the whole trap being made from interwoven palm fronds. Nowadays these are usually made with imported steel from the Far East and tend to be dome-shaped traps with a base diameter of between 1 m - 2 m, supported by reinforced steel bars and a funnel-like entrance. Such traps are normally set in the afternoon and the retrieval of fish is then carried out the following morning.

Other traditional fishing methods utilised in the shallow waters of the Gulf are tidal barrier traps, known locally as *hadrah*. These were originally made by driving a row of palm fronds and wooden stakes into the mud-sand bottom, supported by stones at their base. Other variants of tidal barrier traps exist in the UAE, including *skar*, a wide fence of nets linked by wooden posts, often stretched across narrow estuaries or entrance gaps in lagoons. Ancient stone fish trap barriers have been noted by various archaeologists in both the western region of Abu Dhabi on Delma and Ghagha Islands (Beech 2003; 2004: 46-7, figs. 14-15), as well as along the coastline of Qatar (Breeze *et al.* 2011). Such sites are difficult to date precisely. In the UAE they are mostly believed to date back to the Islamic period, but fish trap barriers are known to have been used elsewhere in the world, even way back into prehistory, i.e. as old as 9000 years ago (BBC News 2012).

Various types of gill nets, known locally in the Gulf as *liekh*, often set on the sea bottom, as well as drifting gill nets, known as *hayal*, are also used in the region. Two nets are used, one is movable, the other being fixed with weights. Beach seines, known locally as *yaroof*, are also sometimes used and can be up to 40 m or more in length. These nets are weighted down with stone net sinkers. A further type of net utilised is the casting net, known locally as *salieya*. Fishermen wade into shallow waters and throw onto the surface of the water a bell-shaped fine net which has small weights around its base to make it sink and surround the fish. Quantities of stone net sinkers were discovered during the UAQ2 excavations (see Chapter 4), so it is likely that some of the fishing at the site was carried out using nets.

Other possible fishing methods may have included the use of harpoons, known locally as *umla*, large wooden spears being referred to as *katra*. Such equipment may have been used to spear larger pelagic fish, i.e. tuna, and was occasionally used in the past to catch cetaceans.

One of the simplest forms of fishing is to use a simple hook and line, known locally as *hadaq*. Shell hooks, made from pearl oyster shell, were discovered at the UAQ2 site, providing the first evidence of shell fish hook technology in the Gulf (Méry *et al.* 2008; see Chapter 4)

As stated earlier, there has been speculation that shark teeth may have also been used as weapons. Such finds have been discovered in Bronze Age levels at Umm an-Nar, as well as from Oman (Charpentier *et al.* 2009). These may have been used as elements in composite tools, designed as a sort of spear.

In any case, it seems likely from the surviving evidence that the occupants of UAQ2 utilised a variety of methods to catch their fish. Different and appropriate methods would be used to target particular species at particular times of the year.

Comparisons

The fish fauna identified from the work carried out at UAQ2 can be compared with other fish bone assemblages known within other Neolithic sites in the Gulf, i.e. as-Sabiyah H3 in Kuwait (Beech and Al-Husaini 2005; Beech 2010), Dosariyah in Saudi Arabia (Beech 2004a; Uerpmann and Uerpmann 2018), al-Markh ALM-J19 in Bahrain (von den Driesch and Manhart 2000), Khor P in Qatar (Desse 1988), Delma DLM19 (DA11) (Beech 2000; Beech and Elders 1999; Beech and Glover 2005; Beech *et al.* 2000; Lidour and Beech 2019), Marawah MR11 (Beech *et al.* 2005; Lidour and Beech 2020; Lidour et al. 2024b), Akab (Lidour *et al.* 2020a), and UAQ36 (Lidour *et al.* 2020b) in the UAE.

Several key families are represented at all these sites, with significant quantities of groupers, jacks and trevallies, emperors, seabreams, barracudas, and tuna being also exploited at other Neolithic sites in the region.

The largest collection of fish bones from an archaeological site dating to this period is the assemblage from al-Markh ALM-J19, located on the south-west coast of Bahrain (von den Driesch and Manhart 2000). The recovery of material from the excavation was carried out initially using a 4 mm mesh sieve. Some of the deposits in the lower levels at ALM-J19 were recovered by wet sieving using a plastic fly-screen mesh (*c.* 1.5 mm). The resulting fractions were subsequently divided into > 5 mm, 1.5 mm - 5 mm and < 1.5 mm. Only the > 5 mm fish bones were analysed, as well as a very small proportion of the < 5 mm bones. The al-Markh fish bone assemblage was dominated by seabreams, which formed 83% of those bones identifiable to family. The most common genera represented amongst these remains were goldstriped/Haffara seabream (*Rhabdosargus* sp.), closely followed by *Acanthopagrus* sp. This is very similar to the situation at UAQ2, indicating a similar preference for fishing in shallow coastal waters and lagoons.

Smaller quantities of fish bones are known from other fish bone assemblages from the 6th and 5th millennia

BCE in the Arabian Gulf (Beech 2002; 2004a: 50-4; Lidour 2018). These sites include H3 (Beech 2010), Dosariyah (Beech 2004a; Uerpmann and Uerpmann 2018), Khor P (Desse 1988), DLM19 (DA11), MR11, and Akab in the UAE (Beech 2004a; Lidour and Beech 2019; Lidour and Beech 2020; Lidour *et al.* 2020a). Seabreams, emperors, and groupers usually form the bulk of the assemblage. A notable quantity of tuna was also noted in the assemblage from Dosariyah, DLM19 (DA11), and Akab, indicating that fishing may also have been carried out there in deeper waters, necessitating the use of boats.

Conclusion

The analysis of the fish bone assemblage from UAQ2 has provided an answer to our question relating to what kind of fishing was carried out.

Most fishing could have taken place in the local nearby lagoon, and in adjacent shallow coastal areas. Some offshore fishing was practised in boats on the open seas, as several types of fish were identified, which, according to a modern fisheries study of the UAQ lagoon, are not present there today. This means that either some fishing was carried out in more open seas, perhaps in boats, beyond the reach of the lagoon, or that perhaps the environmental conditions within the lagoon were different to the present time, being more open to the sea and therefore more accessible to some pelagic species.

As to what kinds of fishing equipment were being used to catch the types of fish identified, the UAQ excavations identified the presence of shell hooks and net sinkers, indicating that fishing using handlines and nets was certainly taking place.

Was there any evidence for seasonal fishing activities at the site, or could occupation have been all year round at the site? Investigation of the emperor otoliths suggested that coastal populations targeted spawning aggregations of these particular fish during the late spring/early summer (April to June) as well as the early autumn months (late September to early October). Taking this into account, plus the fact that fishing is generally optimal during the cooler winter months, plus the evidence of the mammal bones (showing that domestic animals were being bred during certain periods throughout the year), this means that occupation could be almost all year round.

The ancient inhabitants of UAQ2 were well aware of the importance of the lagoon as fishery nursery grounds and deliberately targeted aggregations of key species spawning there. The inhabitants were also aware of the importance of the pearl oyster at this early time, which also kept them preoccupied with related activities on the coast (Charpentier *et al.* 2012a).

Table 5.11. Quantification of terrestrial mammal remains from UAQ2.

Family	Tribe	Species	NISP	WISP
Bovidae	Antilopini	*Gazella* sp.	41	149.5
		cf. *Gazella*	4	19.5
	Bovini	*Bos* sp.	168	1584
		cf. *Bos*	2	48
	Caprini	*Capra* sp.	128	784.5
		cf. *Capra*	3	15.4
		Ovis sp.	83	335.15
		cf. *Ovis*	3	16.7
		indet.	2226	5979.95
	Hippotragini	Oryx leucoryx	6	17.4
		cf. *Oryx*	1	4.5
	indet.	indet.	6	51.8
Canidae	Canini	Canis familiaris	1	1
		Canis aureus/ familiaris	1	0.1
		Canis sp.	33	68.4
	Vulpini	Vulpes vulpes	1	1.5
		Vulpes sp.	3	5.9
	indet.	indet.	2	2.1
Felidae	Felini	Felis catus	1	5
		Felis cf. *chaus*	1	1
		Felis cf. *margarita*	1	1
		Felis sp.	2	2.5
Leporidae		*Lepus* sp.	11	15.5
Mustelidae		Martes martes	1	1
Martes cf. *foina*		1	0.6	
Erinaceidae		*Erinaceus* sp.	1	2
Indet. Carnivora			2	1.7
Indet. Rodentia			1	0.2
Indet. small Ruminantia			1785	3124
Indet. medium mammal			4333	4838.2
Indet. large mammal			391	2098.3
Indet.			2678	2399.6
Total Mammal			11921	21580.1

Mammals, Birds, and Reptilia

M. Mashkour, K. Debue, S. Bréhard

Introduction

UAQ2 provides one of the main zooarchaeological assemblages for terrestrial mammals in the UAE. The

Table 5.12. Quantification of terrestrial mammal remains from UAQ2 by phases.

Family	Tribe	Species	Phase B	Phase C	Phase D	Phase E	Phase F	Unphased	Total
Bovidae	Antilopini	*Gazella* sp.	29	7	2	2	1		41
		cf. *Gazella*	4						4
	Bovini	*Bos* sp.	125	25	3	5	10		168
		cf. *Bos*	2						2
	Caprini	*Capra* sp.	88	19	8	4	8	1	128
		cf. *Capra*	3						3
		Ovis sp.	53	19	1	5	5		83
		cf. *Ovis*	3						3
		indet.	1449	317	100	153	200	7	2226
	Hippotragini	Oryx leucoryx	6						6
		cf. *Oryx*	1						1
	indet.	indet.	5		1				6
Canidae	Canini	Canis familiaris		1					1
		Canis aureus/ familiaris	1						1
		Canis sp.	28	3	1		1		33
	Vulpini	Vulpes vulpes	1						1
		Vulpes sp.	3						3
	indet.	indet.	2						2
Felidae	Felini	Felis catus	1						1
		Felis cf. *chaus*		1					1
		Felis cf. *margarita*	1						1
		Felis sp.	2						2
Leporidae		*Lepus* sp.	9		1		1		11
Mustelidae *Martes* cf. *foina*		Martes martes		1					1
		1						1	
Erinaceidae		*Erinaceus* sp.				1			1
Indet. Carnivora				2					2
Indet. Rodentia				1					1
Indet. small Ruminantia			1168	265	71	151	122	8	1785
Indet. medium mammal			2950	966	199	95	108	15	4333
Indet. large mammal			304	43	4	21	18	1	391
Indet.			1798	104	143	262	357	14	2678
Total Mammal			8037	1774	534	699	831	46	11921

other main site in the region is al-Buhais BHS18 (Sharjah Emirate, UAE) (Uerpmann and Uerpmann 2000), for which similar faunal information exists.

Zooarchaeological analyses have been undertaken by MM and KD since 2011 at the NNHM (Paris, France). In 2016, SB joined the team to treat the kill-off patterns.

Methods

Although limited, the identified remains bear precious taxonomic, morphological, and demographic information. Anatomical and taxonomic identifications were conducted according to the methods of comparative anatomy, using the osteological collections of mammals and avians housed at the NNHM of Paris.

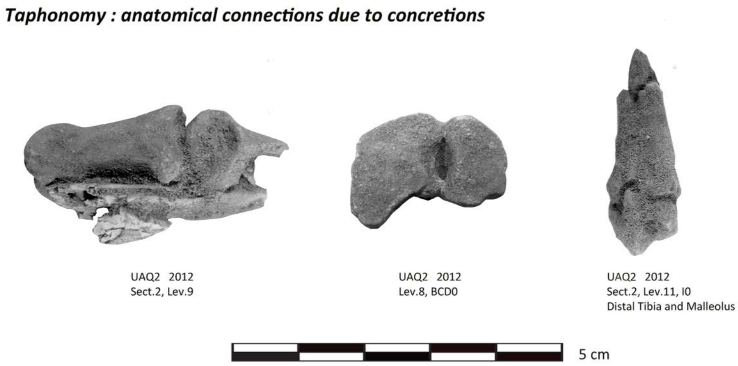


Figure 5.5. Examples of mammal remains showing anatomical connections due to concretions.

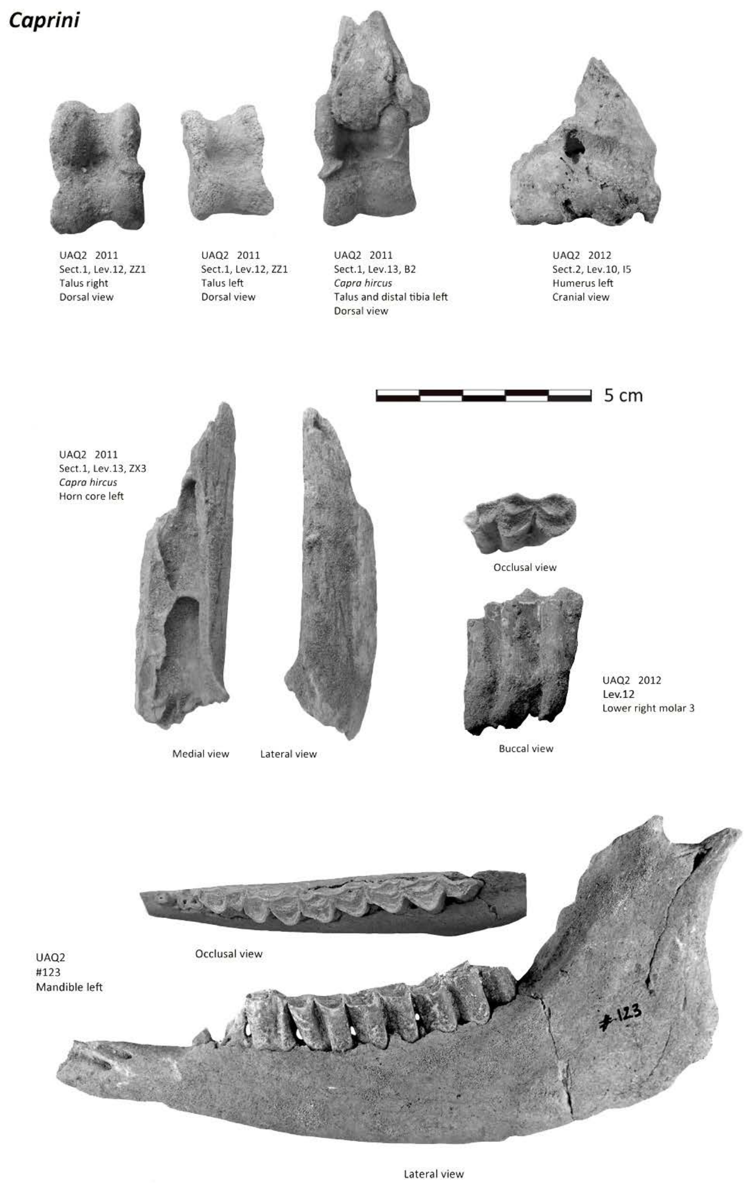


Figure 5.6. Examples of caprine remains from UAQ2.

Figure 5.7. Examples of remains belonging to cattle (*Bos taurus*) from UAQ2.

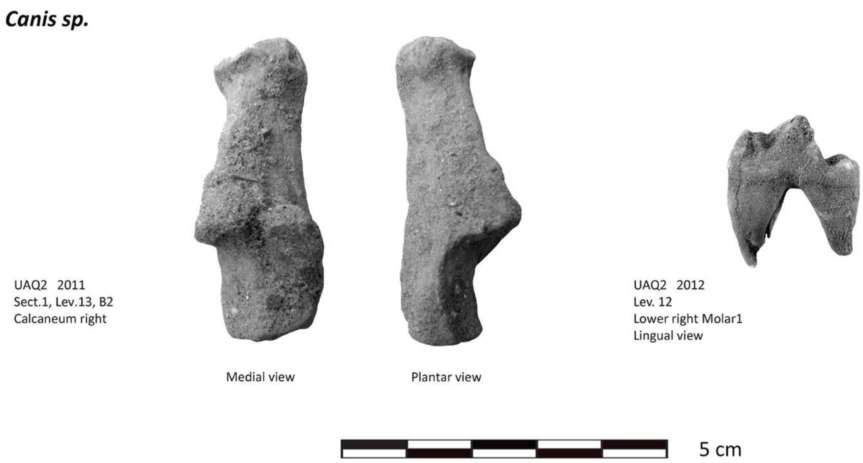


Figure 5.8. Examples of *Canis* sp. remains from UAQ2.

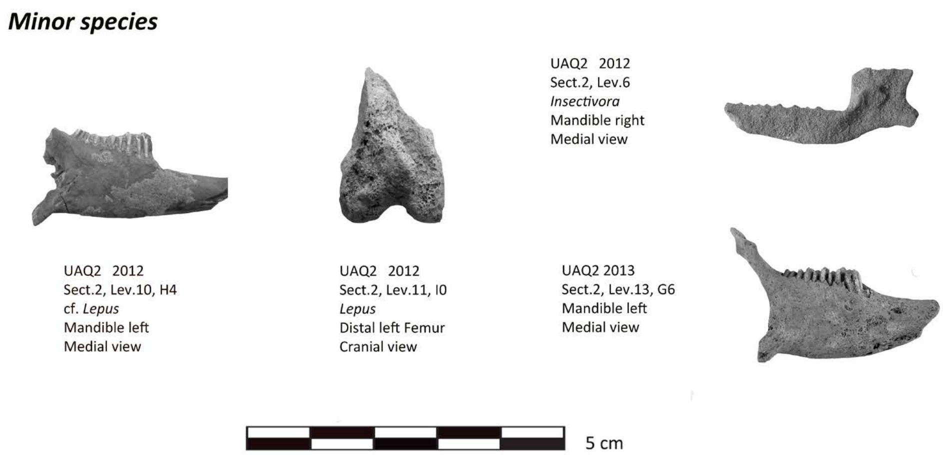


Figure 5.9. Examples of *Felis* sp. remains from UAQ2.

Felis sp.

Figure 5.10. Examples of leporid and rodent remains from UAQ2.

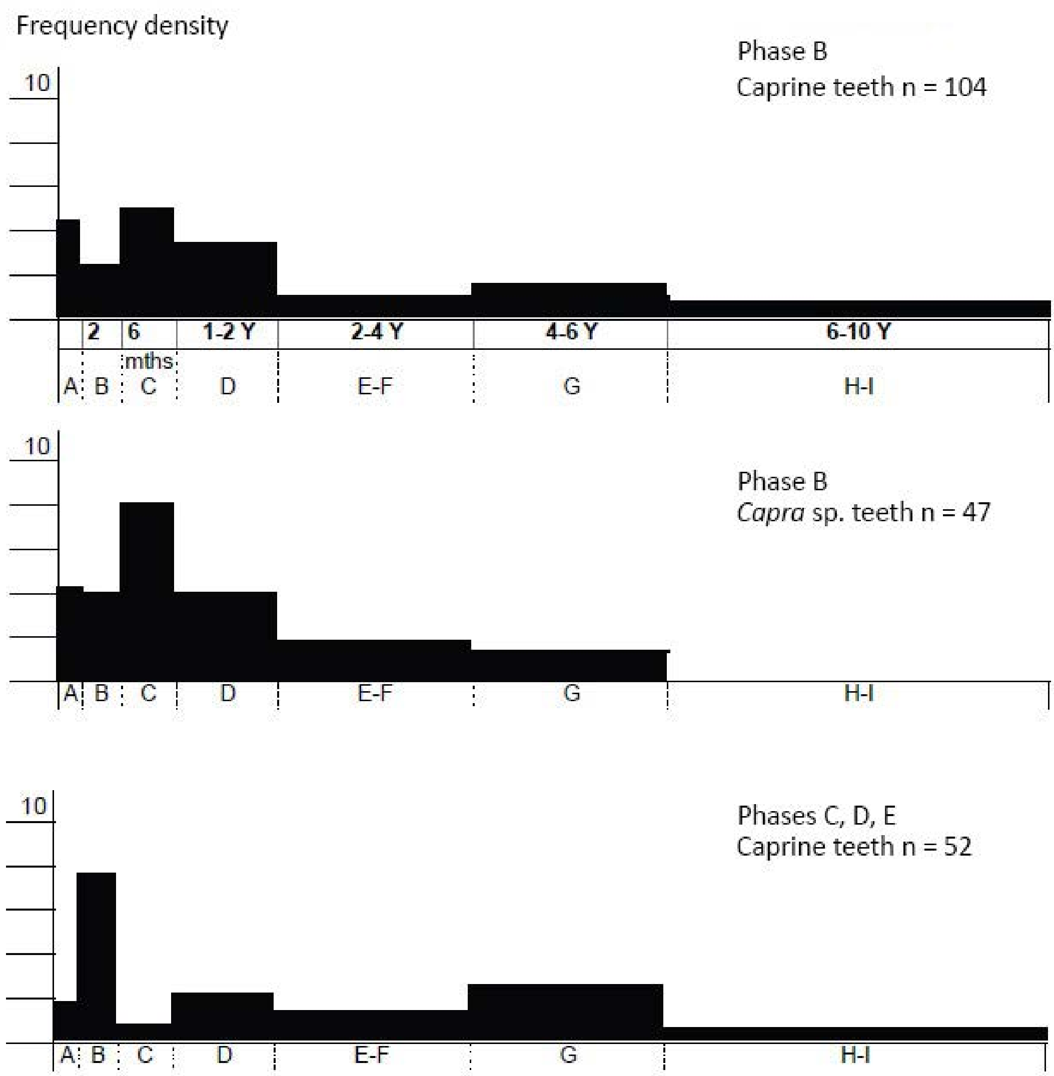


Figure 5.11. Kill-off pattern for the UAQ2 caprines.

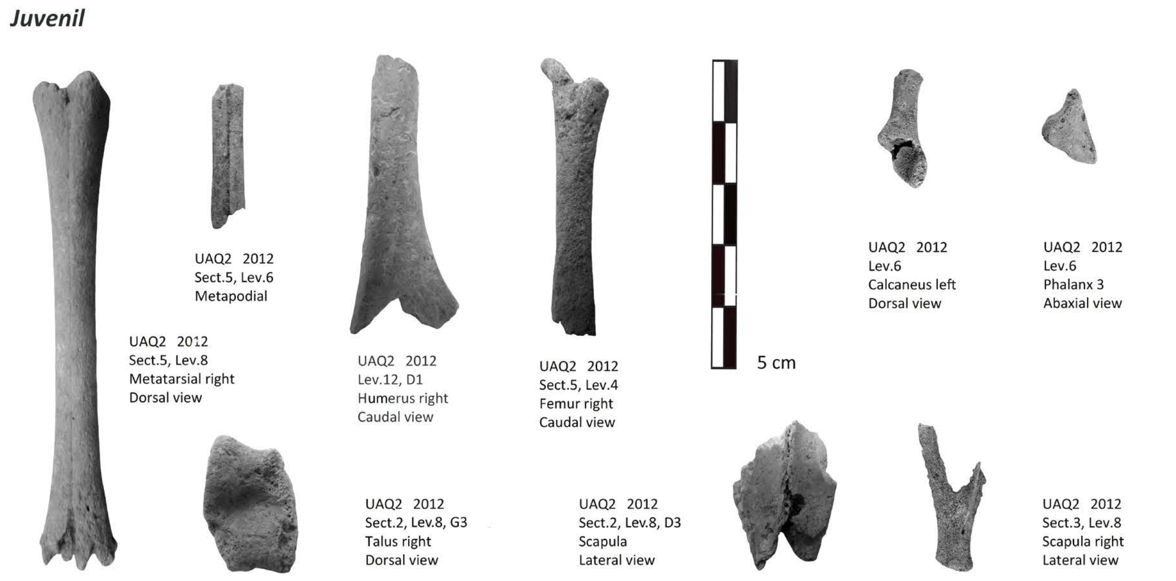


Figure 5.12. Examples of remains belonging to juvenile caprines from UAQ2.

Quantifications are based on the number of identified specimens (NISP), the minimum number of individuals (MNI), and the weight of identified specimens (WISP).

Measurements on bones were carried out using a digital calliper and the Log Size Index (LSI) method (Uerpmann and Uerpmann 1994; Meadow 1999). This method is based on the logarithmic comparison of the metric data, where a modern reference is used as a standard: *Ovis* bones were compared to a wild Sheep (*Ovis orientalis*) and *Capra* bones were compared to a wild goat (*Capra aegagrus*), both published by Uerpmann and Uerpmann (1994).

General results

In total, out of *c.* 12,000 mammalian and avian bones, corresponding *c.* to 22 kg, have been studied (Table 5.11). Only 38% could be identified only taxonomically. Indeed, the mammalian and avian remains are, in general, poorly preserved (with an average bone weight of 1.8 g).

The remains of UAQ2 are distributed all over the site, but mainly in Sector 1+2. Sectors 3, 4, and 5 have provided < 500 remains. The bulk of the material belongs to Phase B (67% of the total assemblage) (Table 5.12). It is followed by Phase C, which gather about 15% of the material. Phases D, E, and F are only represented very little in the faunal remains.

Heavy to medium concretion is the main factor responsible for this bad conservation and the high rate of unidentified remains. We believe that the concretion was deposited quickly, as many carpal or tarsal bones were still articulated (Figure 5.5). The concretion on the bones also made the reading of traces on the bone surface quite difficult. Many bones were either carbonised or calcined and fragmented, and derived from consumption refuse. The high fragmentation may indicate trampling.

The exploited species are predominantly caprines: goat (*Capra* sp.) and sheep (*Ovis* sp.) (Figure 5.6). Goats represent two-thirds of the caprines, with cattle (*Bos* sp.) being the second most important group of herbivores exploited (Figure 5.7). The remains of *Capra* and *Ovis* are of a size compatible with domestic forms, as recorded from other samples of the population of the region: i.e. from the 3rd-millennium BCE occupation at Qala'at al Bahrain (Uerpmann and Uerpmann 1994), and are larger than at al-Buhais BHS18 (Skorupka and Mashkour 2013: fig. 2).

On the other hand, an unusual number of medium-sized *Canis* bones were identified, most of compatible with dogs, although jackals (*Canis aureus*) cannot *a priori* be excluded (Figure 5.8). This animal was part of the diet, according to the multiple cutmarks sometimes visible on the bones. The practice seems to be widespread in the region, as witnessed by faunal assemblages in the Sultanate of Oman (Maini and Curci 2013).

Among the wild ungulates, only gazelle (*Gazella* sp.) bones could clearly be identified. Only five specimens could be allocated to oryx (*Oryx leucoryx*). Very few remains of small carnivores, including *Felis margarita* (Figure 5.9) and

Vulpes vulpes, were identified. Hare (*Lepus* sp.) remains and other small vertebrates were present in the assemblage, some of which were exploited, and some intrusive, i.e. insectivores (Figure 5.10).

Bird remains are represented by a few specimens and their identification has not yet been completed (Table 5.13) – some bones could belong to the Socotra cormorant (*Phalacrocorax nigrogularis*). They obviously did not have an important role in the diet of UAQ2 communities.

Kill-off patterns, seasonality, and residential mobility at UAQ2

One of the key questions is documenting the residential seasonality of the prehistoric human communities occupying coastal sites in this part of the world.

Demographic data were fortunately and exceptionally available for UAQ2, as paradoxically the mineralised concretion on the surface of the specimens was beneficial in preserving the fragile bones and teeth. This is the reason why it was possible to reconstruct the kill-off patterns for caprines based on the tooth eruption and wear methods (Payne 1973; Helmer and Vigne 2007).

The kill-off patterns are based on caprines and *Capra* dental remains (Figure 5.11). The calculation is based on the number of teeth (Vigne 1988). The analysis of tooth remains allows the following observations:

- The presence of very young animals (age class A; 0-2 months) (Figure 5.12). They have also been identified in the post-cranial elements. These individuals most probably result from natural mortality.
- The important presence of very young to young animals (age classes A and B; 0-6 months; from 9% to 17% of the teeth) clearly indicates that herds (or at least part of the herds) and herders were present at the site during at least the period of birth and a few weeks afterwards.
- The analysis of tooth remains raises the question of the birth season. Although difficult to reconstruct without an ethnographic or traditional case study, considering the temperature and insolation in this part of the world, the birth season would have been quite early in the year, between January and March. According to this hypothesis, herders and their flocks were at the site at least from January to June.
- The high frequency of adults over 2 years old (54-66% of teeth) and a significant proportion over 4 years old (42-48%) is an unusual pattern for domestic herds. Typically, domestic animals are slaughtered earlier for meat production efficiency, as highlighted by Payne (1973) and Helmer & Vigne (2007). The UAQ2 pattern suggests alternative management strategies, such as maintaining older animals for milk production or breeding purposes, which is consistent with evidence for early dairying practices.

The kill-off pattern obtained at UAQ2 is consistent with the results from some other coastal Neolithic sites, such as Dosariyah (Drechsler 2018: 466), where goats seem to have been exploited mainly for milk production.

The presence of domestic ungulates is also documented at Akab, al-Buhais BHS18, and Delma DLM19 (DA11) (Beech and Glover 2005; Charpentier and Méry 2008; Méry *et al.* 2009; Uerpmann and Uerpmann 2000; 2008). Farther east, in the Sultanate of Oman, the same observations can be made in the Ras al Hamra RH5 and RH6 shell middens (Uerpmann and Uerpmann 2003: 210-235).

For *Ovis*, not much can be said due to the lack of data; for *Capra,* the proportion of adults is less important (40% of the teeth over 2 years and 18% over 4 years old) because the sample is smaller and 3 of the 5 individuals (based on MNI) in class HI could not be allocated precisely to *Capra* or *Ovis*. This is why it is important to interpret the kill-off profile for goats while considering in parallel the global caprine profile. Given this fact and since at least 40% of the *Capra* teeth represent reproductive adults, we can propose that the *Capra* population was viable, though fragile. Conversely, the cattle (*Bos* sp.) tooth remains were not abundant enough to allow a similar analysis.

The morphology of herbivores

One of the issues with early material in the UAE is to characterise the status of the herbivores, namely the sheep and goat. One of the most common ways to investigate this is using the metric information that is an expression of the morphology of the animals. Measurements were undertaken and compared using the Log Size Index (LSI) method.

Figure 5.13 shows the size distribution of the goats and sheep. Both taxa show very small sizes and thus there is no indication here that the animals could have been wild. This does not mean that wild animals were not present, just that the bulk of the assemblage belonged to animals that had already undergone the process of domestication and had dramatically changed (compared to their wild progenitors).

Conclusion

Within the UAQ2 mammalian remains, domestic herbivores represent between 85% - 95% of the remains throughout the stratigraphy. A variety of carnivores (canids and felids) were also exploited, and dog-sized canids were eaten. One of the remarkable features of

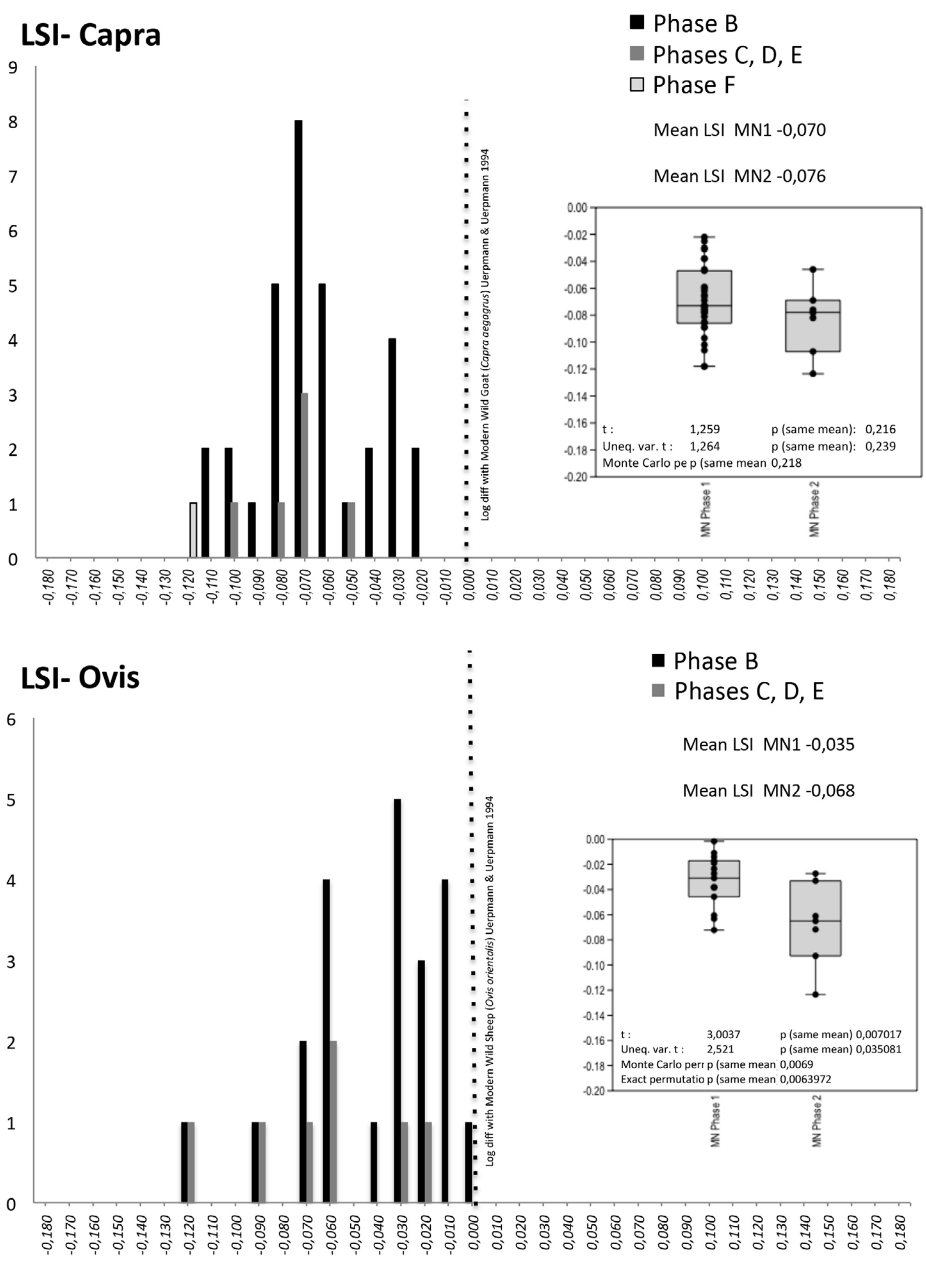


Figure 5.13. LSI histograms for *Capra* and *Ovis* specimens at UAQ2.

the UAQ2 mammalian material is the presence of a high proportion of newborn and juvenile goats, most probably born during the first quarter of the year.

Finally, the integrated study of the faunal remains has clearly contributed to the thorough documentation of the question of the seasonal mobility or sedentism of these coastal human communities. The question of the mobility of Neolithic groups in the UAE and the Sultanate of Oman was recently reassessed, although no firm conclusions were drawn at that time (Méry 2015: 365).

With the current studies, it seems that we are able to propose a reliable scenario, compatible also with

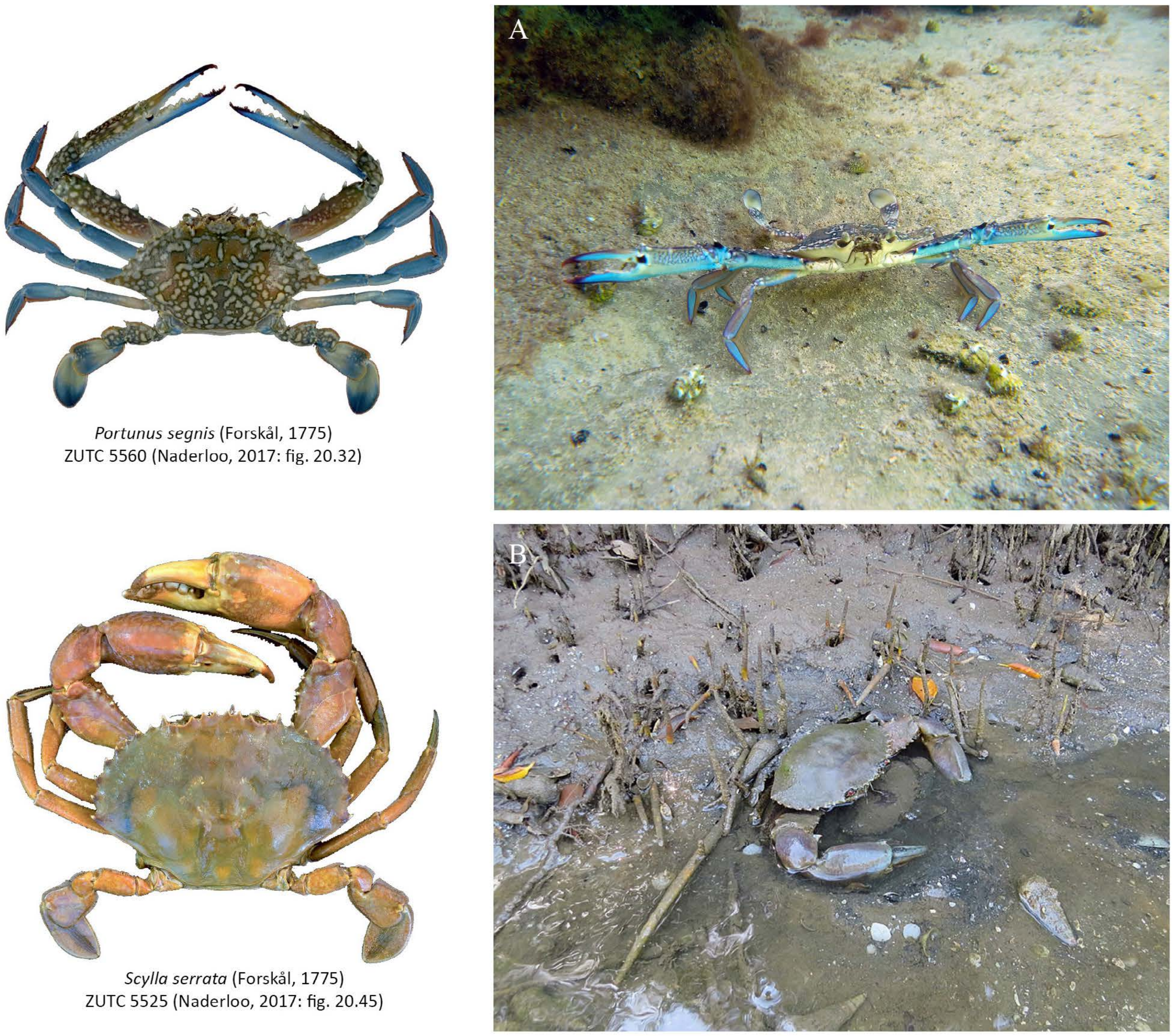


Figure 5.14. Live specimens photos of the main crab species identified at UAQ2. A. *Portunus segnis* in shallow subtidal waters (underwater photography) (Marawah Island, Emirate of Abu Dhabi); B. *Scylla serrata* on mud (*Terebralia palustris* nearby) in a mangrove forest (Khor Kalba, Emirate of Sharjah). Credits: A. K. Lidour, 2020; B. © J. Pereira, Creative Commons BY-NC, 2016.

observations at Ras al Hamra RH5 in the Sultanate of Oman, based on human diet and stable isotope analyses (Zazzo *et al.* 2014). At UAQ2, an almost monthly reconstruction of subsistence activities throughout the year was derived and illustrates our observations (Mashkour *et al.* 2016: fig. 10). Tuna fishing was probably carried out during winters, but the study of pink-ear emperor (*L. lentjan*) otoliths also indicates autumn and spring fishing, which coincides with the bi-annual spawning aggregations of this species. As for pastoral activities, the presence of newborn individuals and the study of kill-off patterns show that birth took place in the first quarter of the year. During the two, presumably, worst months of the year in these areas, i.e. July and August, Umm al-Quwain seems to have been well favoured because of the gentle winds there, as is still observed in this location today, which provides some relief from the heat.

Invertebrates

K. Lidour

Introduction

The discovery of marine mollusc shells is frequent at coastal Neolithic sites in Eastern Arabia. Marine shells within archaeological contexts are not only the remains of seafood consumption but also could have been used as tools, containers, ornaments, building material, or for floor levelling (Nebelsick *et al.* 2018: 437). UAQ2 is a remarkable example of a coastal site where marine molluscs were exploited for such varied purposes.

The Neolithic inhabitants of the UAQ2 shell midden exploited intensively the nearest resources available: in particular the seashores, the lagoon, and its mangrove. For archaeologists, the UAE shell middens represent light to massive accumulations of mollusc shells, fish bones, and less frequently contain crab exoskeletons, resulting from human activities. At UAQ2, the groups that succeeded each other at the site, over a millennium and a half, have left behind them massive quantities of shells which can be divided into two categories of archaeological data, i.e. finds resulting from food consumption (ecofacts), and finds in the form of personal ornaments and tool manufacture (artefacts). The first category is generally the most represented.

At UAQ2, the main shellfish taxa consumed include: within bivalves – clams (*Marcia* spp., *Circenita callipyga*, and *Circe rugifera*) and mangrove oysters (*Saccostrea cuccullata*); within gastropods – giant mangrove whelks (*Terebralia palustris*) and murex (*Hexaplex kuesterianus*), which seemed to have been freshly hollowed out or burnt, being intentionally fractured to extract the flesh. *Marcia* spp. include, at least, two species at UAQ2: *Marcia cordata* (Forskål, 1775) and *Marcia recens* (Holten, 1802).

A study of the crab remains retrieved from UAQ2 is currently being undertaken. Preliminary results show that more than 95% (based on a sample of more than 2000 remains) of the assemblage belong to the Arabian blue crab (*Portunus segnis*), whereas the remaining part of the assemblage is essentially dominated by the giant mud crab (*Scylla serrata*) (Figure 5.14) (Lidour *et al.* 2023a). A few small blue swimming crabs (*Thalamita crenata*) remains were also identified in the assemblage. It is more than likely that crabs were specifically exploited in shallow waters at dusk, when they become active and come out of their burrows to feed. Crabs can be easily speared when dazzled by headlamps or torches. Nowadays both species can still be encountered in the lagoon (Department of Fisheries 1984: tab. 8), although the giant mud crab is rarely seen and is probably less in evidence than during the Neolithic. Burning marks observed on the tips of many pincers suggest that crabs were directly cooked on coals, as was more than likely also the cooking process for fish.

Past and present main marine molluscs encountered in the Umm al-Quwain area

K. Lidour

The northern UAE coast consists mainly of long, sandy beaches that open directly onto the sea and provide little in the way of fishing grounds. Conversely, lagoons, such as UAQ's, host a variety of biotopes (e.g. mangrove, seagrass, algae beds, and rocky flats), which provide suitable habitats for a rich range of marine wildlife.

In the UAQ lagoon, the floors are essentially muddy, in particular around mangrove stands (from the mid-tide level to the upper part of the intertidal area), but more sandy areas are found in the stream channels. Rocky flats have formed in some areas by the slow cementation of fine sediments: at UAQ we noticed that they occur in the upper part of the lagoon (mostly in the lower intertidal area and below). Low, rocky platforms were also observed on certain islets of the lagoon (Figure 5.1.B).

Clams (Veneridae)

Marcia spp. and *Circenita callipyga* generally occur in the shallows (5 cm - 10 cm), including areas of mid-tide sand and sandy mud (Figure 5.15.D-F; Figure 5.16 n°10-11) (Smythe 1983: 57; Bosch *et al.* 1995: 267, 272). On another hand, *Circe rugifera* (Figure 5.16 n°9) is encountered along the lower shore and below (Bosch *et al.* 1995: 266). At the beginning of the incoming tide, clams reach the surface and can be directly gathered in shallow water without the need to dig.

Large venus clams are usually buried deep, i.e. *Callista umbonella* (Figure 5.16 n°7), which is found in the fine sand of the lower shore and below (Bosch *et al.* 1995: 269). Conversely, *Callista erycina* (Figure 5.16 n°6) is reported as being an offshore species (Bosch *et al.* 1995: 269). This suggests that *C. umbonella* could have been gathered fresh, while *C. erycina* shells were more than likely collected when already empty and stranded on shore, or even on sub-fossil beaches, without any consideration for their value as a food source. Archaeological finds of several UAQ2 shells and shell fragments had worm holes, indicating the collection of dead specimens.

At UAQ2, large venus clams (*C. erycina* and *C. umbonella*) were specifically used as shell knives or scrapers, as indicated by the presence of scalar retouches on their ventral margins. Similar tools have been previously reported in the Muscat and Suwayh areas in the Sultanate of Oman (Charpentier *et al.* 2004; Marcucci *et al.* 2014: 242, fig. 5), at Marawah MR11 in the Emirate of Abu Dhabi (Beech *et al.* 2022), and at UAQ: at the nearby site of Akab (Charpentier and Méry 2008: fig. 11). Use-wear analyses have shown their use for a variety of tasks, including for the treatment of animal skins, woodworking, and for cutting vegetal fibres, possibly associated with basketry (Lidour *et al.* 2024a). Unlike other coastal Neolithic sites, where shell tools are rarely found (or identified by excavators), a significant number of *Callista* spp. valves were worked at UAQ2 (at least 171 specimens). Only a few valves can be considered as being raw material, as they show no traces of modification.

Figure 5.15. A. *Saccostrea cuccullata* oysters on an intertidal rocky platform (Khor Kalba, Emirate of Sharjah); B. *Saccostrea cuccullata* on a mangrove (*Avicennia marina*) trunk (Khor al-Beidah, Emirate of Umm al-Quwain); C. *Saccostrea cuccullata* on mangrove (*Avicennia marina*) pneumatophores (Khor al-Beidah, Emirate of Umm al-Quwain); D. Intertidal flats covered with *Marcia* spp. and *Circenita callipyga* shells (Rams' lagoon, Emirate of Ra's al-Khaimah); E. Gathering of living clams (Rams' lagoon, Emirate of Ra's al-Khaimah); F. Living clams (*Marcia* spp. and *Circenita callipyga*) (Rams' lagoon, Emirate of Ra's al-Khaimah); Credits: K. Lidour, 2017.

Saccostrea cuccullata

Saccostrea cuccullata can be encountered on intertidal rocks or attached to mangrove pneumatophores, branches, and roots (Figure 5.15.A-C) (Bosch *et al.* 1995: 228). True oysters, such as *S. cuccullata*, typically attach themselves to supports by cementation of their left valve. In the absence of rocks or other solid substrates in the environment, which is generally the case at UAQ, oysters will often gather and agglomerate to form 'shell

Figure 5.16. Marine bivalve, and scaphopod shells identified in the UAQ2 shell assemblage: 1. *Pinctada persica*; 2. *Pinctada radiata*; 3. *Mimachlamys sanguinea*; 4. *Spondylus spinosus*; 5. *Vasticardium lacunosum*; 6. *Callista erycina*; 7. *Callista umbonella*; 8. *Vepricardium coronatum*; 9. *Circe rugifera;* 10. *Marcia recens*; 11. *Circenita callipyga*; 12. *Anadara uropigimelana*; 13. *Anadara ehrenbergi*; 14. *Asaphis violascens*; 15. *Saccostrea cuccullata*; 16. *Mactra aequisulcata*; 17. *Isognomon nucleus*; 18. *Brachidontes variabilis;* 19. *Cardiolucina semperiana*; 20-22. Undetermined bivalvia; 23. *Dentalium octangulatum*; 24. *Dentalium tomlini*. Credits: C. Dupont.

conglomerates'. At UAQ2, archaeological shell finds frequently show the imprints of the supports from which were detached (Figure 5.16 n°15). The possibility exists that distinct supplies of *S. cuccullata* were opened up during the 6th and 5th millennia BCE, i.e. from the mangrove forest, the lagoon, and the open sea.

S. cuccullata tends to colonise all its habitat, including choking mangrove trees by restricting their pneumatophores and reducing tree productivity. On the other hand, *Terebralia palustris* feed essentially on litter (Jousse *et al.* 2002: 54). Indeed, the reduction and subsequent disappearance of *T. palustris* within the lagoon itself can, in part, be explained by the progressive proliferation of *S. cuccullata* (Jousse *et al.* 2002: 54), and the steady clogging up of the lagoon may have favoured the expansion of sandy-muddy foreshores, thus directly sustaining the increase of *Marcia* spp. (Dalongeville and Sanlaville 2005: 18).

Pinctada

Pinctada radiata (up to 65 mm in length) (Figure 5.16 n°2) can be found on a variety of substrates encountered in shallow subtidal waters – mainly rock crevices, but also seagrass and algae substrates (Yassien *et al.* 2009: 99). They can be directly collected from such habitats by wading out to them at low tide. Of the available species, *P. radiata* is reported as being abundant inside the UAQ lagoon – referred to as *Pinctada vulgaris* (Schumacher, 1817) in Department of Fisheries (1984: 25, tab. 7). Conversely, *Pinctada persica* (Figure 5.16 n°1) (up to 200 mm in length) is generally found at deeper levels, in areas with strong currents and highly turbid waters, often attached to coral reefs and rocky bottoms: acquiring them generally entails diving down several metres (Ranjbar *et al.* 2016: 132). While the meat from *Pinctada* spp. was more than likely consumed during the Neolithic, there is no doubt that pearls and mother-of-pearl were prized and specifically sought.

Within the known Neolithic sites of Eastern Arabia (in particular the UAE and the Sultanate of Oman), pearls are mainly recovered from burial contexts. Excavations at al-Buhais BHS18 and UAQ2 have shown that pearls were used not only as elements of jewellery, but were also of considerable significance within funeral rites (see de Beauclair *et al.* 2006; Charpentier *et al.* 2012a: 4-5). At UAQ2, pearls have been found in association with the dead (including two individuals from Tomb 1) (Méry *et al.* 2016: 336-337). Two recent finds from domestic contexts at Marawah MR11 confirm that pearls were already of some significance from the beginning of the 6th millennium BCE (Beech *et al.* 2020: 10, fig. 9). Interregional exchanges during the Neolithic probably included pearls (unperforated, semi-perforated, perforated), as well as *P. persica* mother-of-pearl – widely used for the production of ornaments (beads and pendants), and, at some sites, fish hooks.

Spondylus spinosus

Spondylus spinosus (Figure 5.16 n°4) attaches to rocks by cementation of its left valve, much the same way as *Saccostrea cuccullata* (see above). Specimens are encountered among rocks and corals located at the lower shore and below (Bosch *et al.* 1995: 233). While relatively common, they rarely constitute large colonies in Eastern Arabia. Although it remains to be studied in more detail (by searching for erosion traces for example), it is likely that *S. spinosus* valves were directly collected on the shores, when washed up after the mollusc dies. However, we must remember that *Spondylus* spp. meat is edible – *Spondylus gaederopus* is traditionally consumed in Sardinia, Italy. At UAQ2, like at Akab (Charpentier and *Méry 2008*: 129-30, fig. 14), *S. spinosus* valves were worked following a specific *chaîne opératoire* to obtain beads in the shape of small, perforated discs (Chapter 4). Similar workshops have been identified more recently at other Neolithic sites, e.g. Ras Dah, on Masirah Island (Sultanate of Oman) (Charpentier *et al.* 2013: 92-3).

Because of their distinctive bright orange to red colour, *Spondylus* spp. shells were commonly used for producing ornaments by various early societies around the world, i.e. *S. gaederopus* in the European Neolithic (Halsteed 1993; Windler 2019) and *Spondylus crassisquama* in pre-Columbian cultures in South America (e.g. Castillo Velasco 2020).

Terebralia palustris

Terebralia palustris (Figure 5.17 n°1) is known to inhabit mangroves in the Indian Ocean (Fratini *et al.* 2004). Specimens are reported to reach up to 16 cm in height in Java (Jutting 1956), while the largest individuals are found in northern Australia, measuring up to 19 cm (Loch 1987). In India, Sewell (1924) recorded that specimens reach an average length of 12 cm. *T. palustris* shells excavated at UAQ2, when complete, rarely exceed 9 cm in height.

It is largely assumed that young *T. palustris* (< *c.* 5 cm in height) are detritivores and deposit feeders, while adults exclusively feed on decomposing mangrove leaves, propagules, and fruits (Houbrick 1991: 309-10) (Figure 5.18.A-B). The distinct diet between juvenile and adult *T. palustris* is reflected by a change in their radula (feeding apparatus) morphology. Juveniles have a radula similar to those encountered in adult *Pirinella* spp. (Houbrick 1991: 309) (Figure 5.17 n°29; Figure 5.19.A), allowing them to feed on benthic microphytic materials (e.g. diatoms). The potential impact of *Pirinella* spp. as food and habitat competitors of juvenile *T. palustris* cannot be excluded, and requires further detailed study.

Figure 5.17. Marine gastropod remains identified in the UAQ2 shell assemblage: 1. *Terebralia palustris*; 2. *Hexaplex kuesterianus*; 3. *Fusinus townsendi*; 4. *Conomurex persicus*; 5. *Trochus erithreus*; 6. *Cerithium caeruleum*; 7. *Neverita didyma*; 8. *Turritella columnaris*; 9. *Semiricinula konkanensis*; 10. *Tylothais savignyi*; 11. *Polinices mammilla*; 12. *Bulla ampulla*; 13. *Naria* cf. *lamarckii*; 14. *Oliva bulbosa*; 15. *Nassarius persicus*; 16. *Lunella coronata*; 17-18. *Priotrochus kotschyi*; 19. *Nerita albicilla*; 20. *Nassarius jactabundus*; 21. *Littoraria* cf. *melanostoma*; 22. *Planaxis sulcatus*; 23. *Umbonium vestiarium*; 24; *Ancilla farsiana*; 25. *Ancilla castanea*; 26. *Engina mendicaria*; 27. *Mitrella blanda*; 28. *Clypeomorus persica*; 29. *Pirenella conica*; Credits: C. Dupont.

Nowadays, *T. palustris* is no longer present on the Arabian shores of the Gulf (being only reported at and near Qeshm Island, Hormuzgan, Iran) (Feulner 2006). Specimens can still be found in natural biotopes in the Gulf of Oman (e.g. Khor Kalba, Emirate of Sharjah, UAE) and the Arabian Sea mangroves (e.g. Khor al-Jaramah, Sultanate of Oman). Particular conditions occur in some artificial environments, e.g. in the Oceanic Hotel storm channel in Khor Fakkan (Emirate of Sharjah, UAE) (Feulner 2000: 19-22). The latter allow the development of both juvenile and adult *Terebralia palustris* populations in the same location. We should note that *T. palustris* is still mentioned among the main marine mollusc species exploited during the late Pre-Islamic period at ed-Dur, in the UAQ lagoon (Van Neer and Gautier 1993: 111-112; Van Neer *et al.* 2017: 18). It remains unclear why the populations of *T. palustris* recorded within archaeological assemblages of the northern UAE progressively declined during the second part of the Holocene, before totally disappearing. As with the mangrove *Rhizophora* cf. *mucronata*, this disappearance

Figure 5.18. A-B. *Terebralia palustris* feeding on mangrove litter, Western Australia; C. Living *Lunella coronata* and *Priotrochus kotschyi* on intertidal rocks (Marawah Island, Emirate of Abu Dhabi); D. Looking for living *Hexaplex kuesterianus* on subtidal rocky flats in the vicinity of the Barracuda Resort (Khor al-Beidah, Emirate of Umm al-Quwain); E. Living *Hexaplex kuesterianus* covered with algae, found in shallow subtidal waters (underwater photography) (Khor al-Beidah, Emirate of Umm al-Quwain); F. Living *Hexaplex kuesterianus* on an intertidal rock (Marawah Island, Emirate of Abu Dhabi); Credits: A-B. © B. & M. Bell, Creative Commons BY-NC, 2014. C-F. K. Lidour, 2017-2019.

Figure 5.19. Examples of non-edible mollusc species found at UAQ2. A. Aggregation of *Pirenella* cf. *conica* in the Wadi Dhaid mouth (Khor al-Beidah, Emirate of Umm al-Quwain); B. Cluster of *Planaxis sulcatus* on a white mangrove aerial root (Khor al-Beidah, Emirate of Umm al-Quwain); C. *Cerithium caeruleum* surrounded by smaller *Clypeomorus persica* in a shallow seagrass bed (underwater photography) (Marawah Island, Emirate of Abu Dhabi); D. *Cerithium scabridum* on an intertidal sand flat at lower shore (Marawah Island, Emirate of Abu Dhabi); E. *Clypeomorus persica* on an intertidal rock at lower shore (Marawah Island, Emirate of Abu Dhabi); F. Association of *Brachidontes variabilis*, *Isognomon nucleus*, barnacles and serpulid shells under an intertidal rock (Marawah Island, Emirate of Abu Dhabi); Credits: K. Lidour, 2017-2021.

Table 5.13. Quantification of the bird and reptile remains by phases.

Family	Species	Phase B	Phase C	Phase D	Phase E	Phase F	Total
Cheloniidae				1			1
Scincidae	*Eumeces* sp.	1			1		2
Indet. Sauria		1					1
Indet. Reptilia					2		2
Indet. Aves		11	10			1	22
Total Aves and Reptilia		13	10	1	3	1	28

Table 5.14. Wet-sieving results: estimates of percentages of main shell species in Sector 1+2. Quantifications based on g/l (gram per litre) (original data: J. Martin; data formatting: K. Lidour).

	g/l residue	Clams %	S. cuccullata %	T. palustris %	H. kuesterianus %
Level 2	1525	94%	3%	1%	2%
Level 5	225	64%	0%	30%	6%
Level 6	7	80%	0%	16%	4%
Level 7	52	7%	44%	6%	43%
Level 8	122	36%	13%	2%	49%
Level 9	493	69%	3%	2%	26%
Level 10	141	70%	5%	1%	24%
Level 11	120	28%	20%	3%	49%
Level 12	187	27%	8%	14%	50%
Level 13	40	26%	7%	1%	66%
Phase F	1750	90%	2%	5%	3%
Phase E	7	80%	0%	16%	4%
Phase D	52	7%	44%	6%	43%
Phase C	122	36%	13%	2%	49%
Phase B	981	54%	7%	4%	35%

could be linked to increased salinity within the UAQ lagoon due to a lack of rainfall and surface streaming (see, e.g., Berger *et al.* 2013).

Hexaplex kuesterianus

Hexaplex kuesterianus (Figure 5.17 n°2) is a large gastropod found on shallow subtidal rocks and rocky flats, such as those still occurring a few hundred metres north of UAQ2 (Figure 5.18.D-E) (Bosch *et al.* 1995: 116). A. Prieur (2005: 160; Jousse *et al.* 2002: 52) suggests that *H. kuesterianus* is usually encountered at depths of between 20 m - 25 m, but comes closer to the shore to spawn, in spring (between the end of January and the beginning of March). Häussler *et al.* (2018: 457) indirectly support this by referring to the ecology of other *Hexaplex* species: *Hexaplex nigritus* from Mexico (Cudney-Bueno *et al.* 2008: 292) and *Hexaplex trunculus* from the Eastern Mediterranean (Elhasni *et al.* 2010: 213). However, we noticed several times the presence of *H. kuesterianus* almost all year round in shallow, subtidal and even intertidal rocky environments in the UAE (KL) (Figure 5.18.F). Although this species seems to be available all year, we cannot exclude that seasonal aggregations of specimens close to the shore were specifically exploited during the Neolithic.

H. kuesterianus produces large shells, particularly favoured by some hermit crabs, e.g. *Dardanus* spp., which could also have been exploited for food by Neolithic groups. Smaller species of hermit crab have been frequently observed re-inhabiting other gastropod shells, i.e. *Clibanarius* spp. for *Terebralia palustris* and *Conomurex persicus*. This illustrates, therefore, that more attention should be paid to crustacean remains within archaeological assemblages in general. However, within the UAQ2 faunal assemblage, no hermit crab remains have yet been found (KL).

Conomurex persicus

Persian strombs (*Conomurex persicus*) (Figure 5.17 n°4) are edible shellfish, traditionally exploited in the UAE and the Sultanate of Oman (El Mahi 1999: 46). They occur in shallow, subtidal waters (sometimes intertidally), especially on muddy sand near to seagrass beds (Figure 5.20) (Bosch *et al.* 1995: 61; Mutlu and Betil Ergev 2006).

Although also edible, *C. persicus* was specifically used for the production of ornaments. Following one specific *chaîne opératoire*, the whorl was cut, abraded, and perforated through the apex to fashion an annular bead (or 'whorl bead'). The production of this particular type of ornament at UAQ2 has been highlighted by the discovery of a series of *C. persicus* shells found together in Level 11, in Sector 1+2 (Square A2) (Chapter 1). However, it is sometimes quite hard to differentiate *C. persicus* and *Conus* spp. shell fragments, even more so when their surfaces have been heavily modified. Therefore, the use of *Conus* spp. for the production of annular beads cannot be excluded (an example, UAQ2.225, was found in Level 12, Sector 1+2). *Conus* spp. shells can be found stranded on the shores, although they are very rarely seen in the UAQ and RAK areas. Conversely, we noticed that *Conus* shells (mostly *Conus betulinus*, but also *Conus textile*) are very common on sandy beaches south of Khor Fakkan, on the UAE eastern coast.

Preliminary analyses

K. Lidour, C. Dupont, J. Martin, S. Méry

Introduction

This chapter collates the results of two different studies – that conducted by JM in 2012, and the second by CD in 2017.

The first study provides information on the main species identified and the general evolution of the shell assemblage throughout the whole occupation of UAQ2. The second study is a more detailed analysis of the taxonomic diversity within the shell assemblage. It allows us to specify the biotopes which were exploited: the results of the two studies partly overlap. The 2017 study also gives information on surface modifications and shell fragmentation.

The following comments are provided by the authors of this chapter, based on the data of these two studies.

Material and method

Specimens were identified taxonomically following the methods of comparative anatomy based on the observation of the shape and thickness of the shell, ornamentations, hinge morphology (for bivalves), and specific traces left by the muscles and ligaments of molluscs (Dupont 2006). Taxonomy and nomenclature follow the updated authoritative classification of the *World Register of Marine Species* (WoRMS Editorial Board, 2024).

Quantification of the shell species present in the different layers of UAQ2 was undertaken by JM in 2012, based on the analysis of several samples retrieved from Sector 1+2 (Table 5.14). Samples are composed of specimens retrieved by wet-sieving, using 6 mm mesh screens. Quantification concerns only the main species encountered in the samples. It is based on the weight (grams) of fragments per litre (standing as g/l residue in Table 5.14).

A more detailed analysis of the taxonomic spectrum was conducted by CD in 2017. This was based on a sub-sampling of archaeological shells sorted from three bulk samples (samples 10, 13, and 29). Samples are composed of specimens retrieved by handpicking and dry-sieving (2 mm and 6 mm mesh screens).

Quantifications for samples 10, 13, and 29 include the Number of Identified Specimens (NISP), the Minimum Number of Individuals (MNI), and the Weight of Identified Specimens (WISP). Fragments specifically used for the MNI calculation were sorted accordingly: hinge, umbo, or cardinal tooth for bivalve; apex, aperture, siphonal canal, or operculum for gastropods. For sample 29, a complete quantification was carried out. For samples 10 and 13, all the fragments over 6 mm were identified, counted, and weighed. Another *modus operandi* was applied for fragments between 2 mm and 6 mm retrieved from sample 10: a sub-sample of 10 g was prepared and analysed. Then, a cross-multiplication allowed us to calculate an average total amount of fragments within the whole sample 10.

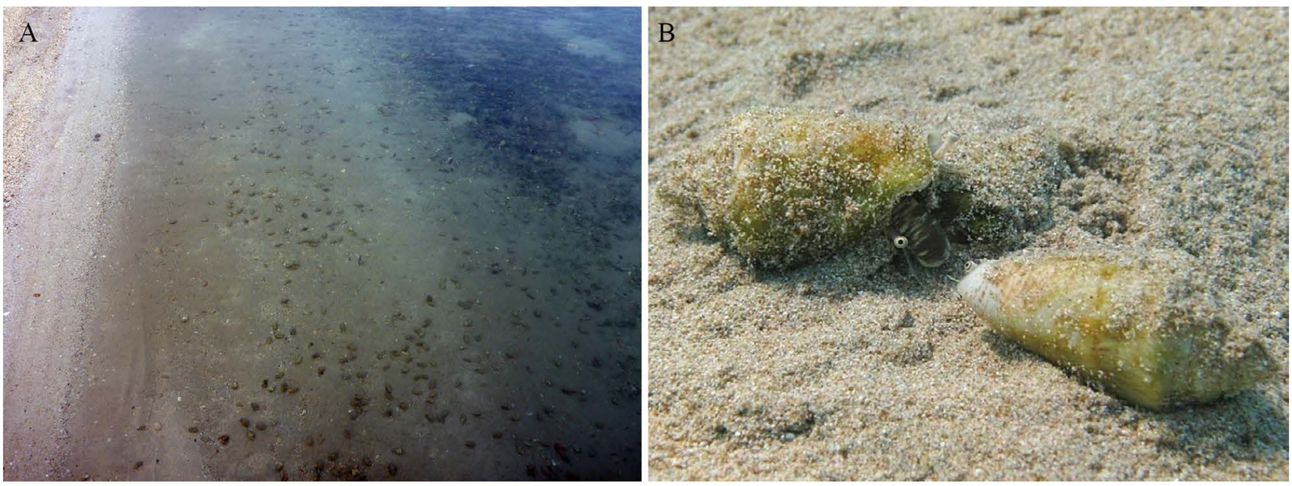


Figure 5.20. A. Aggregation of *Conomurex persicus* in large numbers along the beach of the Flamingo Resort at UAQ (Khor al-Beidah, Emirate of Umm al-Quwain); B. *Conomurex persicus* on subtidal sand (underwater photography) (Karpathos, Greece); Credits: A. K. Lidour, 2017. B. © R. Pillon, Creative Commons BY-NC, 2012.

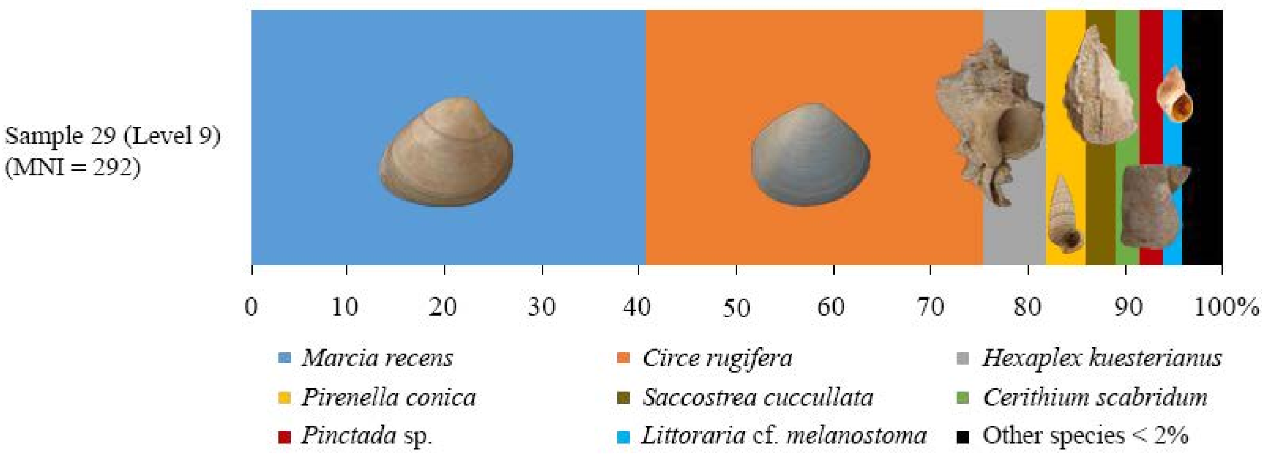


Figure 5.21. Distribution of marine mollusc taxa for the sample 29 (Level 9, Sector 1+2). CAD: C. Dupont.

A total of 15,763 shell fragments have been studied by CD, an assemblage of *c.* 4 kg: sample 10 provided 2,634 shell fragments (243 g); sample 13 provided 12,686 shell fragments (3,845 g); and sample 29 provided 443 shell fragments (no WISP quantification for this sample). MNI calculations provide a total of 660 individuals for the whole assemblage: 25 for sample 10, 343 for sample 13, and 292 for sample 29. Complete specimens selected from the samples were measured using a digital calliper. Observations on surface modifications and fragmentation were annotated.

General results

The whole assemblage includes 34 identified species of gastropod, 19 species of bivalve, and two species of scaphopod (Figures 5.16, 5.17). Only three species of small bivalves were undetermined (Figure 5.16. n°20-22). It includes also: *Volvarina monilis*, *Conus ebraeus*, *Conus taeniatus*, *Conus* sp. 1 (large species), *Euchelus asper*, and *Pardalinops aspersa*, which are not mentioned in the present chapter – nor illustrated, since no specimens have been found in the sample studied by JM and CD. However, they are mentioned and illustrated in Chapter 4.

Bivalve families include ark shells (Arcidae), cockles (Cardiidae), lucinids (Lucinidae), clams (Mactridae), mussels (Mytilidae), true oysters (Ostreidae), scallops (Pectenidae), sunset clams (Psammobiidae), pearl oysters (Pteriidae), thorny oysters (Spondylidae), and venus clams (Veneridae).

Gastropod families include true whelks (Buccinidae), bubble shells (Bullidae), cerithids (Cerithidae), margarites (Chilodontaidae), dove snails (Columbellidae), cones (Conidae), cowries (Cypraeidae), spindle shells (Fasciolariidae), periwinkles (Littorinidae), murexes and rock shells (Muricidae), dog whelks (Nassariidae), moon snails (Naticidae), nerites (Neritidae), olives (Olividae), clusterwinks (Planaxidae), mangrove and swamp whelks (Potamididae), true conchs (Strombidae), top shells (Trochidae), turban shells (Turbinidae), and tower shells (Turritellidae).

Scaphopods are represented by tusk shells (Dentaliidae) and cephalopods by cuttlefish (Sepiidae).

Stratigraphic distribution

The results highlight a variation of the main shell species through the stratigraphy (Table 5.14). Level 2 is almost entirely composed of clams (*Marcia* spp., *Circenita callipyga*, and *Circe rugifera*) and contrasts greatly with Level 5, where giant mangrove whelks (*Terebralia palustris*) represent a third of the shell assemblage. Large amounts of murexes (*Hexaplex kuesterianus*) were found in Levels 7 and 8, and in Levels 11-13 as well. Level 7 has also provided a quite important quantity of true oysters (*Saccostrea cucculata*). Levels 9 and 10 are characterised mainly by a great number of clams (Figure 5.21).

Clams dominate the shell assemblage during the latest occupation of the site (in Phases E and F). The presence of clams indicates the exploitation of intertidal sand flats, while *S. cucculata* and *T. palustris* directly highlight that some of the shell-gathering was carried out among mangrove stands, in the upper intertidal area.

Although also significantly present in Level 12, *T. palustris* were identified mainly in Level 5. Adult *T. palustris* can be found among mangrove roots and pneumatophores, where they feed on fallen and decomposing leaves. *S. cucculata* are more widely distributed but, within mangrove ecosystems, tend to be more frequently encountered attached to mangrove trees: on their roots, pneumatophores, and lowest branches. However, their presence in the overall shell assemblage is quite irregular (mostly observed in Levels 7, 8, and 11).

H. kuesterianus consists of the main shellfish taxa encountered at UAQ2, commonly associated with the exploitation of shallow, subtidal rocks and rocky flats. It was consumed mostly during Phases B-D. Some rare examples of crowned turban shells (*Lunella coronata*) are also registered: it highlights a moderate exploitation of intertidal rocks (Figure 5.18.C; Figure 5.17 n°16). It tends to be also supported by the presence of several bumble-bee snails (*Engina mendicaria*) shells (used in the form of beads; n = 44) (Chapter 4). However, it remains uncertain whether *E. mendicaria* were locally exploited since they are not reported as living in the Arabian Gulf (Bosch *et al.* 1995: 128): they could have been imported as valuable goods from the Musandam area, or possibly from the Arabian Sea (such as from the al-Haddah BJD-1 area, see Charpentier *et al.* 1997: 105, 107). Only one example of *E. mendicaria* was found unperforated (UAQ2.2585, from Level 14, Sector 1+2).

These preliminary results show a distinctive evolution of the main molluscs exploited between the first and final phases of the occupation of the site. At the beginning of the occupation, *H. kuesterianus* seems to have played a key role in the subsistence, representing between 35% and 50% of the shells consumed. The remaining part of the assemblage is composed mainly of clams. In the later phases of occupation, clams reach *c.* 80% - 90% of the total assemblage. This highlights a distinctive change shell-gathering strategy, more concentrated on the exploitation of mid-tide to lower shore sand and sandy-mud flats. However, this awaits confirmation by a more complete study of the shell assemblage, including smaller fragments and using quantifications based on NISP and MNI rather than density of taxa (here, given in g/l).

Natural habitats and gathering strategies

The high taxonomic diversity observed within the marine mollusc assemblages reflects the exploitation of a variety of coastal biotopes encountered in the UAQ area. At first sight, a generalist exploitation can be explained by the proximity of the UAQ2 site to foraging areas. We have also to take into account the variety of purposes of the selection of marine shells (used for food, but also as tools, ornaments, etc.) by the site inhabitants.

Edible species encountered in mangrove areas include: *S. cuccullata*, which attach to mangrove pneumatophores, branches, and roots; *T. palustris*, which feed on mangrove litter; *Trochus kotschyi*, a small gastropod that can live on mangrove roots as well as on pneumatophore. Other small gastropods live on intertidal mud among mangroves and below: *Pirinella conica* (max. 15 mm in height) (Bosch *et al.* 1995: 52) and *Clypeomorus persicus* (max. 20 mm in height) (Bosch *et al.* 1995 : 56), which are quite common but have no nutritional value.

The exploitation of intertidal sands is indicated by several species. *Conomurex persicus* occurs in intertidal and shallow, subtidal muddy sand, in particular in the vicinity of seagrass and algae beds. Clam species concentrate at mid-tide and lower shore levels: these include *Marcia* spp., *C. callipyga*, *C. rugifera*, and *Callista umbonella*. *Cardiolucina semperiana* also inhabits intertidal sand flats, especially the lower shores. Although *C. semperiana* has little nutritional value (not exceeding 8 mm in length) (Bosch *et al.* 1995: 235), specimens could have been caught as bycatch with larger clams. *Asaphis violascens* occurs at the lower shore in coarse sand and gravels (Bosch *et al.* 1995: 259). *Polinices mammilla* and *Neverita didyma* occur in sand at the low tide mark (Poutiers 1998: 509). *Umbonium vestiarum*, *Bulla ampulla*, and *Ancilla castanea* inhabit only intertidal sands, while *Ancilla farsiana* and *Oliva bulbosa* are encountered both intertidally and offshore (Bosch *et al.* 1995: 36, 144-5, 179). *Nassarius jactabundus* and *Nassarius persicus* are to be found at lower shore levels, on muddy sand (Bosch *et al.* 1995: 133; al-Kandari *et al.* 2020: tab. 2). Although *Dentalium* spp. are generally encountered offshore, *Dentalium octangulatum* is reported as inhabiting intertidal sands (Bosch *et al.* 1995: 186). Intertidal sands also contain numerous quantities of small, washed-up shells originating from various marine biotopes, even possibly from submerged archaeological sites.

Edible molluscs encountered on intertidal rocks include *Lunella coronata*, *Trochus erithreus*, *T. kotschyi*, *Tylothais savignyi*, *Semiricinula konkanensis*, and *S. cuccullata*; *H. kuesterianus* is encountered from mid-tide level to shallow, subtidal waters. Smaller gastropods occurring on intertidal rocks include *E. mendicaria* (probably not available locally), *Mitrella blanda*, *Cerithium caeruleum*, and *Nerita albicilla*. Small bivalves include *Brachidontes variabilis* and *Isognomon nucleus*.

The exploitation of intertidal molluscs is quite easy and can be done on foot in bare areas at low tide. Furthermore, molluscs occurring in shallow, subtidal waters could have been collected alive on foot during lowest tides (by wading), or by using specific techniques such as dredging and diving. *Pinctada radiata* can be encountered both on shallow, subtidal rocks and on sandy seafloors, in the vicinity of seagrass and algae beds. *Pinctada persica* is found deeper, mainly on rocky substrates. *Spondylus spinosus*, *Mimachlamys sanguinea*, and *Turritella columnaris* are specifically found on subtidal rocks, although they can occur at quite shallow depths. Small seashells have little nutritional value but could have been brought to the site as bycatch or to be used as beads. Seashells found on the seashore often show natural holes (made by predatory gastropods); these, therefore, could well have

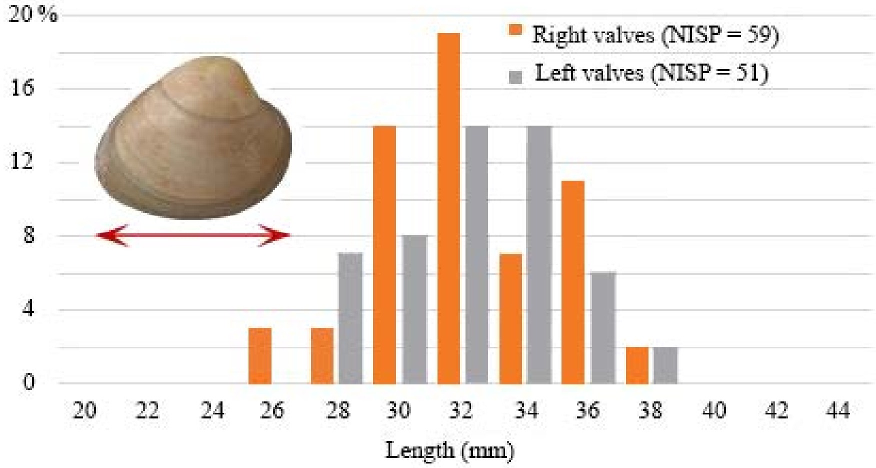


Figure 5.22. Size (length in mm) distribution of *Marcia recens* valves within sample 13. CAD: C. Dupont.

been directly reused as beads without any man-made modification.

Anadara ehrenbergi, *Callista erycina*, *Mactra aequisulcata*, *Vasticardium lacunosum*, and *Vepricardium coronatum* are all large bivalves living offshore, mainly burying themselves into sandy substrates. It is unlikely that offshore molluscs were directly exploited. However, it cannot be excluded that some species could also have been collected directly from the shore. Specimens collected on the beaches generally show specific traces, i.e. marine erosion and wormholes in their internal shell.

Size selection

Within the main edible species, large individuals have been preferentially gathered. Complete specimens retrieved from the studied samples were measured: *Marcia recens* (26 mm - 39 mm in length, but mostly between 30 mm - 35 mm) (Figure 5.22), *Circe rugifera* (33 mm - 41 mm), *Saccostrea cucculata* (23 mm - 78 mm), *Hexaplex kuesterianus* (40 mm - 67 mm in height), *Terebralia palustris* (59 mm - 94 mm). Overexploitation can lead to a reduction in the average size of the molluscs and, subsequently, of their shells. However, a measurement study of a larger number of shells from all levels of the site is necessary to address this issue.

Juvenile and adult *T. palustris* tend to be segregated spatially: young individuals are detritivores and deposit feeders, essentially inhabiting open, intertidal pools and creeks (with a preference for muddy habitats), while adults are encountered on decomposing mangrove litter, in the upper intertidal area (Pape *et al.* 2008). When reaching 3 cm in height, *T. palustris* are able to feed on both detritus and mangrove litter (Nishihira 1983; Houbrick 1991: 311). However, stable carbon isotope analyses on Eastern African populations indicate that a main change in the food source occurs for specimens over *c.* 5 cm in height (Pape *et al.* 2008), when specimens migrate from open mudflats to mangroves (Budiman 1988: 240). This result is supported by Wells (1980) on the basis of the change of radula morphology at 5.7 cm in height within Western Australian populations. Small *T. palustris* are underrepresented at UAQ2, suggesting size-based selection by the site's inhabitants. Therefore, *T. palustris* gathering could have focused on populations encountered among mangroves more than on those found in open mudflats.

Many small species seem to have been involuntarily brought to the site as bycatch (Figure 5.19) – as they are not edible, have little nutritional interest, or were not modified to be used as ornaments. Measurements show that the largest specimens of the following species were not selected: *Brachidontes variabilis* (7 mm - 11 mm in length), *Cardiolucina semperiana* (6 mm - 7 mm in length), *Clypeomorus persicus* (6 mm - 15 mm in height), *Isognomon nucleus* (*c.* 11 mm in length), *Littoraria melanostoma* (7 mm - 11 mm in height), *Mitrella blanda* (5 mm - 13 mm in height), and *Pirenella conica* (4 mm - 14 mm in height). Note that the smallest shell fragments could have been carried to the site by strong winds.

Fragmentation and consumption

Large gastropod shells (over 30 mm in height) are systematically fragmented. This is particularly observed for *Terebralia palustris* (Figure 5.23) and *Hexaplex kuesterianus* (Figure 5.24). It is likely that shells were deliberately fractured to access the mollusc meat. This phenomenon is frequently observed at other coastal sites of Eastern Arabia (Charpentier and Méry 2008: fig. 5). Conversely, it is not surprising to find gastropods < 20 mm in height generally almost intact. When deliberately brought to the site, small gastropods are usually used to produce beads.

According to some scholars, 'pitted' stones (commonly known as 'crushing stones' in the area study) were specifically used to break *T. palustris* and other large gastropod shells before consumption (Uerpmann and Uerpmann 2003: 114, fig. 7.8; Charpentier and Méry 2008: 126, 127). These tools were essentially flattish pebbles with distinct depressions on one or more sides. We must note, however, that such tools are known from several Neolithic settlements where *T. palustris* is absent, e.g. Shagra (Qatar) (Inizan 1988: fig. 55 n°2), and thus they could have been used for a variety of other purposes. At UAQ2, *T. palustris* shells are found broken all along their height by a series of direct, small percussions. Meehan (1982: 163) has described another possible *modus operandi* for removing the meat, i.e. the tip of the shell can be broken off and the meat sucked out through the hole made; if this does not work, then the hole can be enlarged by further breaks in the shell. The discarded shells, therefore, tend to be minimally fragmented. Conversely, at UAQ2, *T. palustris* remains are found heavily crushed. However, the potential impact of post-depositional factors (such as trampling and compaction) still needs to be studied in more detail. Analysis of a larger sample of shells is necessary to reveal precisely the types of fragments produced by different opening techniques.

As with *T. palustris*, *H. kuesterianus* shells required effort to open them. The initial fractures frequently appear in the areas of the apex and last whorls. However, for this species as well, several taphonomic processes should be taken into account as potential factors for the levels of fragmentation encountered. Another way of consuming *H. kuesterianus* was described at Dosariyah (Saudi Arabia) by Häussler *et al.* (2018: 457-9), where the shells are frequently complete (40%), or little fragmented, showing the top whorls cut off (24% of the specimens). The great percentage of shells showing traces of charring (85%) supports the idea that cooking was carried out mainly on coals. It is likely that the apex and the last whorls were removed to get directly to the flesh, if inaccessible from the aperture. When cooked on coals, the gastropod often retracts inside its shell, about the apex. According to Prieur (2011), this phenomenon does not happen when the shell is cooked in boiling water.

Although murexes are edible gastropods, their exploitation is, in some parts of the world, linked to dyeing: murexes have a small hypobranchial gland used in the production of colourants (i.e. 'Tyrian purple'). It is unlikely, however, that this industry existed during the Neolithic at UAQ2 as it requires massive quantities of murexes, although smaller quantities of the colourant could possibly have been used as tattooing ink.

Since shell fragments are retrieved mostly from refuse pits – alongside fish, crustaceans, and mammal remains – there is little doubt that *T. palustris* and *H. kuesterianus* were eaten fresh from the sea by the inhabitants of UAQ2. It cannot be excluded, of course, that some mollusc meat might also have been extracted before being separately cooked, dried, or used as fishing bait.

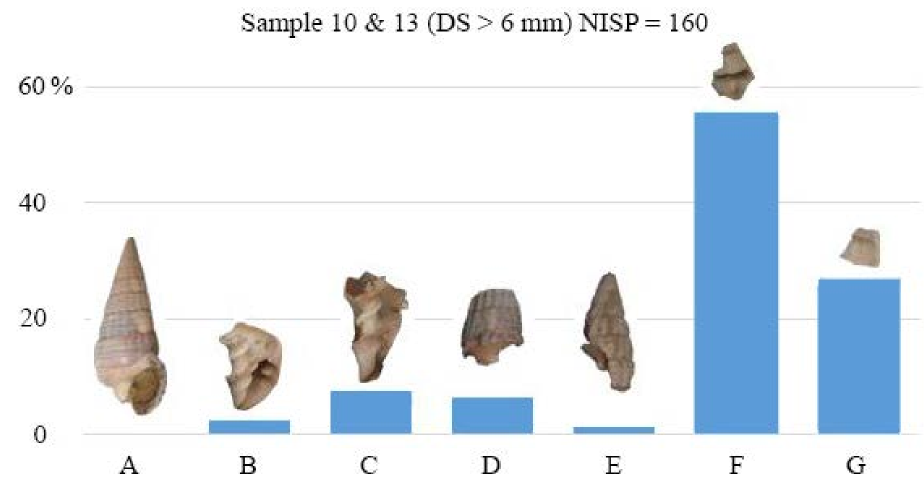


Figure 5.23. Distribution of the types (A-G) of shell fragments of *Terebralia palustris*, encountered within samples 10 and 13. A. Complete shell; B. Siphonal canal; C. Columella fragment; D. Fragment of spire with columella; E. Apex; F. Fragment of spire with more than one suture; G. Fragment of spire with one suture. CAD: C. Dupont.

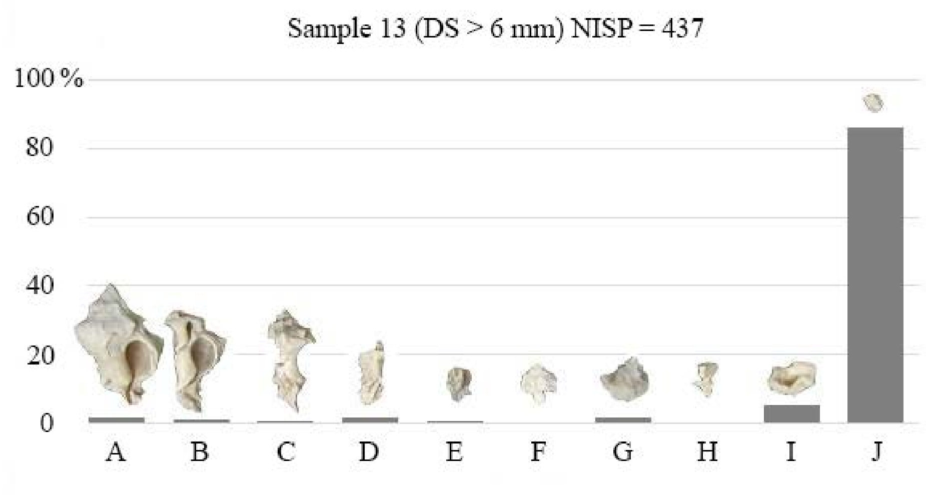


Figure 5.24. Distribution of the types (A-J) of shell fragments of *Hexaplex kuesterianus*, encountered within sample 10. A. Almost complete shell (peristome broken); B. Peristome and apex absent; C. Columella with apex; D. Siphonal canal with columella; E. Siphonal canal without columella; F. Apex with columella; G. Apex without columella; H. Fragment of columella without apex; I. Shell fragment with whorl; J. Shell fragment without whorl. CAD: C. Dupont.

However, the exploitation of shells for specific uses, i.e. dyeing or preparing fish bait, tends to create dense and monospecific accumulations, something we do not find at UAQ2. Furthermore, some specimens show charring traces, indicating that they were cooked.

Bivalves frequently show breakages. As an indicator, a specimen (two valves) of *Marcia recens* was found broken into 17 fragments in sample 10. However, this remains quite low in comparison to large gastropods: in the same sample (10), a *H. kuesterianus* specimen is represented by 48 fragments on average. Therefore, several factors (trampling, weathering, soil acidity, etc.) need be taken into account as potential agents for over fragmentation, in particular for small clam shells (being very weak).

Charring traces have been observed on some shell fragments at UAQ2. However, in the overall shell assemblage such traces remain quite low in number (e.g. only 2% of the *M. recens* valves are calcinated in sample 13). According to CD, it is unlikely that shells were commonly cooked on coals at the site.

Comparisons

In the larger area of the Arabian Gulf, from Kuwait to Abu Dhabi Emirate, Neolithic shell assemblages are dominated by two species: *Lunella coronata* and *Pinctada radiata*, highlighting the exploitation of intertidal rocks and shallow, subtidal waters.

At as-Sabiyah H3 (*c.* 5400-5000 BCE), shell-gathering was almost exclusively carried out on intertidal rocks, evidenced by the large quantities of *L. coronata* (85%) within the assemblage. The presence of *Conomurex persicus* (4%) and *Circenita callipyga* (2%) highlights moderate exploitation of intertidal, muddy sand (from mid-tide to lower shore). *P. radiata* (3%) could have been collected sub-tidally, both on sandy and rocky substrates (Glover 2010).

At Khor (5th millennium BCE), in Qatar, the consumption of marine molluscs was based overall on *L. coronata* (73% - 94%), clams (6% - 18%), and *P. radiata* (up to 8%) (Inizan *et al.* 1988: 77, 89). Clams highlight the exploitation of intertidal sand. A few *Asaphis violascens* indicate that shell-gathering was also undertaken in the coarse sand and gravels located along lower shores.

At Dosariyah (*c.* 5100-4800 BCE), the shell assemblage is dominated by *P. radiata* (80% of the bivalves) and *Hexaplex kuesterianus* (70% of the gastropods) (Nebelsick *et al.* 2018: figs. 22.3-4). This supports the idea that shell-gathering was carried out mainly in shallow, subtidal waters. The presence of other species, e.g. *Chama* sp., *Barbatia setigera*, *Acar plicata*, and *Plicatula australis*, highlights more specifically the exploitation of subtidal rocks (Bosch *et al.* 1995: 206, 208, 229, 242). Nevertheless, the exploitation of intertidal rocks is also indicated by the occurrence of *L. coronata*, *Trochus kotschyi*, *Drupella margariticola*, and *Euchelus asper* in the shell assemblage (Bosch *et al.* 1995: 32, 36, 40, 121). Palaeogeomorphological reconstruction by Parker *et al.* (2018: 44-45, fig. 2.15) suggests that Dosariyah was anciently located on a coastal islet, surrounded by shallow waters. This configuration could have favoured the presence of embayments and sheltered waters providing suitable environments for the development of extensive seagrass and algae beds. Colonies of *P. radiata* could have flourished in such particular biotopes.

At Delma DLM19 (DA11) (*c.* 5400-4600 BCE), *P. radiata* (54%) and *L. coronata* (34%) dominate the shell assemblage. *L. coronata* highlights the exploitation of intertidal rocks, while *P. radiata* is widespread sub-tidally (Beech and Glover 2005: tab. 4). Although *P. radiata* can also be found on sandy bottoms, the preferential exploitation of subtidal rocks is suggested by the presence of remains of *H. kuesterianus*, *Barbatia* sp., *Arca* sp., and sea urchins (*Echinometra* sp.) within the general assemblage (Lidour *et al.* 2023a). However, a few *C. callipyga* (4%) and *A. violascens* indicate that some of the shell-gathering was done in intertidal sand and gravels, from mid-tide to lower shore.

At Marawah MR11 (*c.* 5800-4400 BCE), preliminary results from Lidour *et al.* (2024b) show a more diversified assemblage of *L. coronata* (24%), *P. radiata* (16%), and *B. setigera* (12%); secondary edible molluscs include *A. violascens* (5%) and *Circe rugifera* (3%). This assemblage demonstrates the exploitation of a variety of biotopes, including soft substrates, gravels, and rocks located both intertidally and below the low-tide mark.

The model of exploitation differs significantly in the Northern UAE and in the Sultanate of Oman, where shell-gathering was focused mainly on the exploitation of clams (Veneridae), *Saccostrea cuccullata*, and *Terebralia palustris*. Clams highlight the exploitation of mid-tide to lower shore sand flats, potentially linked to a lagoonal environmental setting. *T. palustris* indicate that the shell-gathering was carried out on mangrove litter. *S. cuccullata* attaches to both rocks and mangroves: imprints of pneumatophores on left cementing valves indicate a mangrove environment.

In the UAQ lagoon, data available for other Neolithic sites confirms the key role of clams within local shell-gathering strategies: *Marcia* spp. represents the main species identified at Akab settlement (Charpentier and Méry 2008: 122), UAQ36 (Méry *et al.* 2019: 228), and Ramlah 3 RA3 (Uerpmann and Uerpmann 1996: tab.2), all dated from the 5th millennium BCE. (Similar observations have been made at UAQ38 (Degli Esposti *et al.* 2019: 11) for the 6th millennium BCE.) Other main species encountered include *H. kuesterianus* and *S. cuccullata*. Preliminary quantifications obtained at UAQ2 fit well into the local model of exploitation. Conversely, at al-Madar UAQ69 (also 5th millennium BCE), *Marcia* spp. represent only 10% of the total shell assemblage (Uerpmann and Uerpmann 1996: tab. 1). The remaining part of the taxonomic spectrum is dominated by *S. cuccullata* (63%) and *H. kuesterianus* (21%) at this site. However, these percentages are based on WISP quantifications. Complete studies of the UAQ shell assemblages, including detailed quantifications based on MNI, are necessary for a better understanding of the potential differences between the shell-gathering strategies. Nevertheless, it is likely that, from a general point of view, *T. palustris* is only represented a little in all these assemblages. However, it should be noted that significant quantities of *T. palustris* shells have been identified in Level 5 at UAQ2 (Table 5.14).

T. palustris dominates at sites located in the Gulf of Oman. At Khor Kalba KK1 (5th millennium BCE) (Emirate of Sharjah, UAE), *T. palustris* (48%) and *S. cuccullata* (38%) represent the main species identified (Phillips and Mosseri-Marlio 2002: 201). The predominance of *T. palustris* and *S. cuccullata* evidences the exploitation of a mangrove environment. It is also confirmed by the imprints of mangrove pneumatophores on many *S. cuccullata* shells (Phillips and Mosseri-Marlio 2002: 201). The presence of *Anadara uropigimelana* (14%) indicates the exploitation of low-shore and soft, shallow, subtidal substrates (Phillips and Mosseri-Marlio 2002: 201). Note that this species as mentioned as *Anadara ehrenbergi* (Dunker, 1868) in Phillips and Mosseri-Marlio (2002) but has been re-identified as *Anadara uropigimelana* (Bory de Saint-Vincent, 1827) in Lindauer *et al.* (2018).

A. uropigimelana likes to bury itself a little way in shallow, intertidal mud and sandy mud, often partly exposed above the surface. According to Tebano and Paulay (2001: 5), *Anadara* spp. are frequently associated with marine angiosperms, while *Anadara antiquata* prefers mangroves, and *A. uropigimelana* seagrass beds. Similarly, *T. palustris, S. cuccullata*, and *Anadara* spp. provide the main edible species encountered at the Neolithic sites of the Muscat and Wadi Quriyat areas (Sultanate of Oman), including Ras al-Hamra RH5 and Khor Milkh KM1 (Uerpmann and Uerpmann 2003: fig. 9.1-5, pl. 9.2).

On the ash-Sharqiyah coast (Sultanate of Oman), the Neolithic shell middens are mainly composed of clam valves (belonging mostly to *Marcia recens*, *Callista umbonella*, and *C. callipyga*), i.e. at Ras al-Khabbah KHB1 (4th millennium BCE), Ruways RWY1 (*c.* 6380-3400 BCE), and Suwayh SWY1 (6th-5th millennium BCE) (Martin 2005: 170-3; Berger *et al.* 2020: 6, 11). This highlights that shell-gathering was focused on intertidal sand, from mid-tide to lower shore, something also suggested by the occurrence of *C. persicus* at KHB1. *L. coronata* is represented at SWY1 and RWY1, indicating the exploitation of intertidal rocks. It can also be confirmed by the presence of *S. cuccullata*, which is attested in all the assemblage of these sites. However, it is known that *S. cuccullata* can also attach to mangrove. Indeed, at SWY1, the greatest amounts of *S. cuccullata* can be observed alongside the main appearance of *T. palustris* in the stratigraphy (during Phase 5) (Martin 2005: fig. 3), perhaps linked to the local development of a mangrove ecosystem. Conversely, at Ras al-Jinz RJ2 Period I (4th millennium

BCE), the shell assemblage is almost entirely composed of species inhabiting intertidal rocks, including *Perna perna* (50%) and several species of rock shells (small Muricidae) (Martin 2005: tab. 1). This seems to make sense as RJ2 is situated on a limestone platform overlooking the sea, where molluscs associated with intertidal rocks are the main edible resource available.

Archaeological shell assemblages from Neolithic sites in the northern UAE and the ash-Sharqiyah coast of the Sultanate of Oman share a number of similarities. They appear to be linked to the exploitation of similar local environments, characterised by the presence of lagoonal and mangrove ecosystems. Large quantities of clams identified in the latest phases of occupations at UAQ2 evidence that shell-gathering was focused mainly on the exploitation of intertidal sand, as is also reported for Neolithic shell middens along the Ruways-Suwayh coast (Charpentier *et al.* 2000; Martin 2005). At UAQ2, and at SWY1, for instance, the occurrence of *T. palustris* and *S. cuccullata* is linked directly to the moderate exploitation of mangrove environments during all occupation phases at UAQ2 (more specifically at the end of site occupation at SWY1). Additionally, the important exploitation of *H. kuesterianus* is more specific to UAQ2, and to some other Neolithic sites of the Arabian Gulf, including Dosariyah. The ecology of *H. kuesterianus* needs to be studied in more detail to understand the specific environmental factors that enabled the abundance of this gastropod locally.

At UAQ2, marine molluscs are exploited for a variety of purposes, i.e. mainly for their meat (*Marcia* spp., *Circe rugifera*, *S. cuccullata*, *T. palustris*, *H. kuesterianus*, etc.), but also for their shells, which were used as tools (*Callista* spp., *Asaphis violascens*, and *Mimachlamys sanguinea*), for the production of fish hooks (*P. persica*) and ornaments (*S. spinosus*, *Dentalium octangulatum*, *Polinices mammilla*, *C. persicus*, and many other small gastropods). However, shells originating from food consumption were not re-used as tools or to produce ornaments at UAQ2. Each species seems to have been deliberately collected for one specific use.

The UAQ2 shell assemblage reflects the local diversity of coastal biotopes and marine wildlife of the northern UAE. Exploited habitats include muddy bottoms, including in the mangrove, fine to coarse sand, gravels, and rocky environments. Specimens are exploited mostly in the intertidal zone, while a few species (little represented within the assemblage) could have been collected at the lower shore and below, sub-tidally. However, it is quite unlikely that species inhabiting offshore environments were collected alive. Washed-up seashells were probably collected directly from the shore.

The large gastropods consumed on-site were systematically broken. It is likely that this phenomenon was due to a specific technique for accessing the mollusc meat. At other coastal Neolithic sites in the UAE and the Sultanate of Oman, the consumption of *T. palustris* has been linked to the use of 'pitted stones' to crush thick shells. *H. kuesterianus* shells were probably opened in a similar way. Bivalves are less frequently fragmented, perhaps due to unintentional breakages (e.g. trampling) or natural processes (e.g. weathering, pedochemistry, compaction of the archaeological levels). However, further analyses are necessary to describe shell fragmentation and opening techniques in more detail at UAQ2.

Further research is also needed to better understand the present-day distribution and chronological evolution of shellfish populations among the different biotopes surrounding archaeological sites in Eastern Arabia, especially in lagoons and mangroves. This approach will help document climate and environmental change, as well as how ancient human societies adapted. Furthermore, such new data might offer a better understanding of shell-gathering seasonality and Neolithic coastal group mobility. More specifically, we have a need for a more complete picture of the evolution of shell-gathering and consumption during the 4th millennium BCE, and post Neolithic, in the UAQ lagoon itself.

Conclusion

K. Lidour, S. Méry

UAQ2 is characterised by a mixed economy, based overall on the exploitation of marine resources – marine molluscs and fish. The latter highlights the exploitation of a variety of shallow inshore habitats, situated mainly inside the lagoon.

The importance of small seabreams and emperors in the assemblages of fish remains indicates that fishing in the main involved nets in shallow, coastal waters, over sandy bottoms, and in the vicinity of seagrass beds. However, to a lesser extent, fishing probably also occurred off the lagoon, using lines and nets from boats, to exploit tuna shoals. Fishing at UAQ2 also included the catching of marine crabs (Portunidae), sea urchins (Echinoidea), cuttlefish (Mollusca: Sepiidae), and, potentially, sea turtles (Cheloniidae) and marine mammals, e.g. dugong (*Dugong dugon*). However, the total remains of sea turtles and marine mammals are rare at UAQ2, or not clearly identified, especially in comparison to other Neolithic sites, e.g. Ras al-Hamra RH5 for sea turtles (Salvatori 2007), Akab for dugongs (Jousse *et al.* 2002; Méry *et al.* 2009), Delma DLM19 (DA11), Ras al-Hadd HD5 (4th millennium BCE) (Sultanate of Oman), and al-Hallaniyah Island (5th-4th millennia BCE) (Khuriya Muriya, Sultanate of Oman) for dolphins (Borgi *et al.* 2012: 34; Charpentier *et al.* 2016: 355; Lidour and Beech 2019: 210).

Shellfish finds consist mainly of clams, which were collected in intertidal sand flats, from mid-tide to lower shore. Large quantities of *H. kuesterianus* have been identified in some levels, highlighting that shell-gathering also took place on shallow, subtidal rocky environments. Additionally, finds of *T. palustris* and *S. cuccullata* confirm the exploitation of a mangrove environment in the vicinity of the site.

The analysis of terrestrial mammal remains indicates that both herding and hunting were carried out during the Neolithic at UAQ2. Domestic herd animals include sheep and goats, with limited evidence of cattle and dogs. The kill-off patterns of caprinids suggests that herding activities were oriented towards the production of milk, which likely played a crucial role in the subsistence of Neolithic communities. Along coastal areas, where access to fresh surface water was limited, milk would have provided an essential and reliable source of hydration and nutrition. The game hunted included gazella and oryx, as much as for their hides and horns as for their meat. At UAQ2, mammal long bones were sometimes worked and re-used as points or needles (Chapter 4).

Excavations at UAQ2 provided no information on the potential consumption of fruit, vegetables, or cereals. The soil chemistry at the site could have resulted in unfavourable conditions for the preservation of macroscopic remains, e.g. carbonised seeds. Similarly, pollens and charcoals have not been preserved at UAQ2. Although it is still hard to suggest which wild plants would have been important for Neolithic diets, evidence of fruits and cereals has been found at a number of sites. Carbonised and mineralised datestones (*Phoenix dactylifera*) have been recovered from as-Sabiyah H3, and Delma DLM19 (formerly DA11) (Beech and Shepherd 2001; Parker 2010: 195, tabs. 10.3-5). Morphological analyses undertaken by Gros-Balathazard *et al.* (2017) have shown that the H3 datestones are similar to those of wild populations of date palm trees recently discovered in the Sultanate of Oman. This would seem to confirm that wild dates were harvested long before the regional domestication of the date palm (during the Bronze Age, according to data from Hili 8, cf. Cleuziou and Costantini 1982). The ancient exploitation of date palms is also suggested by the recent use-wear analyses conducted by KL on shell tools retrieved from UAQ2. Some shell valves were likely used for cutting vegetal fibres which, according to experiments, could have been palm leaflets and leaf sheath (Lidour *et al.* 2024a). Other types of wild fruit were exploited during the Neolithic, including jujubes (*Ziziphus spina-christi*) at H3, Ras al-Hamra RH5, and RH6 (Biagi and Nisbet 1992: 575; Parker 2010: 195). Two barley grains (*Hordeum* sp.) have been found at H3 (Parker 2010: 195), probably highlighting exchanges with Southern Mesopotamia (Parker 2010: 201). Barley (*Hordeum vulgare*) was cultivated in the alluvial lowlands of the Tigris and Euphrates, including at Tell el-Oueili (Iraq), *c.* 270 km north of H3. No evidence for local cereal cultivation has been found so far at H3, nor in the whole of Eastern Arabia. As well as seashells, clastic rocks, soapstone, and even animal skins, it is likely that dried fruits and cereals were exchanged between Neolithic groups. Among the wild plants and fruits that could potentially have been harvested and consumed locally during the Neolithic in Eastern Arabia might well have been wild figs (*Ficus salicifolia*) and desert gourds (*Citrullus colocynthis*).

Future research should focus on the complementarity of the various subsistence strategies, i.e. shell-gathering, fishing, herding, and hunting. The main issues facing us, more specifically, concern the identification of the local biotopes exploited, reconstructing human mobility according to the seasonal availability of natural resources, and understanding ancient diets, based on both nutritional values and isotopic signatures.

Conclusion

S. Méry, K. Lidour

The French Archaeological Mission in the UAE is dedicated to exploring ancient Arabia and conducting research on cultures, exchanges, territories, and their boundaries. From 2018 to 2023, in collaboration primarily with D. Gasparini and A.G. Parker, our focus has been on shedding light on the evolution of human settlements during the second half of the Holocene in the northwest of the UAE, particularly on the environmental changes between the end of the 6th and the end of the 5th millennium BCE. Our efforts have significantly advanced our understanding of the Neolithic period in the Arabian Gulf, with a specific emphasis on coastal Neolithic, which has been extensively studied in the Sultanate of Oman over the past three decades.

In addition to excavations and surveys, our research has offered different perspectives through the study of zooarchaeology, tools, and ornaments. Our investigations have primarily targeted the coastal areas of Umm al-Quwain and Ras al-Khaimah (not published). The excavation of UAQ2 in 2012, followed by UAQ36 (Méry *et al.* 2019) and UAQ38 in 2018 (Degli Esposti *et al.* 2020), has enhanced our understanding of regional Neolithic occupations. These habitation sites are characterised by shell middens, which are accumulations of marine mollusc shells, fish remains, and crabs, evidencing the remnants of meals consumed by their inhabitants.

Our work has contributed to defining the regional context of coastal Neolithic life in the northern UAE, revealing deep stratigraphies for Late Prehistory in the Arabian Gulf region. The sites of UAQ2, UAQ36, UAQ38, and Akab have been excavated, and anthropogenic levels have been well-preserved, revealing different occupation periods:

- UAQ2 shows occupational levels dating from the second half of the 6th to the end of the 5th millennium BCE.
- UAQ36 was not occupied in the 6th millennium, but mainly during the 5th BCE.
- UAQ38 indicates an occupation from the second half of the 6th to the 5th millennium BCE.
- The Akab settlement dates to the second half of the 5th, and the dugong bone sanctuary is dated to the end of the 4th millennium BCE.

In the current state of our investigations, the site of UAQ2 contains the oldest graveyard on the coast of the UAE and in the Arabian Gulf. Although older, dated *c.* 5800-5600 BCE, the individual tombs at the MR11 site (Al Hameli *et al.* 2023b) are directly adjacent to habitation structures and are not gathered within a single ritualised space. This evidences either a cultural difference between the southern and northern UAE or a shift in funerary practice by the mid 6th millennium BCE. Further research is required on this issue.

The ongoing investigations by the French mission present an opportunity to reconstruct a nearly continuous occupation between the second half of the 6th and the end of the 5th millennium BCE in the region of Umm al-Quwain. This would provide a unique research framework within the Arabian Gulf, comparable to regions in the Sultanate of Oman. Conversely, the 4th millennium is underrepresented in the UAE, but we hope that further research will help address this issue.

Due to its rich heritage and exceptional preservation, the coastal region of Umm al-Quwain stands out as a significant archaeological site on the Arabian Peninsula.

Phasing

The UAQ2, UAQ36, and UAQ38 sites are distinguished by their exceptionally well-preserved stratigraphy, comprising layers *c.* 2 m thick. The dense and abundant upper strata in marine shells have effectively protected the sandy lower levels.

At UAQ2, shell accumulations from the upper layers (Levels 2-5) have been dated to the second half of the 5th millennium BCE, roughly between 4500-4000 and 3500 BCE. Most of these shells come from edible taxa, particularly clams of the genus *Marcia*. Associated remains indicate a marked specialisation in the exploitation and preparation of clams, resulting either from successive domestic occupations or an intense, albeit temporally more limited, 'industrial' activity. This activity may also have been seasonal. Many shells bear black or grey marks from burning, and ashy lenses have been identified. Few skeletal remains belonging to fish and mammals have been found in these levels; instead, fragments of crab carapaces and pincers are more commonly found in greater proportion. The associated soils are generally unidentifiable due to shell deposit formation and taphonomy processes – including the compaction and alteration of surface deposits.

However, evidence of more substantial occupations dating from the late 5th millennium BCE has been unearthed at the site, as evidenced by the remains of a post-built structure in Sector 4 (Level 3), associated with several typo-chronological markers of the Late Neolithic. This partially excavated structure reveals the half of a circular plan with an estimated diameter of 2 m, aligning with comparable structures documented at other contemporary sites, such as Akab.

Two sterile sandy layers (Levels 6 and 8) beneath the large shell deposits from the second half of the 5th millennium BCE suggest a period of dune reactivation. It is questioned whether this episode could reflect a regional phenomenon; however, current data do not yet confirm this with certainty. A thin anthropogenic level (Level 7) has been identified between these two sandy layers. Although rather poor in artefacts, this level presents characteristics intermediate between the site's earlier occupation phases and those described above. A few scattered marine shells and two small stone clusters (C3 and C4) confirm a transient occupation of the dune.

During the 4th millennium BCE, an arid and windy climate, combined with significant dune reactivation, could explain the absence of identified occupational levels at Umm al-Quwain, as in the rest of northern UAE, except for a site of strong ritual significance – the *Dugong Bone Mound* at Akab. It is likely that the aridification process characteristic of this period altered site occupation patterns and intensified human group mobility. This aridification could have led to dune destabilisation, potentially compromising the preservation of surface archaeological levels. The Akab site, whose excavation may resume in the coming years, may provide insights into the socio-economic patterns prevailing at the end of the Neolithic in the context of challenging climatic and paleoenvironmental conditions.

At UAQ2, levels dating from the second half of the 6th millennium BCE are remarkably well preserved (Levels 9-14). This endows them with informative potential for understanding society, rituals, economy, technologies, and exchange of that period. Year-round site occupation was feasible due to the complementarity of locally available resources (mainly fish, shellfish, and marine crabs). Micro-regional expeditions were likely organised to hunt and source those lithic resources not found locally. The exploitation strategies and the mode of site occupation differ significantly from those observed in the upper levels. The spatial distribution of post-holes does not always allow for the determination of the nature of former architectural structures. Nevertheless, it is plausible that Neolithic structures included circular huts, fences, hide drying racks, and possibly fish drying racks, although this processing technique has not been attested for UAQ2. However, such structures are estimated to have been used later at Suwayh SWY2 (Charpentier *et al.* 1998). Two polished adzes were discovered in a cache within a circular dwelling at Level 14. Positioned vertically side by side in a small pit dug into pure sand, these adzes may witness a form of ritualisation of the housing – perhaps related to 'superstitious' practices associated with constructing or abandoning a dwelling place. These tools were likely used for woodworking; their symbolic significance could thus be linked to construction domains, including shipbuilding and navigation.

Main domestic activities took place outdoors, including cooking and food consumption – attested by concentrations of faunal remains with coherent taxonomic compositions (i.e. a high recurrence of individuals belonging to the same species), sometimes monospecific. The archaeological fauna reveals concomitant exploitation of fishing sensu lato (including collecting fish and shellfish), hunting, and herding. Ovicaprid herding was oriented more towards dairy production than meat (see Chapter 5), with marine products mainly compensating for the latter. Outdoor activities also included small lithic knapping workshops and bead-making – in softstone or marine shells. It should be added that *Pinctada radiata* oysters were collected and opened to find pearls, as known through funerary deposits from the graveyard. Large valves from the genus *Callista* were reworked into knives or scrapers and used for various tasks: butchery, treatment and softening of animal hides, woodworking, and cutting plant fibres (Lidour *et al.* 2024).

Paleoclimate and its impact on the patterns of site establishment and human mobility

The environments of Umm al-Quwain and Jazirat al-Hamra are similar, i.e. lagoons, including a coastal strip and small islets, with dense mangrove areas. The Neolithic sites identified in these two micro-regions are similar, likely belonging to the same cultural entity. Sites dating from the 6th and 5th millennia BCE are all shell middens located on the summits of portions of Pleistocene megadunes, which were both stable and compact. The economies of all these coastal Neolithic sites are also similar, focused primarily on exploiting marine resources. Domestic animals are few and probably originate from contacts with hunter-herders involved in pastoral movements across the Arabian Peninsula.

Establishing settlements on elevated points, such as the UAQ2 dune (8 m high), was undoubtedly linked to the surveillance of the residential sites' nearby environment – terrestrial and maritime. These elevated positions allowed communities to control their territory by avoiding incursions from hostile human groups and spotting resources such as schools of fish and wild terrestrial mammals. UAQ2 does not show a unique and continuous occupation during the Neolithic but has been occupied multiple times, as demonstrated by detailed stratigraphic analysis and planimetric excavations. The second half of the 6th-millennium occupation is the richest in material culture and archaeological structures and has provided an important graveyard. The levels from the second half of the 5th millennium are extremely dense in shell debris, especially in *Marcia* spp. bivalves. It shows a shift in the use of the site and the subsistence strategies.

The Neolithic period in the Oman peninsula spans *c.* 3500 years, from 6500 to 3200 BCE. This chronology has been recently confirmed in the UAE by findings on Ghagha Island (Al Dhafra region, Emirate of Abu Dhabi) that have revealed an Early Neolithic period (Al Hameli et al. 2023a; see also Charpentier *et al.* 2023: fig. 10) without any evidence of herding, but an economy entirely based on the exploitation of marine resources. Excavations at Marawah, Delma, and UAQ2 have highlighted a techno-cultural sophistication and economic diversification during the 6th millennium BCE – among others expressed in the development of herding, open sea fishing, interregional exchange (Mesopotamian pottery), but also the refinement of industries on plaster (south of the UAE), lithic, and marine shells. Evidence from archaeological sites suggests the presence of – partly or fully – sedentarised coastal communities living in a moderately moist environment. The absence of agriculture has been compensated by mixed economies, including fishing, shellfish collection, pastoralism, hunting, and exploiting mangrove wood.

Moving into the second half of the 5th millennium BCE, data from Umm al-Quwain also highlight cultural adaptations to increasingly arid environmental conditions. It includes more contrasted mobility patterns and economies, more focussed on the exploitation of shallow waters at UAQ2 and UAQ36, while specialised in the exploitation of large fish shoals in the open sea at Akab. This emphasises a persistent optimisation of natural resource exploitation that has characterised the region's development into the 3rd millennium BCE and beyond, extending to the rest of the Arabian Gulf and the Sultanate of Oman. Sedimentological data also points to increased aridity during the 4th millennium BCE, leading to the 'disappearance' of archaeological sites in the Arabian Gulf region – or at least their stratigraphy – in line with environmental and climatic changes along the coast and inland.

Non-pottery Neolithic but exchange and use of exotic pots from Mesopotamia

The Neolithic culture of the UAE and the Sultanate of Oman is distinguished by the absence of pottery technology, a feature that contrasts sharply with regions like Kuwait and the shores of Saudi Arabia, where local pottery production, of the Red Arabian Coarse ware, has been documented (Smogorzewska 2025). However, despite this absence, evidence points to the use of imported pottery from southern Mesopotamia—specifically Ubaid ware—along the UAE coast. The spread of Mesopotamian pottery in the UAE began around the mid 6th millennium BCE, as indicated by its absence in earlier 7th-millennium sites on Ghagha Island and the dating of the only pottery found in a stratigraphic context at Marawah MR11 (Area A) to *c.* 5600 BCE. Additional evidence of Ubaid pottery has been found on Delma Island (DA11-DLM19) and at UAQ2 levels dating from about 5400/5200 BCE. However, its presence significantly diminished during the 5th millennium BCE, as seen in upper levels at UAQ2, Akab, and UAQ38, and its complete absence at UAQ36.

Interestingly, Ubaid pottery is also absent at inland sites, such as those excavated in the areas of Buhais and Faya in the Emirate of Sharjah. For example, the BHS18 site—a significant graveyard dated to the 5th millennium BCE and located about 50 km southeast of UAQ—revealed grave goods like shell beads that suggest coastal connections, either with the Arabian Gulf coast or the Gulf of Oman coast. However, the absence of Ubaid pottery at BHS18 aligns with the decline of Ubaid pottery in coastal areas during this period. It also makes more sense if the site's exchange networks were limited to the Gulf of Oman, where Neolithic sites lack Ubaid pottery.

Chronologically, artefacts such as mother-of-pearl fishhooks and softstone earrings found at UAQ2 point to Late Neolithic cultural traditions oriented towards the Gulf of Oman and the Arabian Sea. This phase coincided with the waning influence of the Ubaid phenomenon in the Arabian Gulf during the late 5th and 4th millennia BCE. Previously considered a unifying cultural element in the region, Mesopotamian culture's influence is now understood to vary significantly across different areas. Late Neolithic sites such as Abu Khamis (Masry 1974) and Ain as-Sayh (Hermansen 1993) in Saudi Arabia reflect cultural trajectories distinct from those found in northern UAE and the Sultanate of Oman.

Carter and Crawford (2010) argued that coastal Arabian communities fully integrated Ubaid pottery into their material culture. At sites like as-Sabiyah H3, Bahra 1, and Dosariyah, local Red Arabian Coarse ware was primarily used for cooking, while imported Ubaid vessels—often decorated and with open shapes (65-80% of the assemblage) (Carter and Crawford 2010: 51-53; Drechsler 2018: 464)—were likely reserved for serving food during special communal events such as feasts. The high value attributed to these vessels stemmed not only from their imported status but also from their elaborate decoration (e.g., 70% decorated potsherds at H3). In contrast, in the lower Gulf region, imported Ubaid pottery and locally produced plaster vessels served both domestic and ritual purposes. At Delma DLM19 (5100-4500 BCE), both types of vessels show signs of firing, suggesting their use for cooking. Meanwhile, at Marawah MR11, plaster vessels were deliberately deposited in graves by 5700 BCE (Al Hameli et al. 2023b), and a complete decorated Ubaid pot was found in association with a grave dated to 5600 BCE (Beech et al. 2005). However, Ubaid pottery is absent in UAQ2 graves and inland sites like BHS18 and FAY-NE15, indicating its limited role in the social practices and rituals of lower Gulf Neolithic groups.

The situation in the northern Gulf seems markedly different. Carter's (2010) regionalisation hypothesis effectively distinguishes between direct interactions in the northern Gulf and more indirect exchanges in central and southern Gulf regions. The Ubaid phenomenon thus appears to reflect a dynamic exchange network centred in Kuwait, with only its marginal influence impacting much of the Arabian Gulf. Sites like as-Sabiyah H3 and Bahra 1 in Kuwait benefited from their geographic proximity to Mesopotamia, which likely facilitated direct interactions and placed greater importance on exchanged objects (Carter 2020). However, Carter's emphasis on Ubaid pottery's role in shaping social and ritual practices—such as communal feasting—might be overstated due to insufficient evidence. While Ubaid pottery held value, its presence did not lead to social stratification or the emergence of a merchant elite, despite other valuable trade items like pearls. It is plausible that interactions were facilitated by the fact that these northern communities shared ethnic or cultural affiliations with southern Mesopotamian groups. Masry (1974) proposed a co-evolution model wherein Arabian societies influenced early Mesopotamian civilisation—a hypothesis yet to be substantiated archaeologically. Rose (2010) highlighted how early Holocene marine transgressions reshaped settlement patterns by submerging parts of the Gulf Oasis valley, driving populations to newly formed coastlines and fostering interaction between communities. By the 6th millennium BCE, stabilisation of coastlines (Cuttler et al. 2023: fig. 1) and the associated development of coastal ecosystems (Lidour 2023) may have further supported human settlement and exchange networks. In the central Gulf, a continuous belt of coastal oases between Jubail and Dhahran likely supported dense settlements that were economically independent yet socially interconnected. Coastal sites specialised in fishing and maritime trade, while inland sites focused on hunting, herding, and possibly gathering wild crops.

Nevertheless, caution is warranted when interpreting interregional dynamics due to the limited number of archaeological sites studied thus far. Smaller-scale investigations focusing on ecosystems and familial or tribal organisation are crucial for understanding these interactions. Lithic techno-complex studies also challenge overarching frameworks like the Fasad and Arabian Bifacial Tradition (ABT), instead pointing to sub-regional traditions with distinct chronological contexts—for example, fusiform points from UAQ2 appear to predate those within the Suwayh typology. Inland Neolithic sites remain poorly documented but are characterised primarily by lithic assemblages that hint at mobile lifestyles involving hunting, gathering, or pastoralism. These inland groups may hold critical insights into broader exchange dynamics across regions.

Ultimately, while pottery production plays a key role in defining Neolithic cultures in the Near and Middle East, the scenario must be entirely reconsidered in the UAE and Sultanate of Oman, where there was either no local pottery production or pottery was entirely imported from elsewhere. The introduction of Mesopotamian pottery did not lead to local production during the Neolithic period, suggesting no technological knowledge transfer. The scenario is likely different in the northern Arabian Gulf, where local production of Red Arabian Coarse ware could have been facilitated by direct contact with Mesopotamian traders, fishermen, and, perhaps, potters – or with non-specialised individuals with basic pottery-making knowledge. It is further supported by the lack of specialised skills and technological investment within the Red Arabian Coarse ware production at Bahra 1 (Smogorzewska 2025). The first evidence for local pottery production in the UAE is documented during the Early Bronze Age by the early 3rd millennium BCE, likely enabled by contact with foreign technologies originating from west Pakistan and southeast Iran, particularly Makran. However, it is important to consider that the innovative use of kilns and the production of plaster vessels on the islands of Abu Dhabi during the mid 7th millennium BCE constitute a distinctive and independent element of regional Neolithisation, differing from other areas of the Near and Middle East.

Lithic and shell tool technologies

While the introduction of pottery was undoubtedly captivating due to its exotic nature and the use of unfamiliar material, its significance should not overshadow the central importance of the circulation of lithic resources – vital for Neolithic groups, such as for making tools, but also for the production of stone adornments, of which some examples have been locally made (as evidenced by the discovery of rough-outs at UAQ2). On the other hand, manufactured items were also exchanged, as was the case for the projectile points made of flint, jasper, and various varieties of chalcedonies that are thought to have originated from the Jebel al-Ma'taradh. Additionally, the exchange of women and children, whether through peaceful means or abduction, probably also had its importance for the maintenance or growth of the group. In this sense, isotopic analyses conducted by Kutterer and Uerpmann (2017) have evidenced that some individuals buried in the UAQ2 graveyard (from the excavations in the 1990s) have not been raised at the site or its area during childhood. The existence of these individual movements raises the question of the transmission of knowledge (including technological, environmental, etc.) that can shape material culture and the economy in different ways.

The UAQ2 site connects the cultural groups of the Arabian Gulf with those in the Sultanate of Oman. It is in line with the cultural traditions of Neolithic Arabia, standing out from the traditions of Yemen and Mesopotamia during the 6th to 5th millennium BCE. Although the plethora of Mesopotamian pottery sherds indicates a closer connection to the Arabian Gulf in the 6th millennium, the discovery of softstone earrings and shell fishhooks implies that UAQ2 had a stronger relationship with the Sultanate of Oman during the 5th millennium BCE.

UAQ2 is the site that has yielded, by far, the greatest number of fusiform points in stratigraphy. However, it is true that today it remains the only Neolithic site in the north of the UAE that has been excavated over such a large area and to such a depth. At both UAQ38 and UAQ2, the Middle Neolithic levels are buried deep, which is likely the case for all other sites in the region. Indeed, the discovery of such ancient occupations will depend on the presence of more recent levels that come to the surface. This is why only a few examples of this type of point have been found on the surface of sites located between Umm al-Quwain and Ras al-Khaimah. Fewer examples are documented in the south of the UAE, within Abu Dhabi's territory, indicating a broader distribution network. Indeed, the fusiform points and blade scrapers were not manufactured at UAQ2 and UAQ38, given the complete absence of their *chaîne opératoire* (only a few re-sharpening flakes are present at UAQ2). The most likely hypothesis is that they were the product of exchange with groups specialised in their production at sites unknown to us today – and probably located inland, closer to raw material sources, such as the Jebel al-Ma'taradh. Indeed, fusiform points and blade scrapers exhibit predetermined and standardised knapping involving pressure retouch, which reveals the high technical level of the lithic knappers and their likely specialisation. It also clearly differs from the more expedient industry of producing irregular flakes by direct and hard percussion, using materials of variable quality and likely directly knapped on-site. An important shift is observed from the 5th millennium BCE, as only these expedient productions persisted at UAQ2.

The absence of local lithic resource deposits is reflected in the intensive economy strategy of raw material use, with cores being exploited until fully exhausted. The question arises how these exogenous lithic resources were obtained, whether through exchange with other communities, or during logistical expeditions by the group – or a part of it. It is not possible to answer this question at a time when the archaeological map is not yet sufficiently documented inland. However, it is essential to keep in mind that a cultural territory is not limited to the residential site and its surrounding logistical stations but also integrates memorial places, sometimes in the form of geosites, whose regular and ritualised visitation contributes to the perpetuation of a group through tradition, the memorisation of resource deposits and circulation networks, exchange, and the maintenance of alliances (Delvigne and Raynal 2021).

The significance of marine shell tools is a feature of the UAQ2 site, which is also prominently found at sites in the Suwayh microregion in the Sultanate of Oman. However, this statement must be qualified since, until very recently, this type of tool was unidentified by archaeologists working in Eastern Arabia, and, by default, was included in the general malacofauna. It seems that valve tools were already fully utilised from the Early Neolithic in the Arabian Gulf, as evidenced by several specimens found on Ghagha Island, including at GHG63, which is dated *c.* 6300 BCE (N. Al Hameli pers. comm.). Furthermore, other specimens are documented at 6th-millennium BCE sites such as Marawah and Delma, confirming a quite widespread geographical distribution. The study of shell tools from UAQ2 shows that the valves were likely all collected from tidal debris on the foreshore (Lidour *et al.* 2024), thus species such as *Callista erycina* and *Callista umbonella* were probably not consumed for their flesh at UAQ2. The diversity of tasks performed with these shell tools covers many of the needs typically met by the lithic industry within Prehistoric cultures. It is, therefore, entirely plausible that shell tools could have partially compensated for the scarce availability of lithic resources for everyday tasks, e.g. meat cutting, leatherworking, and working plant fibres for basketry.

Symbolic productions and identity

Adornment is a significant marker of identity, whether individual or as part of a broader human group. It is why adornment holds an important place within Prehistoric societies, and this is also the case for the Neolithic cultures of Eastern Arabia. The types and associations of beads can vary considerably from one site to another. For example, UAQ2 is distinguished by the prevalence of perforated *Polinices mammilla* shell beads and discoid beads made from *Spondylus spinosus* shells. However, *Spondylus* beads are much more abundant at Akab, alongside cylindrical beads with elbow-shaped perforations, made from murex columella or softstone. At UAQ38, whose occupation appears to be contemporary with the older levels of UAQ2, *Ancilla* sp. shells predominate. These differences within such a limited territory testify to strong identity expressions.

During the Arabian Neolithic, ornaments had a special meaning as symbols of communication, engagement, and affiliation. Even though a large number of these ornaments were produced locally, some of the pendants and beads came from far-off places, suggesting here too the presence of complex trading networks. Some items, like *Engina mendicaria* shells, for instance, came from distant places, indicating that they were a part of a larger system of trade. Beyond their functional or aesthetic value, these ornaments likely had symbolic or diplomatic significance and contributed to organised interactions between various communities. In this way, they might be viewed as symbolic items that were included into transactions involving other necessities like food, tools, or weapons.

Trading goods with social rather than material worth aligns with Mauss (1925) who argued that exchanges in traditional societies were not purely economic but involved moral, social, and symbolic obligations, focusing on the relationships they fostered. For example, *potlatch* ceremonies in the Pacific Northwest used ceremonial gifts to signify prestige and strengthen bonds. Similarly, Malinowski (1922) highlighted the exchange of necklaces (*soulava*) and bracelets (*mwali*) as symbols of reciprocity, trust, and status in the Melanesian *kula* system. Drawing on Bourdieu (1986), these exchanges emphasised the act of giving over material value, serving as tools for recognition and alliance-building.

Funerary practices are particularly powerful symbolic expressions for identity construction and community cohesion. The excavation of UAQ2 has revealed essential information in this regard, especially since it is the oldest known proper graveyard in the Arabian Peninsula. The graveyard is located at the top of a dune, a topographical situation that is a recurring characteristic of Neolithic graveyards in the Sultanate of Oman during the 6th and 5th millennia BCE. In the early 1990s, the UAQ2 graveyard underwent initial excavations by Phillips, affiliated with UCL University at that time. This graveyard contained the burials of 41 or 42 individuals, nine of whom were fairly well-preserved. Two multiple graves were detected amid several other interments that had been significantly disturbed as new individuals were added to this burial space (excavated over 10 m^2). Walls or stones did not delimit the complex, but the existence of post-holes suggests a marking of this burial space, or even a covering in light materials. The burials excavated in the 1990s are attributed to Levels 12-14 of the settlement, then dated to the second half of the 6th millennium BCE. No burials associated with the 5th millennium have been identified, although they may have existed on the site, in an area we have not yet determined. The memory of the location of the 6th-millennium BCE graveyard appears to have faded over time.

Our work in the graveyard has provided important additional information on funerary practices at UAQ2, and, more broadly, during the Middle Neolithic. The two new graves excavated dated from the site’s first occupation, Level 14 of the habitation, just above a sterile sand level. The oldest grave contained the skeletons of four individuals, carefully arranged in a chain and symbolising their bonds in the afterlife (as, with little doubt, in life). Their death was violent and nearly simultaneous, resulting from armed conflicts between different groups likely vying for the coastline and its resources. Evidence of violence leading to death has been widely identified within regional graveyards.

The discoveries made at UAQ2 confirm the significance of pearls within Neolithic funerary rites. These pearls, found close to the hip of two individuals, were likely enclosed in a container made of perishable material (e.g. leaf, basketry, fabric, leather, etc.). They accompanied these UAQ2 warriors in death – who were probably also fishermen – a novel finding since pearls from other UAE and Omani sites are typically associated with adornment. Thus, pearls have played a unique role in Neolithic funerary symbolism. The multiple tombs at UAQ2 and Buhais are highly ritualised: individuals are arranged in a crossed lateral decubitus position and organised in a chain, a body arrangement found over several centuries, from the end of the 6th to the middle of the 5th millennium BCE. This tradition is also widely shared in the Sultanate of Oman, particularly at Ras al-Hamra RH5. Whether the individuals died simultaneously during enemy raids, or if these were companion burials, it is challenging to say. It is, however, unlikely that three or four young men out of a likely small community had been sacrificed to accompany another individual, whatever his social rank.

Symbolic expressions are also reflected in a particularly spectacular manner at Akab, towards the end of the 4th millennium BCE, where a monument was erected with the bones of about 40 dugongs –large marine mammals that are difficult to capture. Although they live peacefully in seagrass beds, they move quickly when threatened, making their capture dangerous. This monument, approximately 10 m^2 and designed to be durable, featured rows of dugong skulls in anatomical position, with their incisors embedded in the ground – and assemblies of ribs were present all around. The monument’s base consisted of hemi-mandibles, laid flat, and scapulae onto which an ochre solution had likely been sprayed. The use of ochre has been part of rituals of various types since prehistoric times in many regions of the world.

This monument contained numerous adornment elements: twice as many as in the Akab settlement during the 5th millennium BCE, including cylindrical beads made of shell and softstone. A unique example of an unperforated softstone bead indicates that a production workshop existed on-site. Other examples are documented at the surface of UAQ36 and UAQ38. Some ovicaprid bones were associated with the *Dugong Bone Mound*, plus a human skull fragment. Two groups of unworked pebbles were also located at the front and back of the monument. Post-holes suggest that the monument was covered or enclosed. The fact that hundreds of adornment elements were deposited on the monument, along with unworked stone pebbles possibly intended to be fishing weights, reveals complex rituals, interpreted by some as propitiatory to ensure good fishing. At Ras al-Hamra RH5 (Sultanate of Oman), very particular funerary practices devoted to marine turtles echo the Akab monument. Both relate to the marine world, with practices of a spiritual order, or even totemic practices (Méry et al. 2009; Charpentier and d'Huy 2023)

Together, these practices reflect a deeply interconnected world where identity, ritual, and exchange were intricately tied to the marine environments that shaped a unique Neolithic culture in coastal Eastern Arabia. This identity would persist until the end of the Neolithic period at UAQ2 and Akab.

Animal economy

The subsistence economy was primarily based on the exploitation of marine resources, in particular shellfish. Clams, mangrove oysters, and mangrove whelks were among the main taxa harvested. This reflects the focused exploitation of estuarine and mangrove ecosystems, consistent with the site's location on the edge of the Umm al-Quwain lagoon. Although edible and present in specific quantities in the lagoon, pearl oysters were not primarily consumed at UAQ2 – unlike at Akab. However, their collection was motivated by the search for pearls, which have been recovered both in the UAQ2 settlement and the graveyard. Marine crabs are another considerable fishing product, with the species consumed being the Arabian blue crab (*c.* 95%) and the mangrove crab (*c.* 5%). These crabs are easily caught in the rocky reef areas of the lagoon.

Fish also represent an important food resource. From the 6th millennium BCE, fishing was mainly conducted in the lagoon's shallow waters, where small coastal taxa and juvenile specimens constituted most of the catch – with breams and emperors being particularly common in this category. It was a fairly generalist type of fishing, carried out in shallow waters, often accessible by foot, and was primarily carried out using small nets, more than likely beach seines, either on foot or from boats. In parallel, nothing precludes the conduct of expeditions in the open sea or in the deep channels of the lagoon, which require the use of boats. In these areas, fishing could allow for the capture of larger taxa, including trevallies and little tunny, but also large sharks, i.e. the tiger shark, *Galeocerdo cuvier*. Here again, fishing was mainly done with nets but did not exclude, by the 5th millennium BCE, the use of luring lines as well. This is at least what is suggested by the presence of shell fishhooks in the upper levels of the site.

The use of nets is supported by the recurrence of stone fishing weights within the domestic contexts. These weights were produced locally from pebbles of various origins: coastal pebbles made of littoral sandstone and limestone for some of them, pebbles made of igneous rocks most likely collected in wadi beds for others. At UAQ2, the different modes of attaching fishing weights are not the result of typo-chronological evolution, but rather an adaptation to the characteristics of the material worked: notches are preferred on flattened pebbles and soft rocks, while creating a central groove by pecking is more suited to larger pebbles and hard rock, e.g. igneous rocks. The production of mother-of-pearl hooks is only documented from the middle of the 5th millennium BCE, and is therefore exclusively associated with the recent levels of occupation at the site and that of Akab's settlement, occupied during the same period. This technology indicates cultural links, including the transmission of knowhow, with other coastal sites in the Sultanate of Oman (Ras al-Hamra RH5, Ras al-Khabbah KHB1, Suwayh SWY2, etc.).

Although the significance of marine resources is notable, the inhabitants of UAQ2 also practised hunting and herding. Zooarchaeological data highlight the importance of domestic ovicaprids at UAQ2, and its management system, which was oriented towards the exploitation of animal milk rather than meat. Milk could be preserved as derived products, such as cheese. Its addition to brackish water is also known to make the latter more digestible. Furthermore, domestic ovicaprids also provided horn sheaths, skins, furs, and bones that could be reworked into many forms, including points and needles found at several Neolithic sites in the region. Livestock was also a valuable resource – a currency that could be traded for adornments, lithic raw materials, sophisticated weapons and tools, knowledge, and even people.

Hunted terrestrial fauna likely played a less important role than domestic fauna within local economies, but caution must still be applied regarding the validity of their nutritional contribution. Hunting was an additional means of obtaining meat and a way to acquire prestige, which undoubtedly contributed to establishing group hierarchies. Hunting was also a means to usefully train for armed conflicts. The Neolithic period in the northern UAE and the Sultanate of Oman was violent, as demonstrated by discoveries made at Buhais, where head fractures and defensive wounds were common. Multiple burials contained up to six individuals, people who had been killed within a brief time frame and buried together, all within a period not exceeding one week. It aligns with what can be observed in the UAQ2 graveyard during the second half of the 6th millennium BCE.

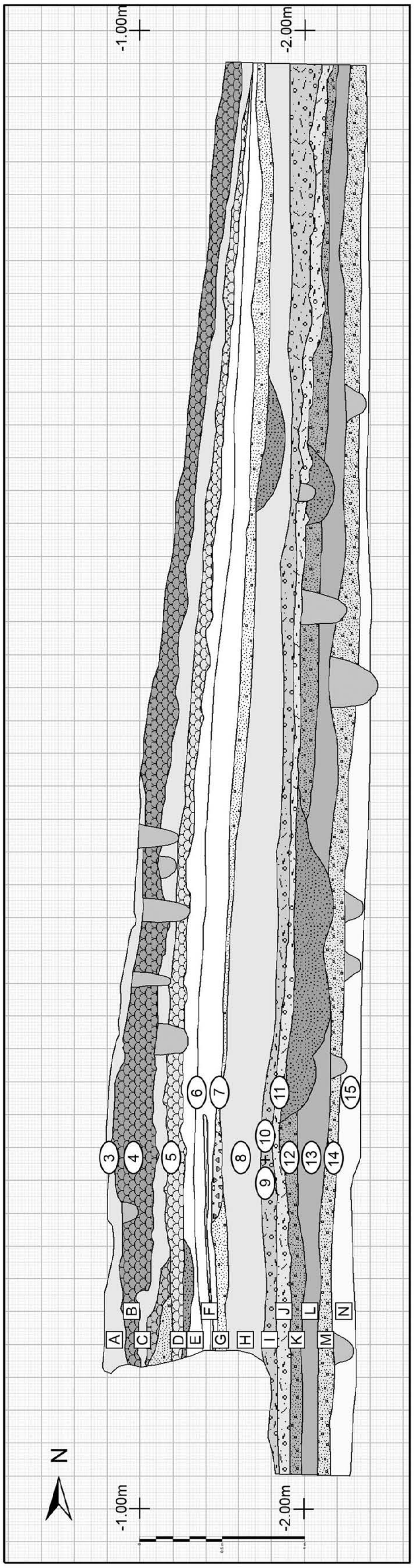
Bilan

At UAQ2, extensive planimetric excavations occurred as part of a multi-year program from 2011 to 2014, and again in 2017. Today, UAQ2 is the Neolithic site in the UAE with the most comprehensive stratigraphic documentation, including 18 sections that inform a 146-m stratigraphic sequence. The coexistence of a habitation area and a significant graveyard, both active during the 6th millennium BCE, further underscore the site's significance. This is particularly noteworthy since the Neolithic graveyards at Fayah and Buhais have not yielded substantial habitats. Moreover, UAQ2 is the first site in the Arabian Gulf to exhibit well-differentiated levels from the 6th and 5th millennia BCE, complete with distinct architectural features, material culture, and extensive zooarchaeological assemblages. A period of aridification, likely induced by strong winds, seems to have driven the changes between these two periods. The transition is characterised by a decline in material culture quality, reduced technical investment, and the emergence of partly new exchange networks. While blade scrapers and fusiform points vanish, artefacts typical of the Late Neolithic in the Sultanate of Oman start to appear.

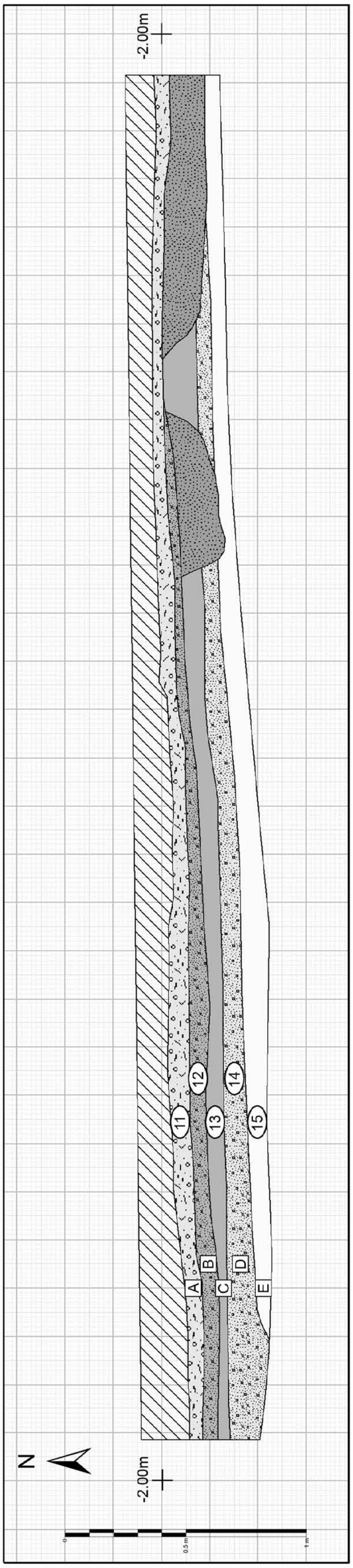
Excavations at Akab in the 2000s, and more recent fieldworks in 2018 at UAQ36 and UAQ38, have provided comparative data for UAQ2. This data has enabled the initial establishment of a typology of Neolithic sites in the region, identifying them as simple stops, logistic sites, or habitats with minimal residential mobility. However, this typology requires further exploration. These sites were strategically situated on the edge of the Umm al-Quwain lagoon, atop Pleistocene megadunes. Beyond the lagoon and its mangroves lay a desert landscape with sparse, shrubby vegetation and a scattering of large wadis that cut through the dune fields.

Recent research has solidified and expanded upon the documentation of a Neolithic culture in the northern UAE that flourished from the latter half of the 6th until the end of the 4th millennium BCE. It has also accentuated the significance of the coastal region of Umm al-Quwain, an important centre of Neolithic activity with exceptional preservation. Complementing these excavations, the French Archaeological Mission in the UAE has carried out annual survey programs in the Emirate of Umm al-Quwain over the past two decades. These surveys have led to the discovery of over a hundred new sites, including 17 from the Neolithic period. As a result, approximately 20 Neolithic sites have now been identified along the coast of Umm al-Quwain. This undoubtedly makes it one of the most significant – if not the most significant – hubs still preserving remnants of the Neolithic period in the UAE. The preservation of these sites and their future investigation are crucial and will hopefully complete our knowledge of the Neolithic period in the Arabian Peninsula.

Appendix 1



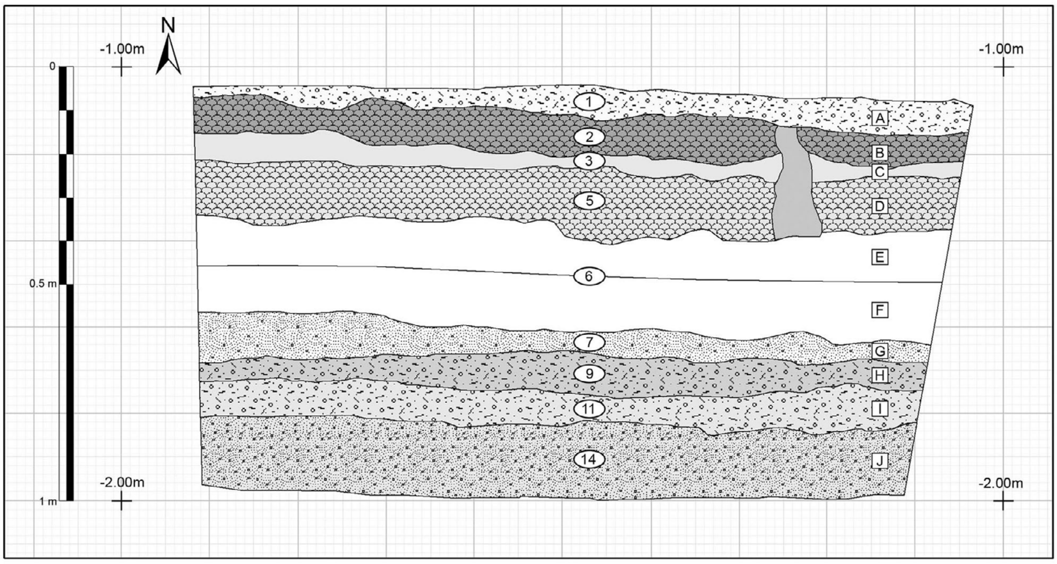
Sector 1+2 - Section 1



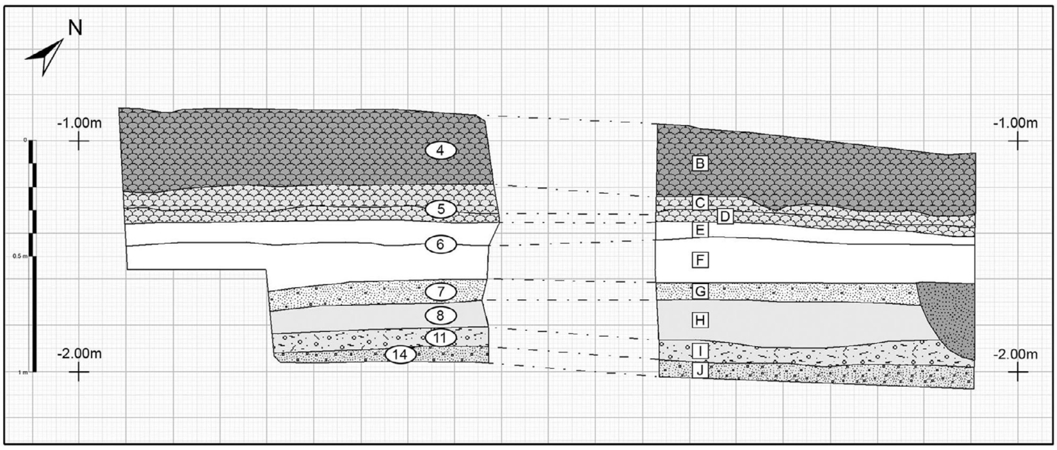
Sector 1+2 - Section 2

Appendix 2

Sector 3 - Section 13



Sector 5 - Section 4



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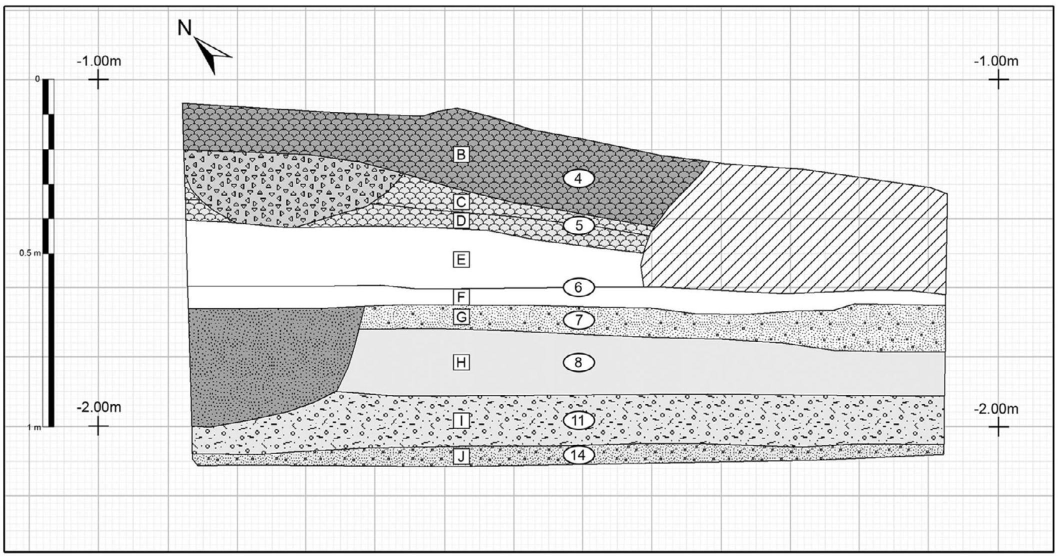
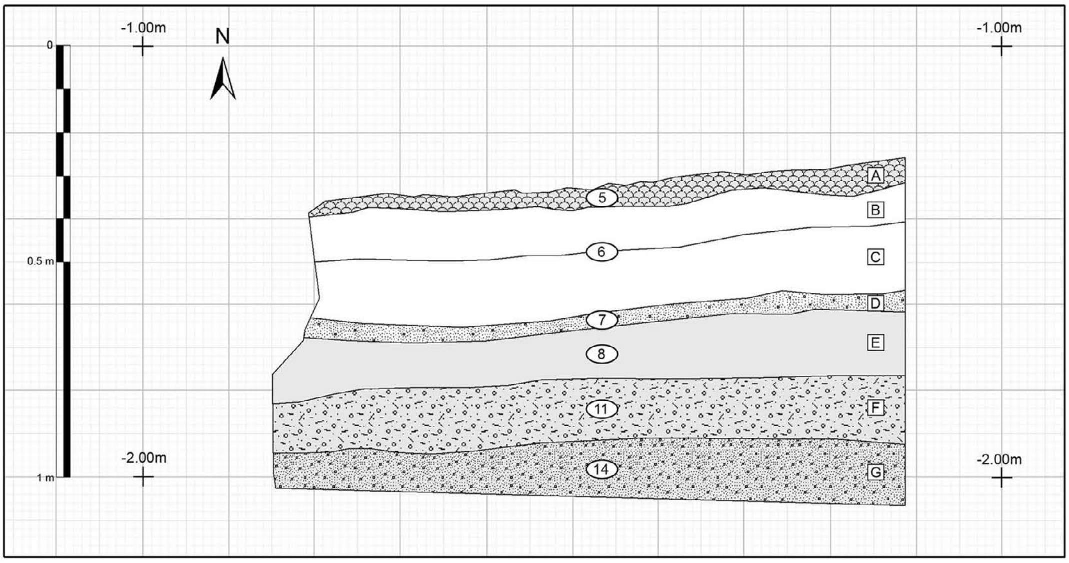


Appendix 3

Sector 5 - Section 6



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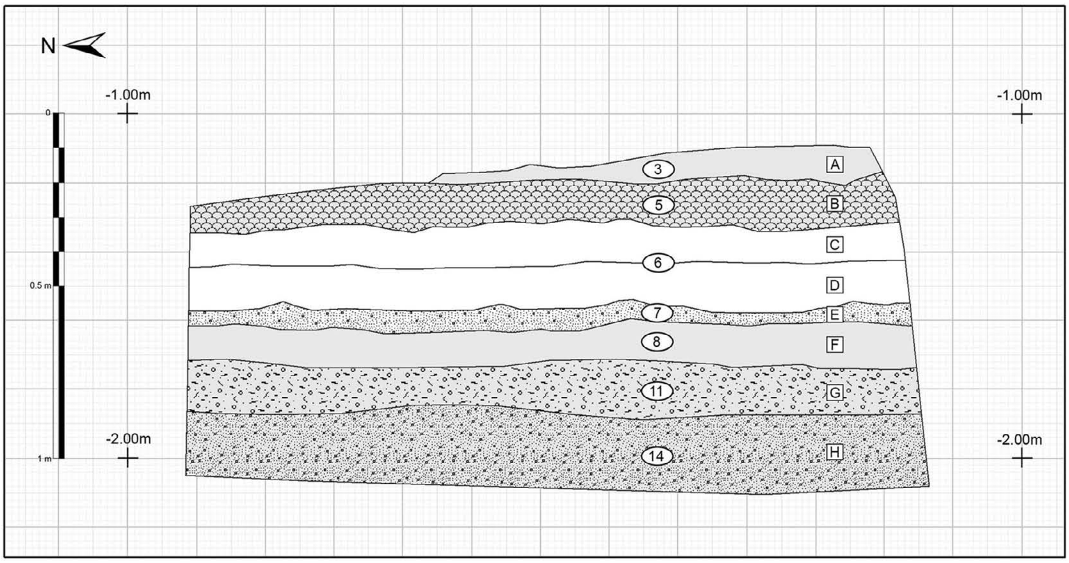

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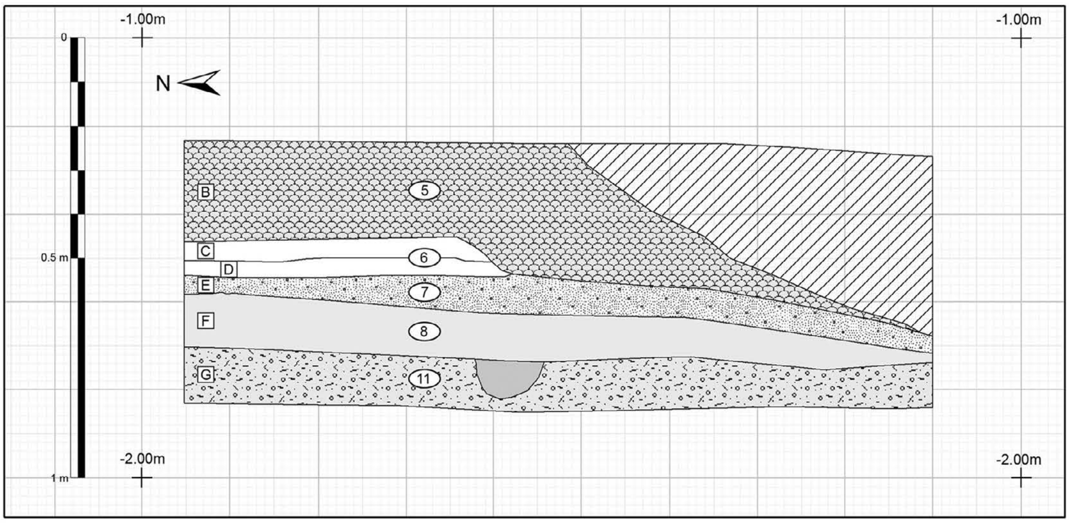
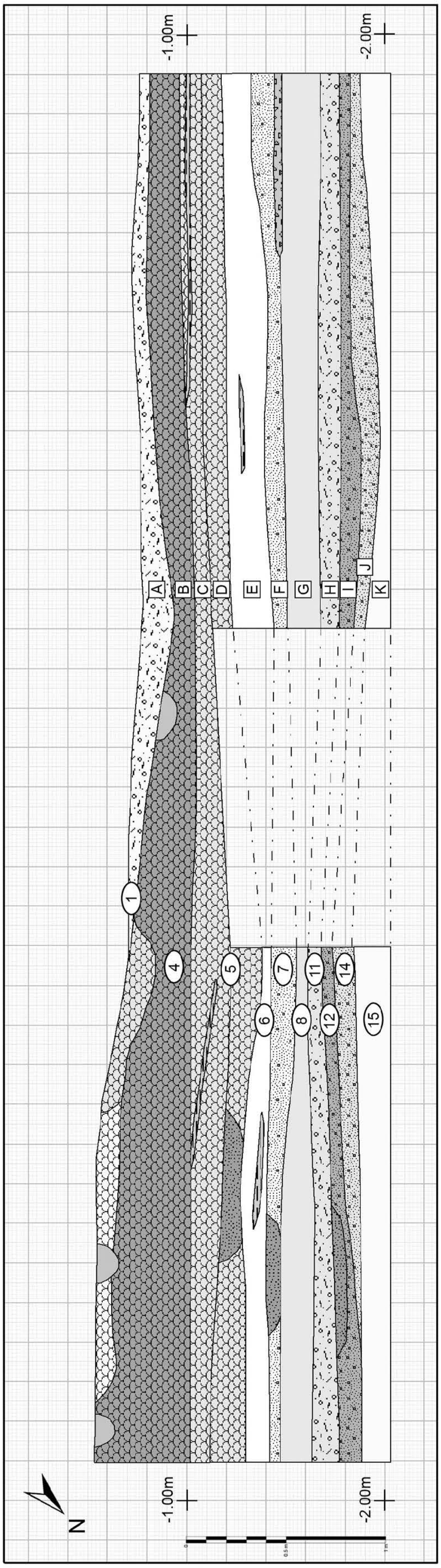
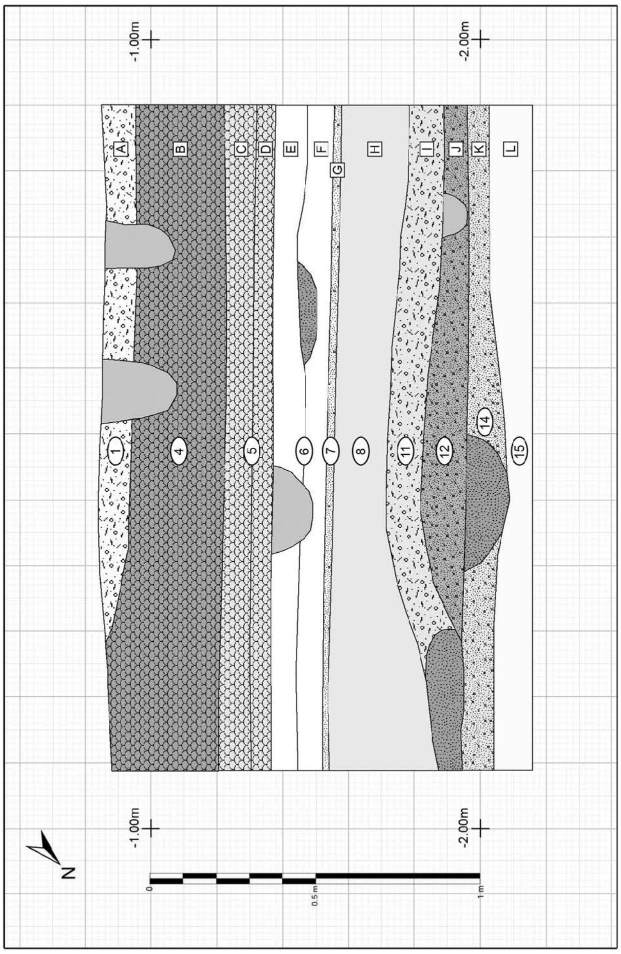


Appendix 4



TT1 - Sections 9-10-11



TT2 - Section 12

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This volume examines the Neolithic period in Eastern Arabia, focusing on the coastal site of UAQ2 in Umm al-Quwain, United Arab Emirates. Based six years of excavations and surveys conducted by the French Archaeological Mission in the UAE, it explores how coastal communities lived and adapted between the 8th and 6th millennia before present. The book highlights the unique features of UAQ2, including its well-preserved stratigraphy, which provides insights into settlement patterns, subsistence strategies, and burial practices. These findings offer a detailed understanding of how these communities sustained themselves through fishing, hunting, and herding. The site contains one of the oldest known graveyards in the Arabian Gulf, revealing evidence of inter-group violence and symbolic practices linked to ancient pearling traditions. In addition to examining local practices, this monograph places UAQ2 within broader regional networks. It explores connections with Mesopotamia, demonstrated by Ubaid pottery, and links with the Sultanate of Oman, reflected in shared material culture and technologies. These interactions underline the UAE's significant place in regional exchange during the Neolithic. The study also considers the impact of environmental changes on human mobility and settlement, including the effects of aridification and shifting coastal landscapes. By integrating archaeological and environmental analyses, this book enhances our understanding of the Neolithic period in Eastern Arabia and its place within the wider prehistoric world.

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