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## Prehistory and palaeo-geography of the coastal fringes of the Wahiba Sands and Bar al-Hikman, Sultanate of Oman

Vincent Charpentier, Jean-françois Berger, Rémy Crassard, Marc Lacaze,  
Gourguen Davtian

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### **Seminar for Arabian Studies**

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# Transliteration

**For further details on the submission of papers and the preparation of papers for publication, authors are requested to consult and follow the latest *Guidelines for Authors* which are available online at [www.thebfsa.org/pdfs/PSAS\\_guidelines\\_authors\\_april2012.pdf](http://www.thebfsa.org/pdfs/PSAS_guidelines_authors_april2012.pdf).**

Quotations, single words, and phrases from Arabic, or other languages written in non-Roman alphabets, are transliterated according to the systems set out below.

- Personal names, toponyms and other words which have entered English or French in a particular form, should be used in that form when they occur in an English or French sentence, unless they are part of a quotation in the original language, or of a correctly transliterated name or phrase. In the latter cases, they should be correctly transliterated, even when they occur in an English or French sentence.
- Names of sites, archaeological periods, types of pottery, which have entered archaeological usage in a particular form should be used in that form: Umm an-Nar, Julfar ware, etc. (and where appropriate the correctly transliterated form should be added in the first instance in any paper, see *Guidelines for Authors* for more details).

The transliteration systems are as follows:

## (a) Arabic

ء	آ	ج	j	ذ	dh (dh)	ش	sh (sh)	ظ	z	ق	q	ن	n
ب	b	ح	h	ر	r	ص	s	ع	ʿ	ك	k	ه	h
ت	t	خ	kh (kh)	ز	z	ض	ḍ	غ	gh (gh)	ل	l	و	w
ث	th (th)	د	d	س	s	ط	t	ف	f	م	m	ي	y

- Vowels: a i u ā ī ū. Diphthongs aw ay.
- Initial *hamzah* is omitted.
- *Alif maqṣūrah* is transliterated as ā.
- The *lām* of the article is not assimilated before the ‘sun letters’, thus *al-shams* not *ash-shams*.
- The *hamzat al-waṣl* of the article should be shown after vowels except after the preposition *li-*, as in the Arabic script, e.g. *wa-l-wazīr*, *fī-l-bayt*, but *li-l-wazīr*.
- *Tā marbūṭah* (ة) should be rendered *-ah*, except in a construct: e.g. *birkah*, *zakāh*, and *birkat al-sibāḥah*, *zakāt al-ḥiṭr*.

## (b) Ancient North and South Arabian

Consonants:

آ	b	t	ṭ	ḥ	g	ḡ	d	ḏ	r	z	s <sup>1</sup>	s <sup>2</sup>	s <sup>3</sup>	ṣ
ḏ	ṭ	z	ʿ	ḡ	f	q	k	l	m	n	h	w	y	

(c) **Other Semitic languages** appear in the transliteration systems outlined in the *Bulletin of the American Schools of Oriental Research* 226 (1986), p. 3.

(d) **Persian, Urdu, and Ottoman Turkish** as for Arabic with the additional letters transliterated according to the system in the *Encyclopaedia of Islam* (Third Edition) except that *z* is used instead of *zh*. These instructions are available online at [www.brill.nl/AuthorsInstructions/EI3P.pdf](http://www.brill.nl/AuthorsInstructions/EI3P.pdf) with information about the transliteration of Persian, Ottoman Turkish, modern Turkish, and Urdu on p. 5 of this document.

## Note on Fonts

Electronic versions of papers being submitted for publication should be submitted in **Times Semitic New** 12-point font if at all possible, with double-line spacing on A4-paper size and with 2.54 cm margins all round. This font set is available for free download from the The British Foundation for the Study of Arabia’s website ([www.thebfsa.org/PSAS\\_guidelines.html](http://www.thebfsa.org/PSAS_guidelines.html)) along with the recommended Greek font set, called TimesClassicGreek (tmsrr\_1.ttf).



## Editor's Foreword

The **Seminar for Arabian Studies** is the only international academic forum which meets annually for the presentation of research in the humanities on the Arabian Peninsula. It focuses on the fields of archaeology, architecture, art, epigraphy, ethnography, history, language, linguistics, literature, and numismatics from the earliest times to the present day.

A wide range of original and stimulating papers presented at the Seminar is published in the *Proceedings of the Seminar for Arabian Studies*, reflecting the dynamism and scope of this interdisciplinary event. The *Proceedings* present the cutting edge of new research on Arabia and include reports of new discoveries in the Peninsula. They are published each spring in time for the subsequent Seminar held in July. We hope you find the papers in this volume fascinating. We encourage you to recommend the volume to your academic institutions and colleagues and look forward to further stimulating and informative Seminars.

The Seminar in July 2011 comprised sessions on Palaeolithic and Neolithic Arabia; The Early Bronze Age and Bronze Age transformations in Arabia; late pre-Islamic Arabia; early Islamic and medieval Arabia; Islamic archaeology in Arabia; epigraphy and ancient Southern Arabia; and the literature and society of Arabia.

A full list of all papers presented at the Seminar in July 2011 is provided at the end of this volume, but it is worth highlighting the impressive geographical distribution and chronological range of these papers, most of which are published in this volume of the *Proceedings*, which also includes notes *in memoriam* on Walter Dostal (1928–2011), a constant and loyal supporter of the Seminar and one of the best-known representatives of the anthropological communities of Central Europe and the German-speaking countries in the last quarter of the twentieth century. He will be greatly missed.

At the July 2011 Seminar there were several papers about connections between Arabia and Africa, including a re-examination of the evidence for the Aterian in Arabia from the perspective of the Saharo-Arabian corridor; and on the ancient Egyptian cultural impact on north-west Arabia in the second and first millennium BC. On Arabia in general, topics included third-millennium fine grey wares found in eastern Arabia; obsidian circulation in prehistoric and early historic Arabia; early graffiti from the first centuries of Islam; and the traditional Arabic poem as ritual. On South Arabia, contributors provided new evidence on the goddess *ʿt(t)rm* and some remarks on the gender of deities; new perspectives on a group of expiatory texts on the Minaean confession of sins from Barāqish, which usefully help better to define certain social and religious aspects in the first millennium BC; and on the South Arabian contribution to the making of Umayyad iconography.

Papers about Bahrain covered topics that included pottery from Qalʿat al-Baḥrayn and Dilmun during the late Early Dilmun period (post-ʿIIcʿ); the fascinating ‘Tree of Life’ site; and settlement at al-Jaww from the late eighteenth century. Papers about Kuwait focused on Kāzimah and the early Islamic landscape in Kuwait Bay. Qatar has consistently been well represented in recent Seminar conferences with a dedicated focus session in 2009. In 2011 topics about Qatar covered an important ʿUbaid multi-occupational site at Raʿs ʿUshayriq in northern Qatar; a late Islamic palace, mosque, and tomb at al-Ruwayḍah; settlement at al-Furayḥah (also known as Freiha), north-west Qatar, from the mid-seventeenth century; eighteenth- and nineteenth-century rural settlement in northern Qatar; as well as an overview of new directions for the archaeology of Qatar.

Saudi Arabia was also very effectively represented. There were papers on the oasis of Taymāʿ in the second millennium BC; on Dūmat al-Jandal, the ancient Adummatu; an archaeological survey of the Farasan islands; and a delightful and informative paper on Medina’s first city wall.

On the Sultanate of Oman, the chronological breadth of coverage was substantial. There were papers on the Late Palaeolithic of the Najd plateau, Dhofar; and on Raʿs al-Ḥadd in the late fifth to third millennium BC. There were accounts about the Early Bronze Age funerary archaeological landscape of the western part of Jaʿalan region and of Wādī Ḥalfayn; the impact of Iron Age occupation on a Bronze Age archaeological landscape with results from excavations at Salūt; and on the prehistory and protohistory of the coastal fringes of the Wahiba Sands and Barr al-Ḥikmān. Topics also included the site of Mulayḥah (also known as Mleiha) where the discovery of luxury goods indicated the affluence of its inhabitants and their integration into long-distance trade networks with southern Mesopotamia, the Levant, and

the Indo-Pakistani area from the beginning of its occupation in the late third century BC; and another well-argued paper on the rediscovery of the Great Mosque of Qalhāt.

There were several papers about the United Arab Emirates: a Neolithic site in the Sharjah Emirate; excavations at Tell Abraq (Sharjah); the rise and ruin of Julfār al-Nudūd, Julfār, Ra's al-Khaimah, the only medieval port site and urban settlement on the Arabian shore of the lower Gulf between the fourteenth and sixteenth centuries AD; and the settlement patterns and foreign contacts of the Islamic period al-ʿAin oases. A major highlight at the Seminar was the delightful paper given by Saif bin Aboud Al-Bedwawi about *dibs* of Arabia, the date-syrup industry in the old Emirates, complete with samples for the audience to enjoy.

Topics of papers on Yemen included the Himyarite capital Ṣafar in al-Najd region with a focus on the latest centuries of the Himyarite empire (AD 270–525) and the late and post-Himyarite period (AD 525–632); the history of medieval Zabīd; fortified Islamic sites of the Dhamār basin in the central highlands; and Yemeni's opposition to Ottoman rule, a topic of interrelationships that has yet to be explored in more depth. There was also a commentary on Soqotri folk literature. Most intriguing and informative was a paper on the restoration of the mosques of Sāḥ and ʿAynāt in Wādī Ḥaḍramawt by Salma Samar Damluji.

This year, a stimulating topic, 'From the capital of Petra to the provincial city of Hegra: new insights on the Nabataeans', was the subject of the MBI Al Jaber Foundation Annual Lecture at the British Museum. It was given by Laïla Nehmé, a Nabataean specialist and epigrapher, who has been working in the Middle East for the last twenty-five years, and is a member of the team Mondes sémitiques of the Laboratoire 'Orient & Méditerranée' (Université Paris IV, Université Paris 1, École Pratique des Hautes Études). In 2008, a French-Saudi team began archaeological excavations at the site of Madā'in Šāliḥ, the former city of Hegra, in north-west Saudi Arabia. We anticipate that fascinating results of the excavations at Hegra will be presented at conferences of the Seminar in future years.

A special session on the Nabataeans was included in the Seminar programme in July 2011, resulting in a Special Supplement entitled *The Nabataeans in Focus: Current Archaeological Research at Petra. Papers from the Special Session of the Seminar for Arabian Studies held on 29 July 2011*, which has been edited most diligently by Laïla Nehmé and Lucy Wadeson. Lucy Wadeson is the G.A. Wainwright Postdoctoral Fellow at the Faculty of Oriental Studies, University of Oxford and the Director of the Funerary Topography of Petra Project (FTPP) and of the International al-Khubtha Tombs Project (IKTP) in Petra. The *Supplement* is testament to the notable expansion in Nabataean studies and the increased interest in Petra. Papers present the latest results of new projects and studies, which focus on little-studied aspects of Petra and Nabataean society.

The *Proceedings* appear on schedule as a result of intense and effective cooperation between the editorial and production team, the Editorial and Steering Committees, peer reviewers, and the many contributors to the volume. The energy of the authors and their efficient cooperation, which are to be applauded, have enabled the production schedule with its very tight deadlines to remain on track. This is particularly impressive when authors are often in the Middle East undertaking fieldwork in very remote locations. In addition, excitingly, Archaeopress is including some colour images in the *Proceedings* for the second year running. Another much welcomed development!

All papers are subject to rigorous peer review in order to maintain the highest academic standards and meet criteria laid down for publication, and therefore not all the papers that are offered are accepted for publication. We are indebted to a wide range of excellent expert peer reviewers. Their rigour, attention to detail, and enthusiasm means that the standard of the papers published is improving year by year. The *Proceedings* also benefit from the support of enthusiastic and diligent Editorial and Steering Committees, which provide an extended range of expertise and support. Apart from the Editorial Committee which includes professional academics of the highest standing in their respective fields, the editorial team includes our copy-editor, Helen Knox, whose attention to detail and cheerful and patient disposition cannot be faulted and is much appreciated. Paul Starkey has kindly continued to check any Arabic transliteration queries, for which many thanks. The professionalism and kindness of Rajka Makjanic of Archaeopress, who is always ready to sort out production issues with enthusiasm, are also really appreciated. The amount of time-consuming attention to detail and accuracy dedicated by the team cannot be overestimated, as previous editors of the *Proceedings* can also attest. As one example, over the last four years there has been considerable time and effort invested in providing as correct and consistent a transliteration of place and personal names as possible, as well as a really thorough provision of correct publication details for cited references: time and effort that has been well spent

## *Editor's Foreword*

and should provide useful starting points for future research — for there is so much more waiting to be discovered about Arabia.

Dr Ardle MacMahon, the Secretary for the Seminar, and Lloyd Weeks, the Seminar Chairperson, also provide excellent logistical support. Thanks are also due to Guillaume Charloux for providing a delightful image of Qaṣr Mārid, the fortress dominating the palm grove and the ancient villages of Dūmat al-Jandal oasis (north-west Saudi Arabia) looking south, for the cover of this edition (©Dūmat al-Jandal Archaeological Project).

I am very pleased to announce that there has been an exciting new development which should be much appreciated by anyone researching aspects of Arabia that are covered by the Seminar. From February 2012, past papers that were published in the *Proceedings* are now available online through JSTOR. This followed discussions between Rob Carter and myself with Archaeopress: we are indebted to Dr David Davison of Archaeopress who made all the necessary arrangements and to Derek Kennet and Michael Macdonald for arranging their initial digitization. It is also possible to buy a CD-ROM containing the entire *Proceedings* up to 2007 as searchable PDF files. For details, please contact Archaeopress (bar@archaeopress.com).

Another important development is that from late 2012, the existing Seminar for Arabian Studies website will cease to operate. All Seminar-related information has been migrated onto the website of the newly established charitable organization, the British Foundation for the Study of Arabia (BFSA; [www.thebfsa.org](http://www.thebfsa.org)). All necessary information regarding the Seminar can be found on the relevant Seminar and Publications pages of the BFSA website, including the annually updated *Guidelines for Authors* and *Guidelines for Editors* and the Times Semitic New font that is used by most contributors to the *Proceedings*. From July 2012, the traditional 'slash' method for including symbols and diacriticals will no longer be used. Authors should note too that the recommended Greek font is also available online.

For more information about the Seminar for Arabian Studies please visit the website of The British Foundation for the Study of Arabia (BFSA) or contact: Dr Ardle MacMahon (Secretary), Seminar for Arabian Studies, The British Museum, c/o Department of the Middle East, Great Russell Street, London WC1B 3DG, UK. E-mail: [seminar.arab@durham.ac.uk](mailto:seminar.arab@durham.ac.uk).

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# Prehistory and palaeo-geography of the coastal fringes of the Wahiba Sands and Bar al-Hikman, Sultanate of Oman

VINCENT CHARPENTIER, JEAN-FRANÇOIS BERGER, RÉMY CRASSARD, MARC LACAZE†  
& GOURGUEN DAVTIAN

## Summary

The aim of the new French archaeological mission in Oman is to study overall cultural development along the shores of the Arabian Sea, from hunter-gatherer societies to the emergence of the first complex societies, i.e. from the end of the Pleistocene to the Bronze Age, between 10,000 and 2000 cal. BC. The area of exploration is situated between the eastern end of Arabia (the present city of al-Şūr) and the shores of Dhofar.

In November–December 2010, the coastal fringes of the Wahiba Sands (Ramlat al-Wahībah) and Bar al-Hikman (Barr al-Ḥikmān) were surveyed. Prehistoric and protohistoric sites, which date from the eighth to the first millennium BC, were discovered and investigated. Most of the sites are shell middens. They are sometimes deflated, but some have deep stratigraphy, especially in Ra's Jibsh or in al-Khuwaymah, where both the Neolithic necropolis and the settlement were investigated. Analysis of satellite images of coastal morphology and development were combined with geo-archaeological fieldwork better to locate archaeological sites.

**Keywords:** Oman, Neolithic, Bronze Age, Wahiba Sands, Fasad points

## Introduction

A new mission was created in 2010 to study prehistoric sites on the shores of the Arabian Sea, from hunting societies to the emergence of the first complex societies, i.e. from the end of the Pleistocene to the early Bronze Age. The territory concerned extends from the eastern end of Arabia, from Sur (Şūr) and Ra's al-Ḥadd in the province of al-Sharqiyyah to the shores of Dhofar, covering a distance of 800 km as the crow flies. This project is led by a team of archaeologists and geo-archaeologists, who have previously worked in Oman, Yemen, the UAE, and Saudi Arabia. They have all worked under the aegis of the French archaeological mission of the Joint Hadd Project in Oman, some of them from the very beginning in 1985.

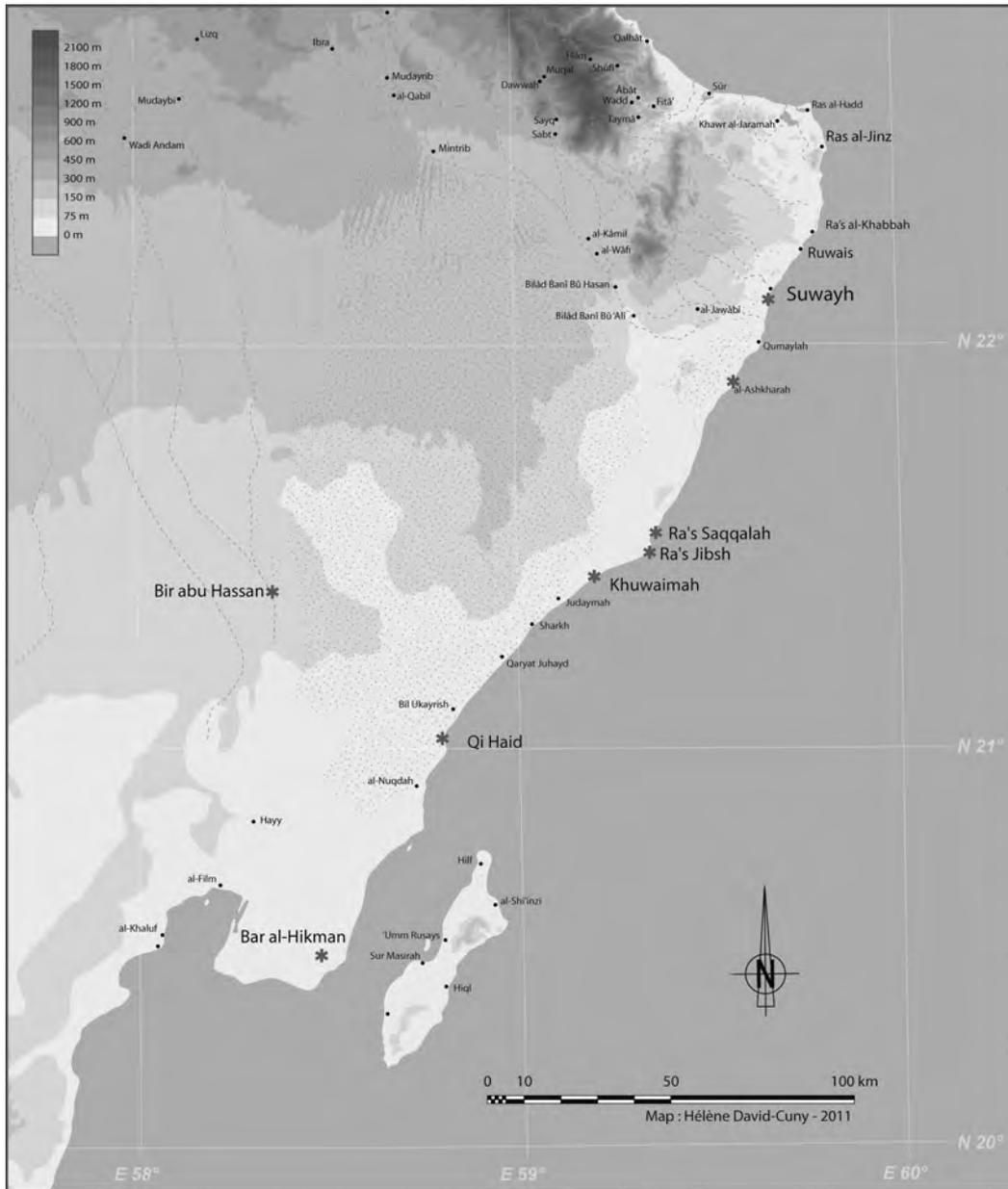
The prehistory of the shores of the Arabian Sea is still largely unknown, and the pressure of building projects is very strong (road infrastructure, airports, urbanization plans, and construction of tourist facilities). In order to expand our understanding of prehistoric occupation over time, the mission is developing an inter-disciplinary approach, combining archaeology and palaeo-geography.

One of our main goals is to record to what extent climatic, deltaic, and sea fluctuations modified the balance between the natural environment and human groups.

In this coastal environment, the survey method was based on geomorphological analysis (study of the evolution of the landscape, geological and anthropic formations, satellite imagery analysis) to detect potential zones. The main sites were then tested by exploratory excavations of several square metres in order to determine the viability of the stratigraphy. At this point, developments in the early and mid-Holocene were also studied by taking cores from the natural environments (palaeo-lakes, palaeo-mangroves). Our first season consisted of surveying the 250 km of coasts, first from Suwayh to Bar al-Hikman (Barr al-Ḥikmān) (Fig. 1), then from Ra's al-Madrakah (N 19° 0' 012" E 57° 50' 25") to Juwayrah (al-Juwārah (N 18° 56' 53" E 57° 16' 45")).

## Qi Haid and the Fasad points

The Wahiba Sands (Ramlat Ahl Wahībah) were surveyed in 1986–1987 by Christopher Edens (1988). In the



**FIGURE 1.** A map showing the Arabian Sea coast from Ra's al-Hadd to Bar al-Hikman. (Drawing Héléne David.)

middle of these sands, the environs of the village of Qi Haid (Haidd or Quhayd, N 21° 10' 35" E 58° 56' 37") produced evidence of a lithic industry composed of points on 'worked blanks' called 'Fasad points', and some Neolithic bifacial arrowheads. This assemblage was then included in the technical complex of the 'Arabian Bifacial Tradition', attributed to a period between the fifth and

third millennia BC (Edens 1988]). We know, however, that Fasad points characterize a part of the industries of hunters of the early Holocene of the eighth millennium BC, even of an earlier period. A quick survey in the inter-dune system at Qi Haid enabled us to find two Fasad points on the eolianites directly above the sea (Fig. 2/1–2). These projectile points are generally made on flakes,

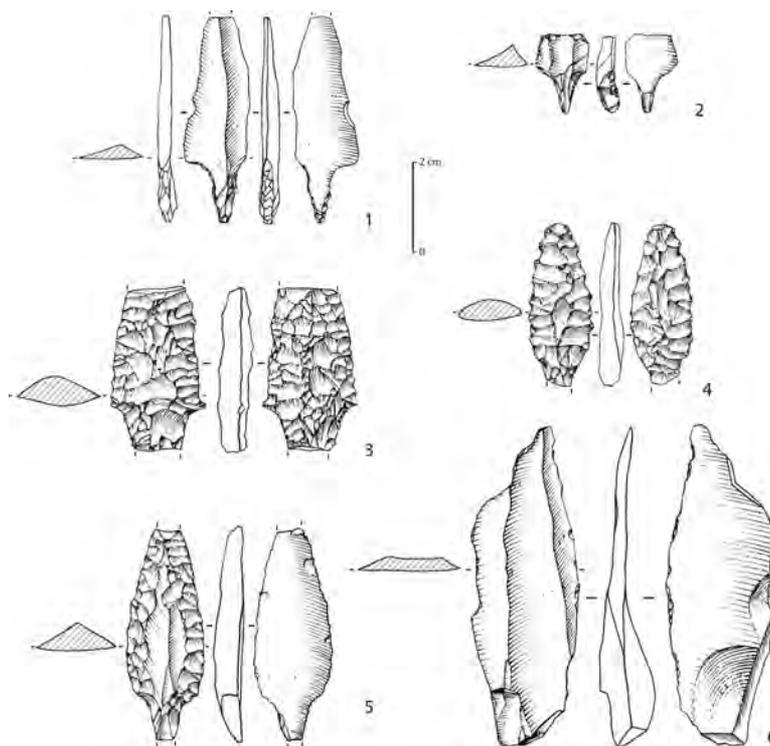


FIGURE 2. *Lithic industries. 1–2. Fasad points, Qi Haid; 3. the mesial part of an arrowhead, Qi Haid; 4. an arrowhead, Ra's Jibsh; a unifacial arrowhead, al-Khuwaymah KHU-5; 5. a blade from Bar al-Hikman. (Drawings G. Devilder.)*

more rarely on blades, of which only the tang is shaped by bifacial retouch, sometimes direct or inverse, more rarely alternate (Charpentier 1996). The two points found at Qi Haid were made on small blade blanks shaped on unidirectional cores. The points previously known from the Ja'alan region are always larger than our examples, with big, barely shaped tangs (Charpentier 2008: 96). Those of Qi Haid are very slender and reminiscent of an example found in the Wahiba Sands or in Dhofar (Edens 1988; Zarins 2001).

In 1995 Maurizio Cattani discovered an important Neolithic site (ALH1) (Cavallari 2005) containing microlithic debitage of fusiform points and foliate pieces attributable to the first phase of the late Neolithic (4500/4200–3800/3700 BC). This site was not surveyed, but some Neolithic vestiges were discovered at Qi Haid, including a medial part of a point (Fig. 2/3) attributable to the fifth millennium BC and very similar to another point found at Ruwaih 1 (Charpentier 2008).

### Suwayh 20 and the southern Ja'alan

Neolithic occupations in the southern part of the Ja'alan region are now well known thanks to excavations we carried out at Suwayh (al-Suwayh) between 1996 and 2004. These Neolithic shell middens sometimes have a very deep stratigraphy (2.10 m at Suwayh 1, for a time period between 5700 and 4200 BC). Suwayh 1 and Suwayh 11 are the oldest shell middens so far identified in south-east Arabia.

The site of Suwayh 20 (SWY-20), overlooking the sea, is a little hillock a few hundred metres long. Dry in 2004, today this hillock is in the middle of a double delta of the Khawr Banī Bū-<sup>ʿ</sup>Alī lagoon because of the heavy rains caused by Cyclone Phet in June 2010. During the height of the marine transgression, Suwayh 20 would have been an island a few metres from the sea, in the middle of a mangrove lagoon. This occupation is well stratified, with a minimum of 81 cm of stratigraphy at

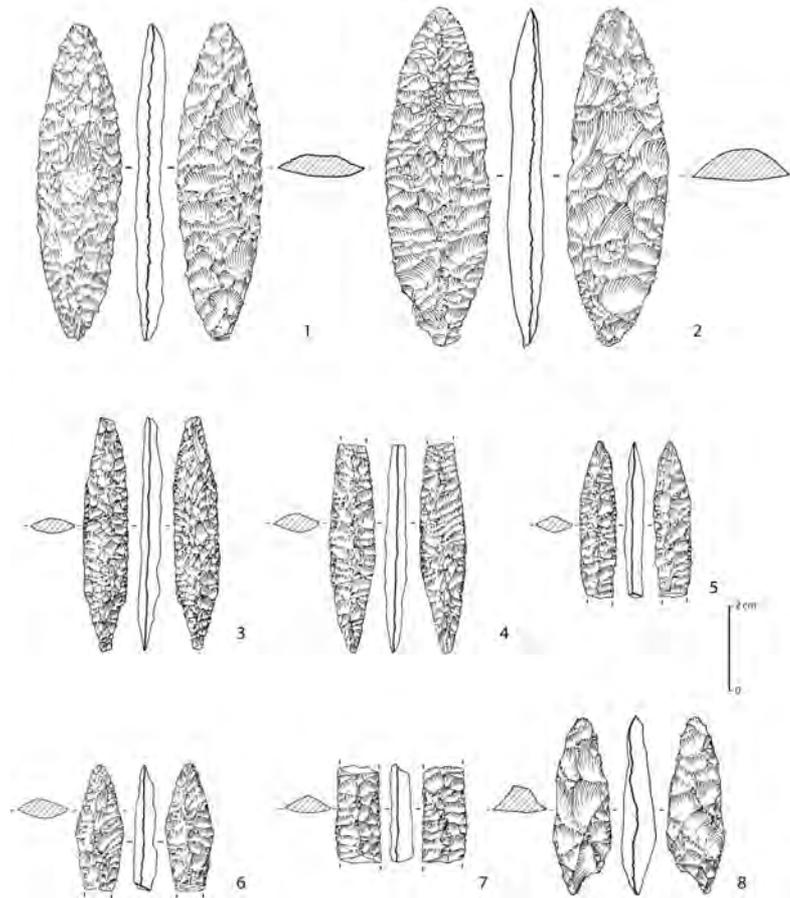


FIGURE 3. Suwayh SWY-20. 1–2. long foliate points; 3–7. arrowheads with lozenge-shaped or biconvex section; 8. a preform (Drawings G. Devilder.)

its top. The oldest levels are dated to 5700 cal. BC, i.e. the oldest coastal occupations known today on the Oman peninsula (7760±80, 5652–5511 BC 1 sigma; 5731–5454 BC 2 sigma;  $\Delta$ R 210±15, Pa 2486). It also reveals, with the occupations of Suwayh 1 and Suwayh 11, the presence of the mangrove in this period. Its top, not yet dated, could be attributed to the first part of the late Neolithic (4500–4200/3800–3700 BC). A 1-m<sup>2</sup> test trench revealed the presence of a structure built with stone slabs.

The material culture collected on the surface and in the test trench on this well-preserved site is exceptionally rich: a vessel cut from a conch of *Lambis truncata sabae*, beads of *Engina mendicaria* and *Conus* sp., net sinkers with longitudinal notches, shellfish hooks. The lithic industry is characterized by a series of arrowheads with lozenge-shaped section (Fig. 3/3–8), daggers, and long

bifacial pieces dated to the late Neolithic's first phase. In addition there is a very large group of daggers with parallel or convergent edges (Fig. 4/1), long foliate points (Fig. 3/1–2), and a few small bifaces (Fig. 4/2–3). The raw materials from which the bifacial tools were made are very diverse: local radiolarite, flint from Jabal Saffān (located near the locality of Ra's al-Jinz [Ra's al-Junayz], some 40 km farther north) as well as quartzites from inland wadis. Red-brown, green, and yellow jaspers sometimes cemented with translucent chalcedony were also exploited. Tools made on local pebbles are oddly abundant at Suwayh 20, such as large macro-drills with trihedral points. This type of industry was also observed in the period II layers of Suwayh 1, 3, 4, and 11 (Charpentier 2008).

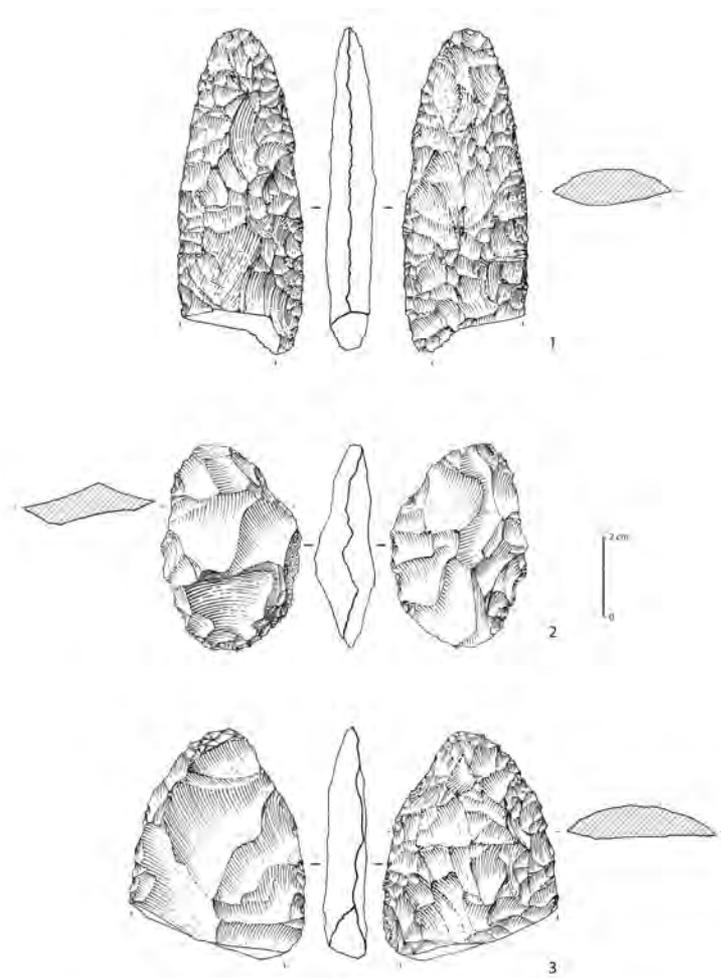


FIGURE 4. Suwayh 20. 1. a dagger (test trench, level 2); 2-3. bifaces. (Drawings G. Devilder.)



FIGURE 5. Suwayh 17: a house from the Umm an-Nar period (2500-2100 BC).

### **Suwayh: a new occupation of the Umm an-Nar period**

At the present time, only Ra's al-Jinz, Ra's al-Hadd, Ruways 2 (al-Ru'ays), and Suwayh 3 have produced sites of the early Bronze Age. The architecture of the Umm an-Nar period (2700–2000) has only been seen in the excavations of Ra's al-Jinz RJ-2 and Suwayh 3. The mission has revealed a new structure at Suwayh, located slightly inland from the present-day shore (700 m). This is a quadrangular structure, 7.60 x 6.70 m, built with large blocks (Fig 5). This architecture, subjected to deflation, was built in mud brick and framed by limestone blocks, like the buildings of periods I–II of RJ-2 and Khawr Banī Bū-<sup>c</sup>Alī. We can also probably attribute it to a period between 2500 and 2100 BC, which some of the surface objects appear to confirm (pottery, ring of *Comus* sp., oblong net sinker with many grooves).

### **Ra's Saqalah (Saqalah): a partially destroyed Neolithic occupation**

Discovered in the 1980s by P. Biagi, Ra's Saqalah (Ra's Şawqirah), has been dated to 6040 ± 60–5920 ± 60 BP, i.e. the end of the fifth millennium BC (Biagi 1988; 1994). Like Suwayh 20, the lithic industry that was recovered consists of fusiform points, micro-drills on blades, and a few small end-scrapers. Bladelets and small cores are abundant on this site, as are the micro-drills. Two 1-m<sup>2</sup> test pits were excavated on the site of Ra's Saqalah 1 (SAQ-1), one on the top and a second in the middle of the south slope. These test pits both revealed a thin stratigraphy (25 to 30 cm), indicating strong erosion over millennia, and/or an occupation that was little sustained on the site. The anthropic layers found are mainly sandy-ashy, dense, and full of seashells. This Neolithic site, despite a strong potential indicated by Biagi's previous work, was disappointing due to a highly deflated surface.

### **A huge Neolithic shell midden: Ra's Jibsh**

Discovered by P. Biagi, Ra's Jibsh has been surveyed many times in the past by the Franco-Italian mission of the Joint Hadd Project, until very recently, but publications on the site are rare (Biagi 1988; Biagi & Maggi 1990; Cavallari 2005; Berger et al. 2005), no exploratory trench has been dug, nor has dating so far been carried out. Ra's Jibsh, 4 km from the village of Bandar Qurūn, consists of a hillock 40 m above sea level (N 21° 26' 54" E 59° 20' 56"), partly set on a sandstone hill, directly overlooking

the sea and a bay in which fishermen still collect salt (Fig. 6). Because of its surface (about 100 ha) and the height of its sandy hillock, Ra's Jibsh represents the most important Neolithic site known today on the Arabian Sea.

### **Palaeo-geography of Ra's Jibsh**

Interpretation of the satellite images of Ra's Jibsh enables a part-reconstruction of its palaeo-geography. Behind a late coastal band stretches a vast sabkha of about 2 x 3 km. An even larger clayey zone, dark in colour in the satellite images, connected to two wadis that converge towards the sabkha, could represent the surface of a lagoon or a fossil mangrove, measuring 4–5 km each side (see Fig. 6). The presence of many *Terebralia palustris* shells in the archaeological levels of the site appears to indicate the existence of a mangrove, during a period in which the two wadis would have brought more fresh water. It is possible that the whole of this sector was invaded by the Arabian Sea, during the maximum of the postglacial transgression in c. 5000 BC. The first occupants of the site of Ra's Jibsh could have chosen to settle at the end of the peninsula.

Two trenches were dug on this site (Fig. 7), one at the top (T1), the other in the lower part of the shell midden (T2). About 2 m deep, these trenches were complemented by cores taken by hand in order to estimate the potential of the stratigraphy and to reveal the sequence of occupation. In both cases, anthropic horizons with charcoal and shells were identified at about 3.5 m from the surface. The sequences indicate strong alternation between sandy aeolian horizons containing jumbled artefacts and anthropic horizons with a high component of ash and charcoal, shells, and fish bones. Radiocarbon dates in the process of being determined at the Artemis laboratory (Saclay-Lyon 1) will enable estimation of the duration of occupation of these two archaeological sequences. Trench T1, at the top of the shell midden, was studied in stratigraphy on its north and east faces, enabling an understanding of the geometry of the sedimentary formations. Four principal sedimentary groups were observed in the visible part of the trench (Fig. 7). The first three (up to phase 2B) present a slope that was clearly more pronounced than today. The construction of a dune during phase 2 explains the modification of the morphology of the slope, and the creation of a sandy platform that was then last occupied during phase 1, above. The sequence studied presents two principal occupation phases (Unit 1 and 3), which have a much higher content of ash, charcoal, and shells. Structures of

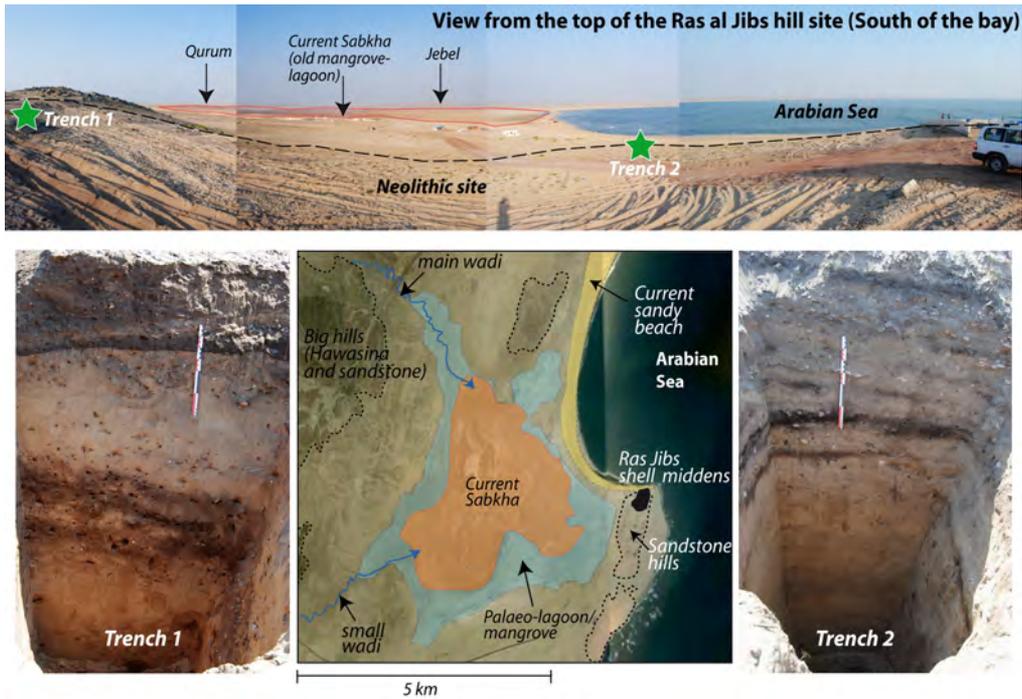


FIGURE 6. The palaeo-geography of Ras Jibsh. The site and the sabkha.

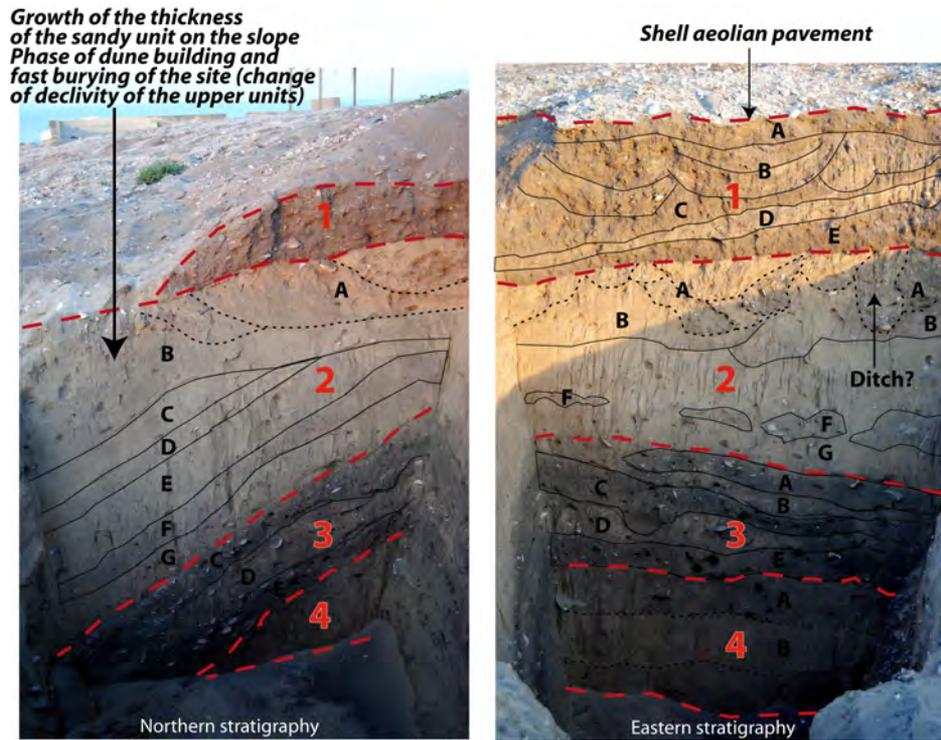
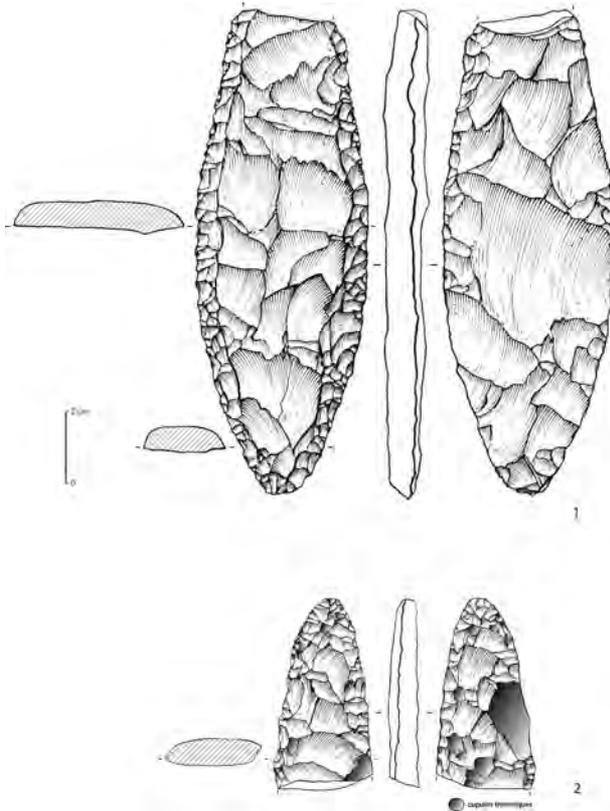
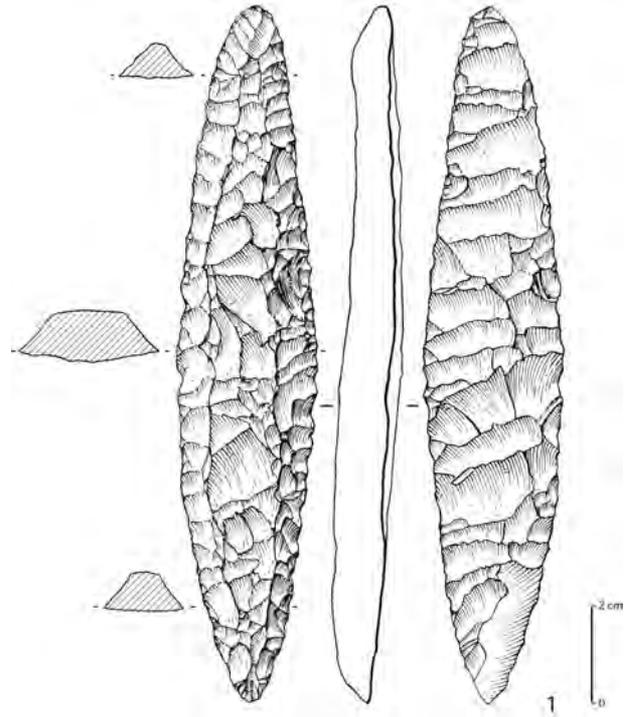


FIGURE 7. Test trench T1, Ras Jibsh. Four principal sedimentary groups were observed in the visible part of the trench.



**FIGURE 8.** *Ra's Jibsh.* **1.** a dagger, shaped with a soft percussion tool, found at the top of the site; **2.** the distal of a dagger, found at the bottom of the site. (Drawings G. Devilder.)

occupation of space are absent, and indications of shifting by wind are clearly more present, especially in the unit at the top, in which there are many pockets of deflation and sandy-layered formations, indicative of erosion and local shifting of occupation horizons (Fig. 7). On the surface a paving of shells protects the site well. Unit 2, which separates the two most productive anthropic stratigraphic units, indicates a period of high aridity associated with a deposit of thick sandy layers. It can be divided into two phases: the first (2G to 2C) shows a succession between the sandy deposits shifting the earlier horizons and the sandy discontinuous (lentic-shaped) deposits of occupation, associated with slight traces of pedogenesis (bioturbations and slightly hardened rhizoconcretions). The upper part of Unit 2 shows even more arid conditions, associated with the construction of a probable dune (2B) and the intensification of the winds, seen in the sedimentation of coarser sands, sometimes slightly



**FIGURE 9.** *Ra's Jibsh:* a dagger, shaped with a soft percussion tool then by pressure, found on top of the site. (Drawings G. Devilder.)

gravely in the fill of the many deflation pockets (Fig. 7). The number of artefacts is clearly reduced. Certain occupation horizons in the lower part of trench 2 appear to show better preservation, but on the whole the site of Ra's Jibsh appears to be less well preserved than others, such as e.g. al-Khuwaymah 2 (KHU-2) and the groups of shell middens of the region of Suwayh (SWY-1, 2, 3).

#### Neolithic material culture at Ra's Jibsh

The quantity of artefacts is particularly rich. Microlithic industries have been found on the surface of the site, at its base (Middle Neolithic), and in its upper part, dated to the early fourth millennium BC. The notable discoveries are two exceptionally large 'daggers' discovered at the top of the site. One has a slightly broken extremity and measures 13.6 cm long, 4.8 cm wide, and 1.2 cm thick (Fig. 8/1). It was shaped with a soft percussion tool. The second is

complete and measures 14.4 cm long, 3 cm wide, and 1.3 cm thick; it was shaped by a soft percussion tool, then by pressure (Fig. 9). These two pieces were made from large flint blades from Jabal Saffān, at a distance of about 110 km as the crow flies.

A specific workshop for this kind of dagger is recorded at RJ-38 in the Jabal Saffān (Charpentier 1999). It is thus probable that the daggers of Ra's Jibsh come from RJ-38 or from a similar workshop. These points are not very functional and should be considered as objects of prestige. A tanged arrowhead (Fig. 2/4), large convex side-scrapers, many blades as well as some bladelet debitage characterize the assemblage of the lithic industry. Decorative elements are also present, with a few beads made from *Engina mendicaria* (Trench 2) and discoid beads. A fragment of a stone bracelet, plano-convex in section and bi-perforated at one end, is reminiscent of a larger one from Suwayh 1 (about 4200 BC) (Méry & Charpentier 2009). Fishing equipment is well represented in the form of net sinkers. These are of a type very specific to Ra's Jibsh, as the large majority has no notch on the end but rather two biconical longitudinal perforations (Fig. 10). In the Oman peninsula only the late levels of

Suwayh 1 have produced two examples of this type of net sinker. Local gabbro was exploited to produce two net sinkers of exceptional type and size (Fig. 11). Both were found at the top of the site and are thus from a late period (end of fifth millennium?). One is a pebble (12.2 x 13.5 cm) in which a 2 cm groove was made by dot-chiselling or bush-hammering on the two faces of the object. The other is a sphere weighing 7.5 kg, also bush-hammered all along its edge. Such objects are thus far unknown in Neolithic material culture related to fishing.

### Al-Khuwaymah: a vast ria on the coastal plain of Qurūn

The plain of Qurūn is a flat zone of oblong shape, surrounded by low hilly outcrops of Hawasina formations. Late Holocene aeolian processes have divided it into two almost equal parts: the western part is sanded up by an advancing dune that masks a large part of the landscape shapes that are earlier than the late Holocene; and the eastern part, in which earlier formations in the process of erosion are still visible, is being deflated (Fig. 12). On the satellite images, scattered whitish spots between the



FIGURE 10. Ra's Jibsh: fishing equipment. Net sinkers with two biconical longitudinal perforations. This type is very specific to Ra's Jibsh.



FIGURE 11. Ra's Jibsh: fishing equipment. A net sinker of exceptional type and size.

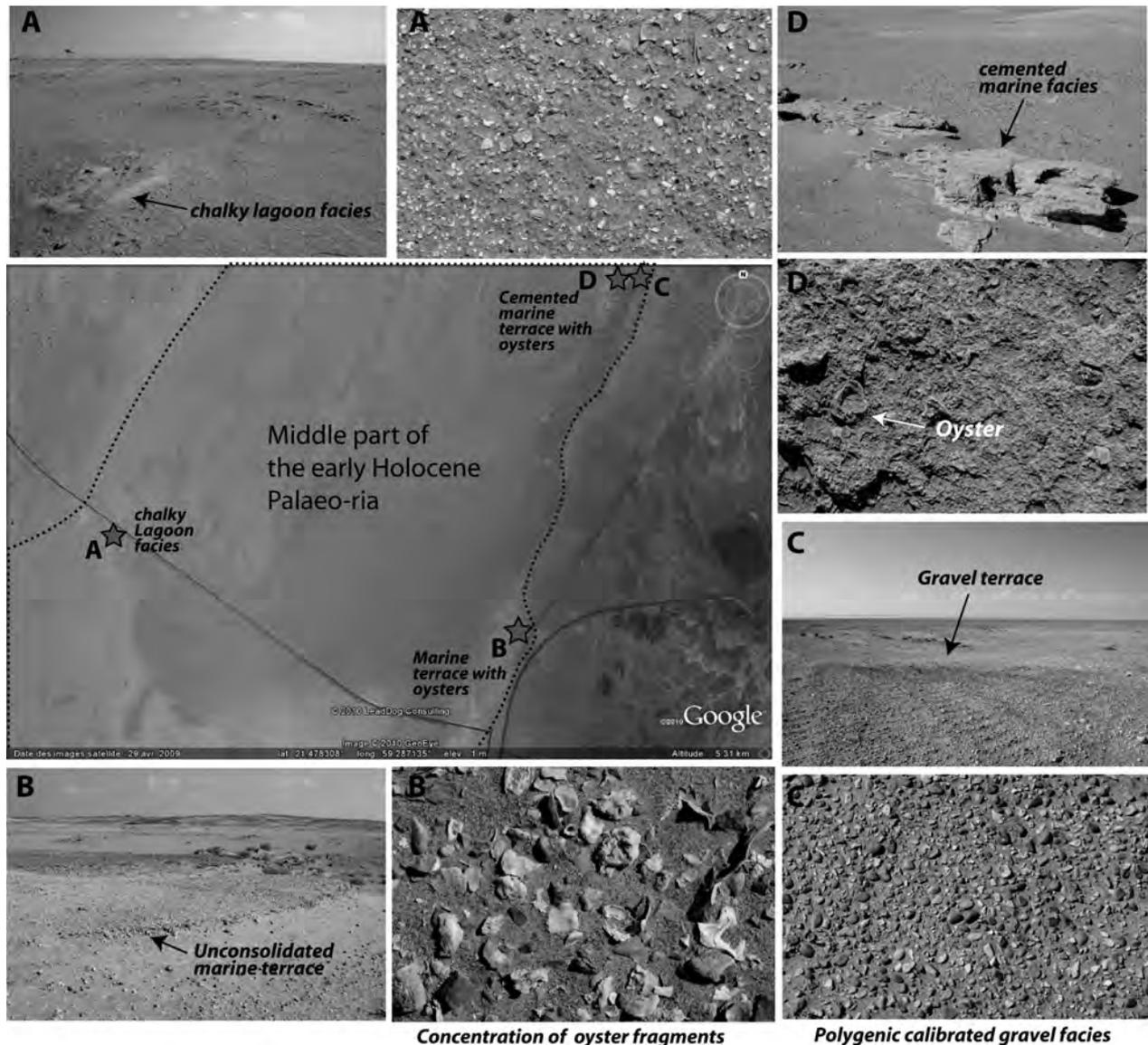


FIGURE 12. The plain of Qurun, sites and geomorphology.

dunes, rich in lagoon-marine shells seen on the ground, indicate the presence of clayey-chalky relict formations, non-indurate, probably Holocene in the western part of the plain. Whitish and greyish parallel continuous alignments, the whitish parts strongly reflective in the images, represent the probable eastern edge of the fossil rias (Fig. 12; sites B, C, and D). Site B disclosed a strip of marine terrace, non-indurate and rich in oyster shells, 30 cm thick. Site C revealed some kilometres uphill, in the continuation of the clear coastal band, another marine

fossil formation with oysters, but here strongly cemented by calcium carbonates. Nearby and set back, site D revealed the presence — between 0.5 and 1 m higher up — of a strip of terrace that is probably fluvial, with small well-graded pebbles, and earlier than the marine terrace C (Fig. 12). This could be an alluvial formation immediately earlier than the postglacial transgressive maximum. It is however possible that the strong hardening of the marine formation could indicate a much older age (Eemian). Marine formations dating to this period have already been

reported by J-C. Plaziat, a little farther north in the region of Suwayh (Ruways) (Plaziat, personal communication). These initial field observations indicate the probable existence of a very large coastal ria during the early Holocene, invaded by the sea then filled by fluvial and aeolian processes. Radiocarbon dates and excavation will enable verification of this hypothesis in the course of the next missions.

Other observations based on interpretation of satellite images and through geomorphological verifications on the ground, between Qurun and al-Khuwaymah, will complement in general outlines the palaeo-geography of the sector. A first series of coastal bands with prehistoric lithic vestiges, probably early and indurate, has been identified east of the village of Qurūn. It could indicate a transgressive stage of the Arabian Sea above its present

level (see Lambeck 1996). The second palaeo-geographic stage corresponds to the transgressive maximum and the maximal invasion of the palaeo-ria. The very particular position of the *c. ten* shell middens identified during the archaeological surveys, north-south and on the western periphery of the fossil ria, allows us to observe that these sites lie along the western edge of the ria, and that they could have been established on a coastal band or a series of coastal dunes edging this ria (Fig. 13). The last palaeo-geographic stage that can be reconstructed only from observation of the surface is associated with a series of sub-late coastal bands, very clearly identified on the satellite images as they have not shifted, or hardly so. A late Holocene date for them is highly plausible (Fig. 14).

A focus on the south-west part of the fossil ria of Qurūn illustrates the north-south orientation of the series



FIGURE 13. Palaeo-geography: the ria of Qurun, Khuwaymah and Ra's Jibsh archaeological sites.

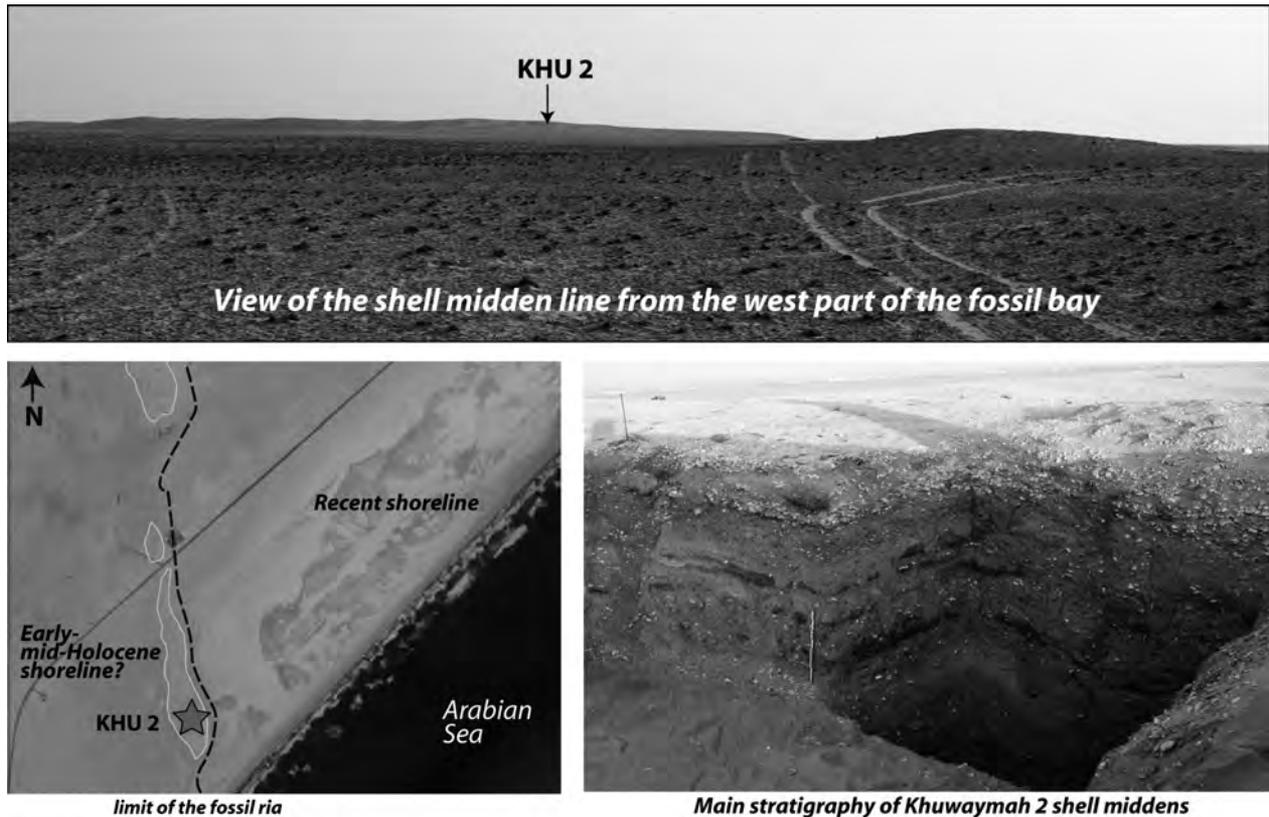


FIGURE 14. *The shell midden of Khuwaymah KHU-2.*

of shell middens (Fig. 14). Their position on the periphery of the palaeo-ria and to the south of a succession of coastal bands may be seen. The shell midden of al-Khuwaymah KHU-2 is situated in the southern part of the alignment, at about 5 m above the beach, and presents a sedimentary depth of 2 m (Fig. 14).

#### Archaeological discoveries at al-Khuwaymah

Five major sites have been identified that represent the Neolithic, Bronze Age, and Iron Age. Apart from a survey, the sites of KHU-2, KHU-3, KHU-4, and KHU-5 have all been explored by excavation to reveal their stratigraphy.

Al-Khuwaymah 1 (KHU-1) was clearly occupied during several periods, first during the late Neolithic, probably between 3700 and 3100, indicated by debitage of radiolarite and the presence of circular net sinkers made from slabs of calcite. The early Bronze Age (Umm an-Nar period) is also present, with pottery and cornelian bead.

Al-Khuwaymah 3 (KHU-3) presents only bivalves on its surface. The presence of the bivalve *Meretrix* sp., a sub-species known at Suwayh and a native of the Omani coast of the Arabian Sea that today has totally disappeared from conchological records, implies that this shell did not disappear after the third millennium as has been supposed. An exploratory trench of 1 m<sup>2</sup> revealed a stratigraphy 50 cm deep. The five anthropic horizons found are very ashy and two sherds probably belonging to the Iron Age (?) were found in place.

Al-Khuwaymah 4 (KHU-4) possesses a late Neolithic occupation (large denticulated side-scraper, blades, atypical tanged arrowhead [Fig. 2/5], all in flint from Jebel Saffān, net sinkers with longitudinal notches). An occupation is also represented on the surface by abundant pottery (sixty-seven samples collected) that is clearly protohistoric. A 1-m<sup>2</sup> test trench was excavated in the centre of the site, not far from the maximum density of the pottery. This was revealed to be sterile, as the site has suffered strong deflation.

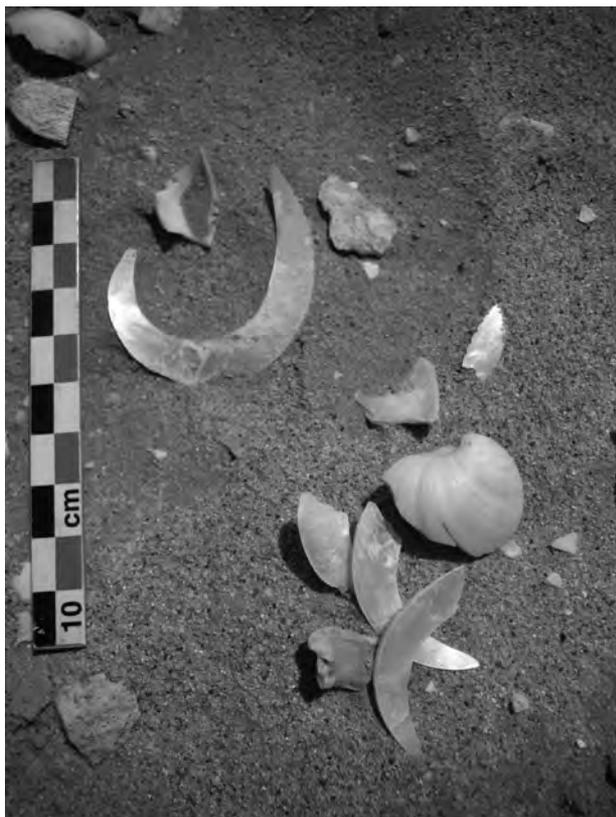


FIGURE 15. *Al-Khuwaymah KHU-5. Exfoliated elements of a pearl-shell fish-hook.*

Al-Khuwaymah 5 (KHU-5) has produced from its surface ten net sinkers, oval in shape and of various dimensions (4–12 cm in length), having large longitudinal notches on the largest and incisions on the smaller. A crushing-stone is the only tool of this type found during the campaign. It is probably related to the consumption of *Terebralia palustris*. The debitage is generally macro-lithic and the tools consist of a large convex side-scraper made from chert, a smaller one made from flint, a narrow retouched blade, and larger blades, some of which are denticulated. The assemblage confirms the attribution to the fourth millennium BC. Exfoliated elements of a pearl-shell fish-hook were discovered. This remarkable piece is a circular fish-hook, with a nearly closed point and a head with retention grooves (Fig. 15). This example is reminiscent of one from Suwayh, as well as another older one from the upper horizons of Ra's al-Hamra 6 (RH-6). An exploratory trench was excavated in this Neolithic occupation, but revealed no stratigraphy because of very strong deflation.

### The Neolithic settlement and graveyard of al-Khuwaymah KHU-2

This site was the subject of special attention as elements of a necropolis were uncovered in the middle of a Neolithic occupation. Al-Khuwaymah 2 (KHU-2) is the largest and highest hillock in this coastal fossil band (Fig. 14). An initial 20-m<sup>2</sup> trench was opened. The stratigraphy, more than 2.3 m deep, confirmed the presence of many dwelling structures, but the material culture found in this little excavation was not abundant. It consists of debitage, some small blades, a large flint flake from the Jebel Saffān, net sinkers with longitudinal notches, and vessels made from *Scapharca inflata*.

An unstratified fish-hook fragment in pearl-shell was collected. The assemblage is attributable to the fourth millennium, perhaps even to the first centuries of the fifth millennium BC (4100–3100). In stratigraphic unit 4 (Fig. 16) the excavation revealed a long circular structure which belonged to a house (Fig. 17). This structure consists of a curved gutter or channel, whose eastern and northern edges were not excavated. Inside this channel there are no stones, but internal and external post holes are present. This long circular channel has an external diameter of 4 m and an internal diameter of about 3.5 m and is reminiscent of certain structures already excavated in the Oman peninsula. The most frequent structures previously observed were built using load-carrying posts (e.g. Dalma, Akab, Ra's al-Hamra 5, Suwayh 1 & 2). They may possess a small gutter/channel as at Ra's al-Hamra 5 (RH-5) or Suwayh 2 (SWY-2). Other structures are composed of a long continuous or discontinuous gutter/channel. This is the case at Suwayh 1 for the sixth and fifth millennia BC, Ra's al-Hamra 5 (RH-5; Marcucci et al. 2011), and Ra's al-Kabbah 1 (KHB-1; Cavulli 2004) for the fourth millennium. These structures are always circular, usually small in size, between 1.5 and 3.5 m. The structure at al-Khuwaymah 2 is thus a large dwelling within this group.

### The necropolis of al-Khuwaymah 2

During the excavation, a burial of a child was revealed. A second burial was found in the south-west angle, during an extension of the trench made in order to understand the architecture of the Neolithic house. A third in the north-east angle was not excavated, while a probable fourth was very eroded at the surface of the trench.

Burial 1 is that of a young child (between 4 and 6 years old). It is lying on the left side, with the body

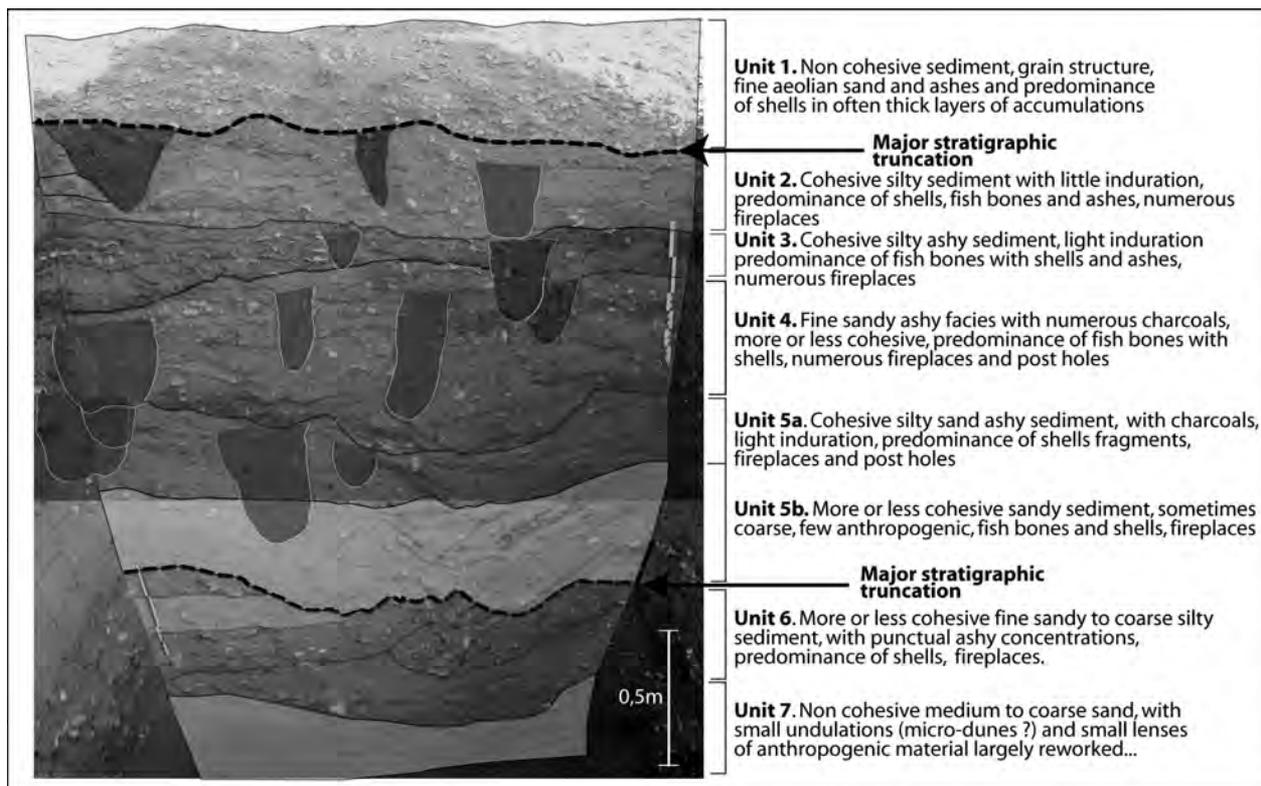


FIGURE 16. *Al-Khuwaymah KHU-2. Stratigraphy, north section.*

oriented north–south, facing west towards the setting sun. The burial was carried out by digging a simple grave in which the body was directly placed. The preservation of the bones is good in comparison to those in other known necropoleis in Oman. The bones of the arms were not found, probably because of later disturbance (anthropic digging or bioturbation). The fill of the grave consisted of a homogeneous ashy-sandy matrix, which produced no archaeological material.

The other individual (Burial 2; Fig. 18) is a young adult, in the same flexed position but on the right side with the face facing east towards the rising sun and the body also oriented north–south. Here again, no associated objects were found, in spite of careful sieving of the fill of the grave, which presented the same characteristics as Burial 1.

Neolithic burials and necropoleis are always located within or near Neolithic dwellings, but in the absence of any construction in elevation, they are particularly difficult to detect for archaeologists. The example of the Jaʿalan is thus significant. Twenty-six years of intense exploration

in a region that covers 3000 km<sup>2</sup> has produced only three necropoleis (Suwayh 1 SWY-1, Ruways 1 RWY-1, Raʿs al-Khabbah 1 KHB-1) (Charpentier, Marquis & Pellé 2003; Méry & Charpentier 2009). In the whole of the Oman peninsula, there are only eleven recorded necropoleis or isolated burials that date to the Neolithic. Al-Khuwaymah 2 (KHU-2) is thus the tenth necropolis to be discovered in the Oman peninsula, and could of course be excavated. It has the highest potential for this Neolithic period on the shores of the Arabian Sea.

### Stratigraphy of al-Khuwaymah KHU-2

A localized but detailed stratigraphic study of these shell middens has enabled the first establishment of the history of their formation during the fifth and fourth millennia BC. Seven principal sedimentary units were distinguished, based on the density of the anthropic structures and vestiges and the inter-stratification of sandy formations of aeolian origin (Fig. 16). We are able to propose three pedo-sedimentary stages: 1) a predominance of

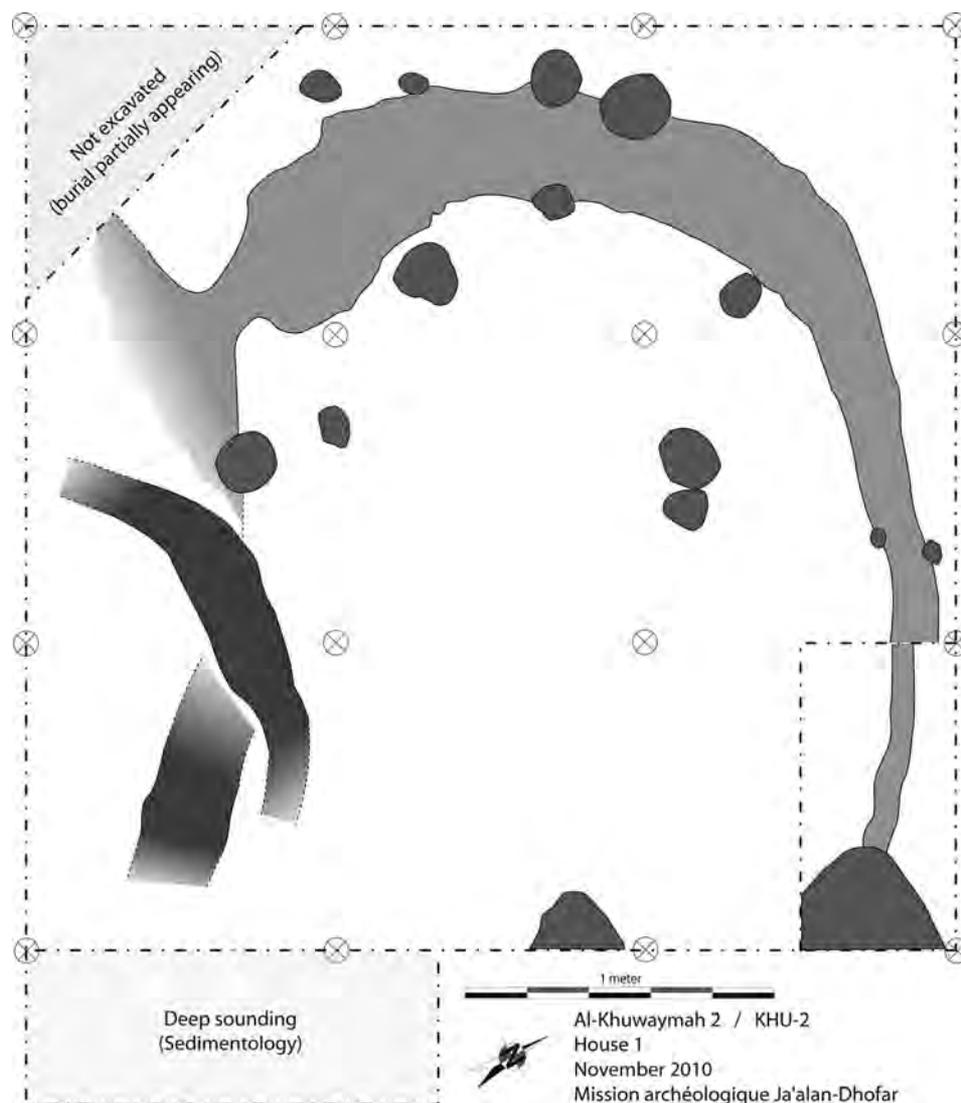


FIGURE 17. *Al- Khuwaymah KHU-2, House I.*

clearly aeolian facies, not very cohesive, sometimes associated with deflation pockets or truncations of underlying horizons, in which scattered artefacts indicate dismantling by the wind of some of the earlier traces of occupation; 2) intermediate facies where the dynamics of aeolian sedimentation are still present, but often finer (less intense winds) and associated with more continuous anthropic formations of the shell midden; 3) facies in which the ashy charred anthropic formations and shells are predominant, with sometimes possible contributions of silty earth, in which the architectural structures are the

most meaningful (basin-shaped hearths, pits, post holes, etc.) (Fig.16). These facies are often slightly indurate and locally present characteristics of bioturbation, which could indicate more favourable climatic periods, less windy and more humid, conducive to vertical redistributions of  $\text{CaCO}_3$ , to the development of low herbaceous vegetation on the surface of the shell middens and to the activity of soil fauna.

The base of the sequence (Unit 7) indicates intensive processes of aeolization (medium to coarse sands) and the possible construction of small dunes (Fig. 16). This



FIGURE 18. *Al-Khuwaymah KHU-2, Burial 2.*

formation strongly disturbs the vestiges of an initial occupation, highly eroded and shifted, in the form of shells and scattered coarse macro-charcoal and small decimetric lentil-shaped elements rich in ash and charcoal. The same processes have been identified in the upper part of Unit 6, Unit 5b, and the uppermost unit of the shell midden (Unit 1), still more or less protected by an imposing paving dense with the shells of *Veneridae*, between which small deflation pockets and sandy beds can be distinguished.

The intermediate facies were observed in Units 6 and 5a, in association with some hearths and post holes that are highly visible in the excavation and in the stratigraphy. They are situated in the lower half of the stratigraphy that characterizes a period that is still arid, associated with frequent sandy coverings of the site (Fig. 16).

The more clearly anthropic facies (Units 2, 3, and 4) are dominated by cohesive silty formations, sometimes somewhat indurate, very sandy, rich in hearths, in beds of shells and in lentil-shaped areas of orange-coloured fish bones. They contain the majority of post holes, clearly visible in stratigraphy (Fig. 16). This is clearly the major occupation phase of the site, in which the circular house of Unit 4 was identified.

A sudden sedimentary break was identified in the top part of Unit 2, at the contact with Unit 1 above. Some underlying layers appear bevelled and thus appear to be partly truncated (Fig. 16). This episode could correspond to intense aeolian erosion on the top part of the shell midden, and thus a quite abrupt climatic change towards

aridity. Tomb 1 corresponds stratigraphically with this US 1-US 2 interface; it is mostly filled by yellow aeolian sands with a particular structure. This use as a necropolis indicates at least temporary abandonment of the shell midden as an occupied site, at a time when the winds and the aeolian deposits increased. This situation is reminiscent of that observed at the site of SWY 1, 85 km to the north.

### **Bar al-Hikman: a once habitable region that is hostile today**

The region of Bar al-Hikman is a vast sandy rectangle, about 2400 km<sup>2</sup>, situated south-east of the Wahiba Sands, which presents no relief higher than an altitude of 4–5 m. Located between the present-day delta of Wādī ʿAndām in the west and the island of Masirah (Maṣīrah) in the east, it presents a series of coastal bands, palaeo-channels, sabkhas, and lagoons, which indicate an ancient deltaic construction, very clear in aerial photographs in its southern half (Fig. 19). For Glennie and Singhvi (2002), it consists of relics of Mio-Pliocene sediments of the upper Fars Group together with an area converted to a sabkha in recent millennia. It is suggested by the authors that formerly this was a zone of sand dunes transported to the north by south-west monsoon winds, before the postglacial marine transgression. It is possible that relief of a few metres could be associated with highlands, before the construction of the delta. We associate this

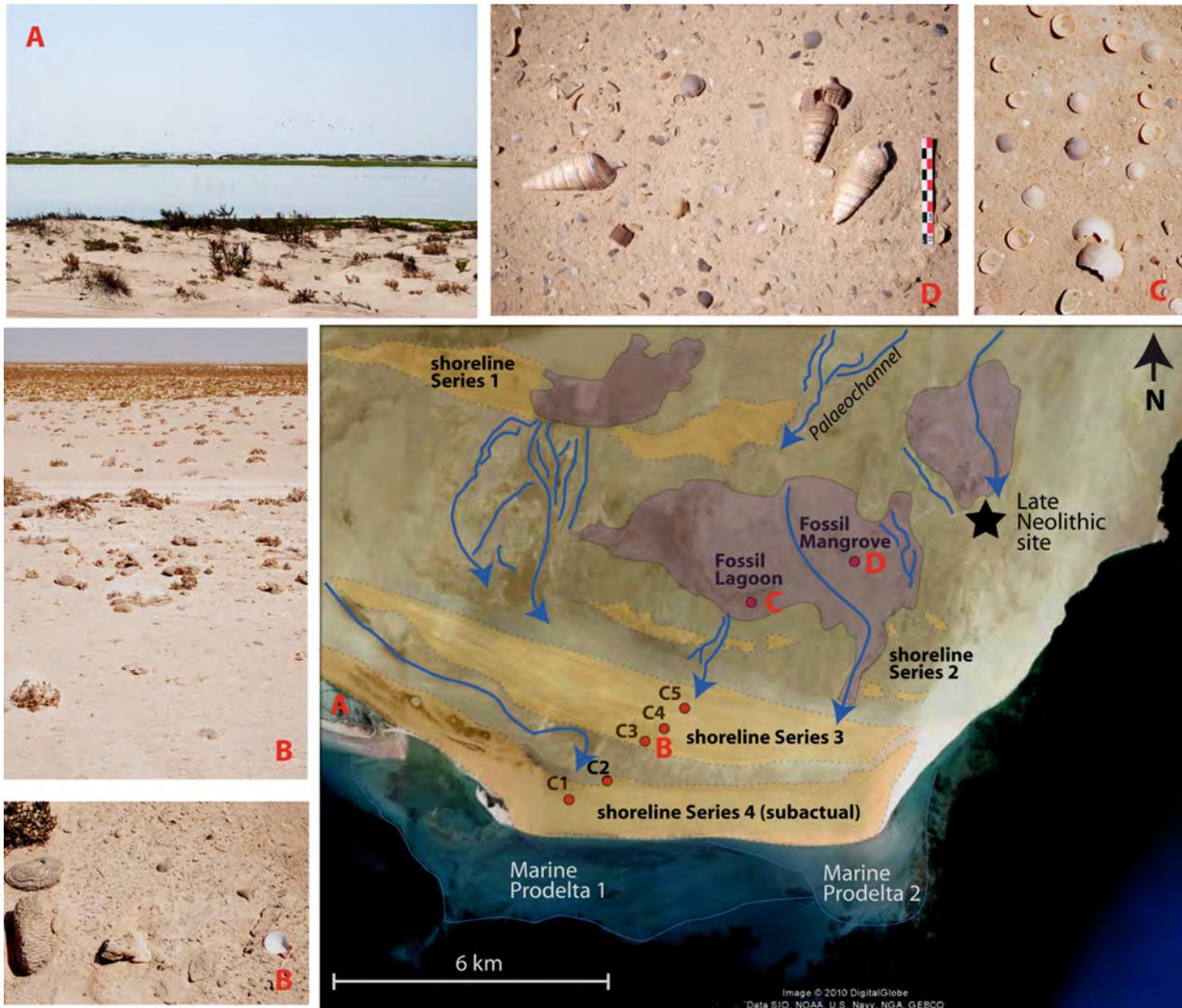


FIGURE 19. Bar al-Hikman: mangrove, lagoon, palaeo-channels, and archaeological site.

large sabkha region with an early to mid-Holocene delta of the Wādī ʿAndām, where large ancient lagoons and mangroves became a sabkha because of the late arid phase. Its south-eastern part was surveyed particularly along its ancient marine shapes, overlooking the vast coastal plain by several tens of metres.

Eight geomorphological points of observation were determined using a SW–NE transect that cuts across the various morphologies identified on the satellite images (Fig. 19). The most characteristic forms observed in this part of the fossil delta are levees that are recognizable often over several kilometres, 10 to 40 m wide, and not

very high (from 50 cm to 1 m above the alluvial plain). They consist of sand, shells, and madrepores. These palaeo-forms correspond to fossil coastal bands that are sometimes clearly cut across or dismantled by palaeo-channels that are sinuous in shape. Of the nine bands followed and observed (Fig. 19), only one, no. 6 BAH-2, produced a lithic artefact: a 7 cm blade, made in grey-black flint of good quality and attributable to a period between 4500 and 2700 BC (Fig. 2/6). This artefact already indicates the middle Holocene, which will be determined by future radiocarbon dates on the shell material from the bands and palaeo-mangroves.

Several stages in the development of the delta could be identified on the map, based on analysis of the satellite photographs. The first identifies two sources of ancient channelling, a large coastal band and two probable lagoons, in immediate proximity to where the Neolithic lithic artefact was found. The second series of bands (shoreline series 2) and still very numerous palaeo-hydrological traces are probably associated with two prodeltaic lobes that are still visible under the marine level in the south of this delta (Fig. 19). These traces are associated with a vast darker depression, several kilometres square, for which surface observations indicate shell assemblages typically associated with a freshwater lagoon, with a surface concentration of shells of dead bivalves, sometimes still in life positions, and with a mangrove with many *Terebralia palustris* shells (Fig. 19). Traces of fossil channels cross these ancient humid coastal environments and the marine bands behind which they were formed, to finally come up against a series of fossil bands (B, shoreline series 3) more than 1 km wide and continuous over nearly 10 km (Fig. 19). This indicates a probable long-term stagnation of the marine level and a change in the position of the mouth of the Wādī ‘Andām, towards the west. A final series of very close bands of the same width was identified 2 km downhill, just behind the present-day band (shoreline series 4) (Fig. 19). The present-day band is connected more to the west to a lagoon that is probably fed by fluvial water from a more western source of flow. A palaeo-channel circulates between these last two series of bands. It illustrates the difficulty for the flow to cross the wide marine belts.

### Provisory palaeo-geographic reconstruction of the Bar al-Hikman

Based on observations made on the ground and morphological information taken from the study of the satellite images, three main palaeo-geographic stages may be proposed, while future field studies are awaited (Fig. 20). The first corresponds to the early Holocene, a period in which the delta did not yet exist. Sea level rose progressively from the minimum attained during the pleniglacial. The geomorphological inheritance of the last glaciation led to the formation of a deep canyon, dug by the wadi during the regressive maximum, then invaded by the sea up to several kilometres uphill from the 10 m topographic line during the maximum postglacial transgression (in orange in Fig. 20/1). Early Holocene sites could be identified along this ancient fossil ria if

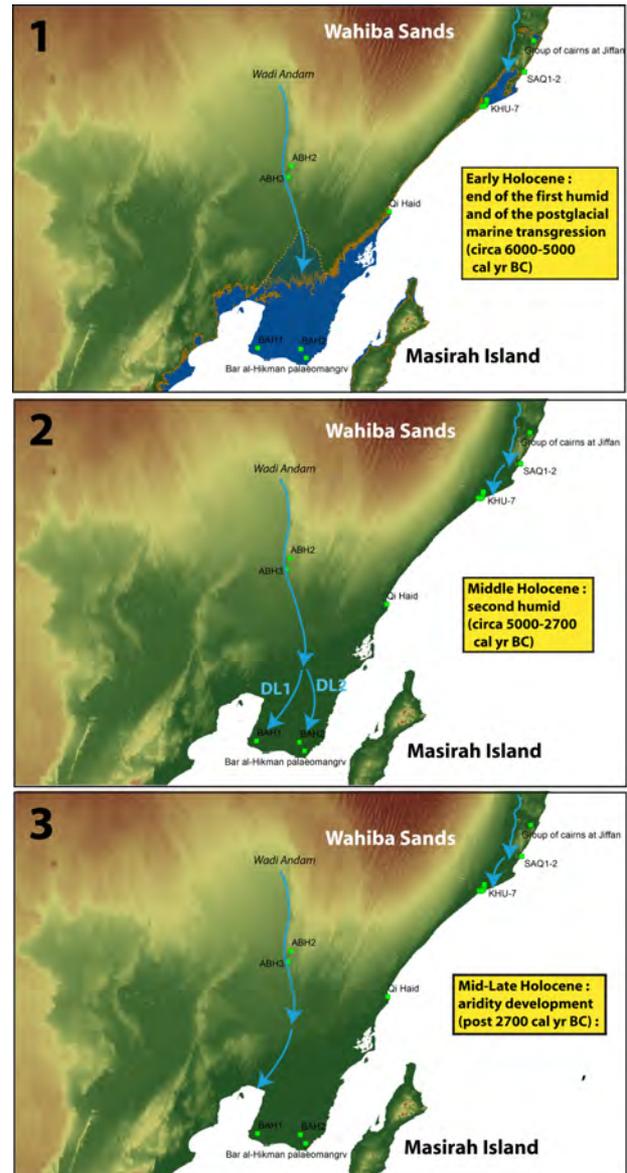


FIGURE 20. The palaeo-geography of Bar al-Hikman from the Early Holocene to the mid- to late Holocene.

they had not been covered by later alluvia, but today only a radar or seismic image can enable location of the line of this ancient canyon. This period corresponds to the progressive filling of the bottom of the bay by a mixture of fluvial contributions from uphill and marine contributions from downhill. The relative stabilization of the continental landscapes of Arabia, is observed during

the optimal period of precipitation there, then reduces the contributions to the coast (Lézine et al. 2010; Parker et al. 2006; Wilkinson 2009; Berger et al., in press).

The second palaeo-geographical phase observed (5000–2700 cal. BC) corresponds to the period just after the stabilization of the marine level to a level slightly above that of the present day (2–3 m), of which the transgressive maximum is seen to be about 5000 BC in the northern part of Arabia and the Makrān (Sanlaville & Dalongeville 2005; Lambeck 1996) (Fig. 20/2). The duration of the deltaic activity is still not known well enough to discuss without the use of sequential analysis and absolute dating. But we know from rare continental interior data that gravel formations of piedmont fans and fluvial silts in lower valleys would represent fluvial activity during the climatic optimum following the last glaciation. Dalongeville (1999) mentions gravelly terraces dated to the early Holocene and fluvial silts dated to the mid-Holocene in the Wādī Dhaid (Wādī al-Dhayd) catchment (UAE). In al-Harmaliyyah (Ḥarmalī N 23° 40' 4" E 56° 55' 36") area, OSL dates indicate alluvial fan activity from 8000 to 3000 cal. BC (al-Juaidi, Millington & McLaren 2003); and Berger et al. (in press) describe a semi-continuous fluvial aggradation with the deposit of very fine material during flood events in the bottom of Wādī al-Masīlah (Ḥaḍramawt, Yemen) and those of its northern tributaries, from 10000 to 3200 cal. BC. They also mention aggradation phases until 800 cal. BC. These compiled data enable us to postulate that the deltaic construction phase could have taken place up to the middle of the mid-Holocene (to which the lithic artefacts found on the beach ridge are dated), or even later if we consider the possible impact of Mediterranean rains on the fluvial systems of southern Oman. Photo-interpretation allows the differentiation of two phases of coastal pro-gradation, probably successive, associated with two deltaic lobes (DL 1 and 2; Fig. 19).

The third and last palaeo-geographic phase of Bar al-Hikman corresponds to a perceptible decrease in the water from the Wādī ʿAndām and to the reduction of the sedimentary yield. This situation corresponds to a relative stabilization of the delta, in a shape that is close to that of the present day. This phase is associated with a major fluvial avulsion to the west of the Wādī ʿAndām, in today's deep bay (Fig. 20/3). It corresponds to the beginning of coastal erosion processes seen in the southern and eastern parts of the delta (Fig. 20), with an anomalous interruption of the ancient coastal shapes, the active erosion of ancient lobes, and the construction of a coastal spit by marine currents. Starting at this still

unknown date (beginning of late Holocene period?), the south-west monsoon blew from south to north, deflating the new flat, dry Bar al-Hikman sandy-to-silty lagoon-deltaic formations and contributing to the construction of the high Wahiba dunes. This area became a hostile zone for human communities, which probably left the area to follow the river's course to the west.

## Conclusion

Not identified until now, the large bay with the lagoon and mangroves of Qurun and al-Khuwaymah is the fifth one to be identified between Ra's al-Ḥadd (Jaʿalan) and Qi Haid (Wahiba) and the third one that we have studied after those of Suwayh and Khawr Banī Bū-ʿAlī.

The combination of archaeological survey methods and analysis of satellite and geomorphological data has proved to be very efficient for the discovery of all the habitats in their palaeo-geographic context. In parallel, systematic excavation has led to the discovery of stratified occupations and the study of their development over time. Thus a number of sites that have been attributed to the second half of the fourth millennium have proved to be older: the middle of the sixth millennium for Suwayh 20, probably the same date for Ra's Jibsh, the end of the fifth and the beginning of the fourth for al-Khuwaymah 2. This research also sheds light on the diffusion of lithic objects from the workshops of Jabal Saffān, near Ra's al-Jinz, more than 100 km to the south. These are not only bifacial objects such as the daggers of Suwayh 20 and Ra's Jibsh 1, but also more modest tool blanks, blades, and large flakes transformed into tools at al-Khuwaymah. The discovery of two occupations of the Umm an-Nar period is also interesting, because they are the only ones. Six are known in the Jaʿalan, but none have been discovered south of Suwayh and the A'seelah Mediumwave Transmitter (Asyilah, N 21° 59' 40" E 59° 39' 24").

The vast alluvial plain of Bar al-Hikman is a case apart, because no archaeological site has yet been found there. The dating (in progress) of the palaeo-mangrove, associated with new archaeological and geomorphological surveys, will enable further understanding of the evolution and the past of this peninsula. To integrate and study the information gleaned on the dynamics of a great Arabian delta, rich in lagoons and mangroves, and on its human occupation is a very new but risky challenge, as remains are greatly disturbed by the strong mobility of these coastal environments, which has probably erased or covered forever most of the vestiges of occupation.

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