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Riyadh
1435 H. - 2014 M.

King Abdullah Project for Cultural Heritage Care

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Series of Archaeological Refereed Studies No. 15

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*King Fahd National Library Cataloging-in-Publlcation Dats*

A.M, Alsharekh
Coastal Prehistory in Southwest Arabia and the Farasan Islands 2004–2009 Field Investigations
Alsharekh A.M ; Bailey G.N., - Riyadh, 2013

217p ; 21x28.5cm

ISBN: 978-603-8136-01-0

1- Arabian Peninsula - History 2- Coasts - Arabian Peninsula I-Bailey G.N. (co. author) II-Title

953.001 dc 1434/7544

L.D. no. 1434/7544
ISBN: 978-603-8136-01-0

## Foreword

Antiquity is the most distinctive component of a country's national and cultural heritage, as well as a scientific and cultural treasure, an economic source and a cornerstone of the tourism sector.

SCTA, represented by the Antiquity and Museums Sector, offers an opportunity to scholars and experts to publish their research work, academic dissertations and studies with the goal of protecting, raising awareness and promoting Saudi Arabian antiquities through all available means, including publication and authorship.

This book is the end product of implementing the policy of the Antiquity and Museum Sector. in promotion of the objectives of the King Abdullah Project for Cultural Heritage Care. By making available scientific publications that highlight and boost the public interest and awareness about the Saudi Arabian culture, the cradle of Islam. we are able to bridge the cultural links and communication across the continents that have existed since ancient time.

**SCTA president**

**Sultan Bin Salman Bin Abdulaziz**

## Glimpse

As part of the action plan for Antiquities and Museums Sector of the Saudi Commission for Tourism and Antiquities (SCTA) has given special attention to scientific research and developed different publication venues in which results of ongoing discoveries, researches and archacological investigations are presented so as to promote and raise public awareness and knowledge on all archaeological sites and research activities, in the Kingdom, to enrich libraries with specialized publications and to provide students and researchers with valuable resources on Saudi cultural heritage.

In this regard, Antiquities and Museums Sector has released a series of publications- archaeological studies and introductory books to raise awareness among the general audience about the importance of archaeology and their role in preserving them. Further, several academic dissertations, periodicals and scientific magazines have been published.

Furthermore, SCTA is keen to provide various gateways for publications to make them accessible to the public such as CDs, electronic media and the website.

**Vice-President of SCTA for Antiquities and Museums**

**Prof. ali bin Ibrahim Al Ghabban**

# *Table of Content*

# Introduction

### *Abdullah M. Alsharekh and Geoffrey N. Bailey*

This volume brings together the combined reports produced during the course of field investigations conducted between 2004 and 2009. The 2004 fieldwork was largely exploratory in nature, and intended to lay the foundations for the later work. It involved an attempt to re-locate the sites recorded by the Comprehensive Archaeological Survey Programme in the 1980s, particularly in the lava fields and coastal terraces of Gizan Province, and to assess the potential of the Farasan Islands for underwater and offshore survey. The 2006,2008 and 2009 field seasons all involved a combination of fieldwork on land on the Farasan Islands, particularly with regard to the shell middens that have turned out to be so abundantly represented there, and underwater work offshore designed to explore the submerged landscapes that existed as dry land for human settlement during the period of low sea level that extended from about 100,000 years ago to the establishment of present-day sea level some 6000 years ago. Preliminary surveys were also carried out to search for early Stone Age archaeological sites in hinterland regions, both on the Farasan Islands and on the mainland.

The original intention was that these reports should be published as sequential reports in the Journal Atlal. However, a combination of circumstances, including delays in obtaining radiocarbon dates and other aspects of the analysis, has resulted in our decision, at the suggestion of the Saudi Commission of Tourism and Antiquities, to combine the reports into a single volume.

In combining the reports in this way, we have resisted the temptation to revise the reports with the benefit of hindsight. We have left the reports largely as they were written at the time of the work. In this way it is possible to see how the strategy and thinking underpinning the project evolved in the light of each season's results.

Some aspects of the work have been published elsewhere in the interim, or incorporated into wider syntheses (Bailey 2007a,b; Bailey 2009; Bailey 2011; Williams 2010; Demarchi et al. 2011; Lambeck et al. 2011; Bailey et al. 2013).

The reports presented here provide more substantial detail and evidence on the field investigations that underpin previously published conclusions. At the same time, it should also be emphasised that the results as presented here are preliminary in nature and may be revised in the light of subsequent fieldwork and ongoing analysis.

Amongst the most important results of this phase of investigations, we draw attention to the following. The first is the extraordinary abundance of shell mounds present on the Farasan Islands, amounting to nearly 3000 sites in total, including shell scatters as well as taller mounds. In their overall dimensions and their concentration, these sites are impressive, and indeed unique, representing a near-pristine distribution of sites to equal anything known anywhere else in the world. In part this reflects the low population density of the Islands, their relative isolation, and the lack of development until very recently.

However, with the gathering pace of development of roads, new buildings and other infrastructure during recent years, and the new growth of tourism, many of these sites are now under threat, and some have already been damaged or removed. It is to be hoped that this unique cultural record can be protected and preserved, and that sites that must necessarily be destroyed to make way for new building work can, at the very least, be subjected to some archaeological examination before the developers move in. The greatest threat to these sites is not so much their destruction to make way for new projects, but their quarrying and removal by building developers as attractive sources of raw material for road-building and other construction projects. The toll of destruction caused by such activities in other parts of the world is a doleful one with a long history (see chapters in Bailey et al., 2013), and in some cases continues today thanks to a mixture of ignorance, indifference, or economic necessity, despite the presence of legislation designed to protect the cultural heritage. It is much to be hoped that the Farasan sites will prove to be an exception.

A second important feature of our work has been the exploration of the submerged landscape that existed when sea levels were lower than today. This is a last frontier of archaeological discovery and has been avoided by archaeologists for many decades despite the knowledge that sea levels have been much lower than the present for most of the past 100,000 years and for long periods before that. Resistance has been largely due to the belief that underwater work is too difficult and too costly, and that in any case little would remain to be discovered. This attitude is changing (see in particular Benjamin et al., 2011; Bailey, Sakellariou et al., 2012) as a result of a growing number of underwater finds, often with spectacular conditions of organic preservation, the availability of new technologies, and the development of new research strategies of investigation including collaboration with offshore industries.

Nevertheless, this field is still in a pioneer phase, in which we are finding our way, and learning as we go how landscape features and archaeological remains are modified or preserved by inundation caused by sea level rise, and how to recognise favourable targets for investigation. What is certain is that extensive areas of land, and of course hundreds of kilometres of coastline, were available for human use during periods of low sea level and that most of these dating before about 6000 years ago, when sea level stopped rising after the last glacial period, are now submerged. What is equally certain is that we will not know what use earlier human societies made of these landscapes, their coastlines and their associated marine resources, until we set out to investigate them.

A third result of our investigations, though more preliminary in nature, is an assessment of the potential for discovering very early Stone Age material on land, building on the pioneering work of the Comprehensive Archaeological Survey Programme of Saudi Arabia. Although our observations have led to a revision of some of the conclusions reached in those early reports, it is clear that many more sites most probably await discovery, and that much more work remains to be done, particularly in finding in situ remains with the possibility for obtaining absolute dates. Of particular interest is the discovery of a small number of flaked stone artefacts at high elevation in the northwest of the main Farasan Island. Although these are surface finds without secure context or dating, they look like material typical of the Middle Stone Age or earlier. Their position on a flat hilltop with commanding views over the surrounding landscape is certainly consistent with what we know of Stone Age locations in other parts of the world. This suggests that the Islands were intermittently visited by Stone Age hunters most probably at a time when sea level was lower, and the Islands could be reached on foot from the mainland, representing low hills in an extensive coastal plain that extended further out into the Red Sea by some 50 km compared to the present-day topography.

At the time of writing, our investigations are entering a new phase of work with the initiation in 2011 of the five-year DISPERSE Project, with new sources of funding (Bailey et al., 2012). This project is founded on the belief that the southern Red Sea and the Arabian Peninsula are of central importance on the world stage of early prehistory, both as an attractive habitat in their own right for early human settlement, as key regions for cultural contact and population movements between Africa and Eurasia, and as a region with a distinctive history of landscape change and cultural innovation. Projected work includes more extensive investigation of the Farasan shell mounds, and the application of new geochemical and physical techniques to the shells themselves to improve our understanding of the seasons of the year when the shell mounds were used, their chronology, and associated changes in climate and environment; more extensive offshore exploration of the submerged landscape and its environmental and archaeological potential; and an improved understanding of landscape history and climate change on the mainland coupled with the search for new archaeological sites from the earliest periods of the Stone Age.

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***Report on the 2004 and 2006 surveys of the joint Saudi-UK Southern Red Sea Project***

## *Report on the 2004 and 2006 surveys of the joint Saudi-UK Southern Red Sea Project*

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### *Introduction*

This is a preliminary report of a joint Saudi-UK project initiated in 2004 to investigate the coastal prehistory of the Red Sea region of Saudi Arabia. We report on our observations of sites on the mainland between Qunfudah and Gizan during a brief survey in 2004, and the more detailed results of archaeological investigations undertaken in the Farasan Islands during May 2006 (Figure 1), which included survey and test excavation on land and underwater survey.

### *Background*

Our interest in this region is motivated by two principal themes. The first is the possibility of early movement across the southern end of the Red Sea region – the ‘southern corridor’ of human dispersal – into the Arabian Peninsula as part of the initial process of colonisation by which human populations spread out from Africa to populate Europe and Asia. This process may have occurred several times, the earliest dispersal taking place as early as 1.8 million years ago, followed by a more recent dispersal of anatomically modern humans out of Africa some time after 150,000 years ago (Lahr and Foley, 1994; Petraglia, 2003; Petraglia and Alsharekh, 2003). By convention, archaeological attention has focussed on the pathway from the Nile Valley to the Levant as the main route of population movements out of Africa, on the assumption that the Arabian Peninsula was a cultural cul-de-sac largely bypassed by early human population movements because of climatic aridity. However, genetic studies tracing human ancestry from variability in modern DNA along with new archaeological discoveries have stimulated intense international interest in the southern corridor of human dispersal (Lahr and Foley, 1994; Walter et al. 2000; Oppenheimer, 2003). It is also clear from the early work of the Comprehensive Archaeological Survey of Saudi Arabia that there is a substantial and widely distributed but poorly dated record of Palaeolithic archaeology in Saudi Arabia. This picture is confirmed by early work in the Yemen (Amirkanov 1991) and by more recent investigations in Oman (Rose, 2004). It is also well established that Arabia benefited from a wetter climate than today during many periods of the Pleistocene (Sanlaville, 1992). Also, during the maximum lowering of sea level during the glacial periods, the Red Sea, although it appears not to have been closed off from the Indian Ocean, would have been reduced for over 100 km to a narrow channel extending from the vicinity of the Hanish islands to the Bab al Mandab Strait, and this would most probably have been relatively easy to cross without the need for boats or seafaring skills (Bailey et al. 2007a, 2007b; Bailey, 2009) (Figure 2).

A second theme of interest is the role of coastlines and marine resources, such as marine molluscs, fish and sea mammals, in the broader pattern of human social development. Coastal archaeological sites, often shell mounds representing the food debris of eating molluscs and usually containing artefacts and other food remains such as the bones of fish and terrestrial vertebrates, are known in their tens of thousands throughout the world. Almost all of these sites are confined to the period from about 6000 years ago onwards. Evidence for coastal sites and the use of marine resources is much rarer in earlier periods. Many archaeologists have seen in this pattern evidence for a growth in human populations and an intensification of subsistence economies in the postglacial period, and have assumed that in earlier periods of prehistory marine resources were ignored or were considered too labour-intensive or technologically demanding to be worth exploiting.

However, this view is now being challenged from a variety of perspectives (Erlandson, 2001; Bailey & Milner, 2002). Perhaps the most important point is that the great explosion of coastal sites in the archaeological record after about 6000 years ago coincides with the period when sea level stopped rising after the melting of the continental ice sheets formed during the last glacial period. Figure 3 shows the pattern of sea level change over the past 140,000 years, with short periods of high sea level associated with modern or interglacial climatic conditions, and much longer periods of low sea level associated with the last glacial period, when sea levels were at least 50 m below the present and occasionally as much as -130m (Figure 3). During these periods of low sea level, extensive areas of the continental shelf were exposed as dry land, and the coastlines of the period are now deeply submerged and far out from the present-day coastline (see also Figure 2). It follows that earlier coastal sites with potential evidence for the exploitation of marine resources are now destroyed, or submerged on ancient shorelines that are now in deep water and many kilometres offshore. Pioneering investigations in the Baltic and the Mediterranean have demonstrated that prehistoric coastal sites can survive the process of inundation and can be discovered and investigated, often with excellent conditions of preservation of organic materials such as wood, fibre and other plant materials (Fischer, 1996; Flemming, 2004). Similar results are being revealed in other parts of the world, but these underwater investigations have for the most part been confined to relatively shallow water within easy reach of conventional diving techniques using normal air mixtures, and therefore to sites that are quite late in date, namely in the earlier part of the postglacial period when sea levels were approaching the present level. The possible existence of earlier archaeological sites on shorelines formed when sea level was much lower has yet to be explored in any systematic way.

### *Objectives*

The above considerations form the basis for our investigations and the strategy that we have adopted. Many coastal sites have been previously reported on Saudi Arabian coastlines, including some potentially very interesting early sites that appear to be associated with an earlier period of high sea level about 125,000 years ago, particularly on the Red Sea coastline. More recent coastal sites are also present around the coastlines of the Arabian Peninsula. The best known are on coastlines of the Gulf and Oman (Beech, 2004; Biagi & Nisbet, 2006), but some coastal shell middens were also reported on Red Sea coastlines by the Comprehensive Archaeological Survey Program (Zarins et al., 1980, 1981). We therefore established three main objectives at the beginning of this work:

1. To visit known coastal archaeological sites on the Red Sea coastline in order to evaluate their likely significance and potential for shedding light on early patterns of coastal settlement and exploitation, and to assess the prospects for new investigations.
2. To begin a comprehensive survey of the archaeology on land to find out more about the history of coastal exploitation in recent millennia.
3. To carry out underwater exploration including experimentation with deep diving techniques and mixed gas technology, using the results of work on land as a guide to what to look for underwater.

We made a preliminary visit to the mainland coastal sites in the vicinity of Al Birk in 2004, and in the course of that survey we also visited the Farasan Islands with a view to assessing the potential for underwater exploration. The Farasan Islands are an attractive prospect for such an investigation for a variety of reasons. When sea level was lower than about 50 m, the Farasan Islands would have been connected to the mainland, so that we can expect that the Islands and their surrounding territory would have been accessible to human populations from the very earliest period of human occupation in the Arabian Peninsula without presupposing the need for seafaring technology. Secondly the waters of the southern Red Sea are warm and fertile with a rich marine fauna including fish, intertidal molluscs and sea mammals, and this is likely to have been the case even during glacial periods of low sea level, at least at the southern end of the Red Sea. These are the ideal circumstances in which one might predict ease of sea crossings by swimming, early experimentation in the development of simple rafts or boats, and the collection and consumption of marine resources. Thirdly, the complex configuration of the shorelines of the Farasan Islands, the complex offshore topography, and the varied oceanographic conditions suggest a high likelihood that some archaeological sites, palaeoshorelines and other features of the terrestrial landscape could have been protected from the destructive force of wave action during inundation by sea level rise. In addition, these variable conditions mean that there are many areas that lack the thick blanket of coral growth that would otherwise obscure the nature of the underlying deposits.

### *The Mainland Coast: Investigations in 2004*

Our main focus of interest in 2004 was the lava fields in the region of Al Birk, which reach down to the present-day coastline in places (Figure 4). These are associated with coral terraces elevated some 4–6m above present-day sea level, most likely formed at the time of the previous high sea level about 125,000–130,000 years ago (MIS 5e). Zarins et al. (1981) examined a number of these lava fields and terraces and reported artefacts of Lower Palaeolithic (Acheulean) and Middle Palaeolithic or Middle Stone Age (Mousterian) type. They suggested that some of the Middle Palaeolithic artefacts were embedded in the coral terrace deposits, indicating occupation of the shoreline 125,000 years ago, with the further implication that these sites might provide some insight into early coastal adaptations and an interest in marine resources. This expectation has been reinforced more recently by the discovery of the site of Abdur on the Buri Peninsula of Eritrea on the opposite side of the Red Sea (Walter et al., 2000). Here artefacts have been found embedded in coralline beach deposits well dated by Uranium-series dating to 130,000 years ago and associated with bones of large mammals including elephant, hippo, rhinoceros and bovids. Large oyster shells were also present in this deposit and Walter et al. (2000) originally suggested that they were the remains of food eaten by the human occupants. However, subsequent study by the same team has demonstrated that these oyster shells are a natural death assemblage and have no demonstrable relationship with human activity at this particular site (Bruggemann et al., 2004). Our specific objective in the Al Birk region was therefore to visit as many as possible of the sites originally identified by Zarins et al. (1981) to see whether we could replicate the results of the work in Eritrea.

Locating the original sites proved more difficult than we had anticipated. In part this is because the sites were recorded before global positioning devices and satellite maps had become generally available. A more serious problem, however, is that considerable development has taken place along the coastline, with the building of new roads and the creation of tracks and other facilities by bulldozing activity over the two decades since the original surveys. Some sites have been damaged or perhaps destroyed, and at least one is an area that has been heavily disturbed to create a local municipal rubbish dump.

The most important site of this group, and the one where we concentrated our investigations, is the site referred to by Zarins et al. (1981) as site 216-208 in the lava field between Ash Shuqayk and Al Birk (Figures 4, 5 and 6; Zarins et al., 1981). Here, Middle Stone Age material was reported on the surface of a coral beach terrace 3 m above present sea level, and presumed to be of Last Interglacial age (MIS Stage 5). Zarins et al. (1981) reported stone artefacts embedded in this beach deposit, but we were unable to replicate that observation in 2004 either at this site or anywhere else along this stretch of the Red Sea coastline where stone tools have been reported in association with lava fields and coral terraces.

At site 216-208, we found numerous stone artefacts of Middle Stone Age type lying on the surface of the elevated terrace (Figures 7 and 8), but none embedded within the deposit, although the area has undergone considerable disturbance and damage from bulldozing activity, road building and other development since the original surveys. It is also clear that the beach terrace at Al Birk is banked up against lava flows from the nearby volcanic cone, is stratigraphically later than them, and is not stratified beneath the lava as originally believed (compare Zarins et al., 1981, plate 5A). This is consistent with K/Ar ages of 1.37 ± 0.02 million years (KSA04/AR1) and 1.25 ± 0.02 million years (KSA04/017) for the lava cone. These dates give a maximum age for the artefacts of Acheulean type found in the vicinity by Zarins et al. (1981), and by us (Figures 9 and 10).

The age of the elevated coral terrace has not yet been confirmed by radiometric dating, but a shell sample from a terrace of similar height to the north of this site, north of the town of Al Birk, has produced a radiocarbon date of 38,380 ± 1290 BP (Beta 191459), in effect a non-finite date in the sense that the deposit is beyond the range of radiocarbon dating. This is consistent with the hypothesis that the elevated terrace was formed during a high sea level period within MIS Stage 5. If this argument is correct, it indicates a maximum age for the Middle Stone Age artefacts lying on the surface of the elevated terrace at site 216-208, but no better than that. In other words, the artefacts could have been dropped on the surface of the coral terrace at any time after its formation. Given our current, and admittedly incomplete, understanding of Middle Stone Age chronology in the Arabian Peninsula, the artefacts could date to any time within a period that extends from about 125,000 years ago to as little as 40,000 years ago, or possibly even later. In other words the artefacts could have been made, used and discarded during a period when sea levels were much lower than the present and the coastline of the time was many kilometres seaward of its present position. Given these uncertainties, it is inappropriate to refer to these sites as 'coastal' sites in the sense of sites close to the seashore.

A second site of interest in the vicinity of Al Birk is to the north of the town. Here an irregular scatter of shells and stone tools made on local basalt was found extending over an area of about 100 m x 40 m (Figures 11 and 12). The stone tools are mostly small, irregular flakes and have no diagnostic characteristics that would allow a chronological attribution. They could have been made at any period. This material lies directly on the surface of the elevated 3 m coral terrace referred to above. This is the same location from which the material used for the radiocarbon date (Beta–191459) was recovered; the shell used to provide this date was extracted from a vertical section eroded into the terrace by marine action, so that there is no doubt about the stratigraphic integrity of this sample. A second radiocarbon age was determined on a shell found on the surface of the terrace in association with the stone tools. This shell like others in the immediate vicinity is believed, from its close association with the stone tools, to have been collected for food by the human occupants of the area. The date is 5560 ± 70 (Beta–191460), and is consistent with the use of the site at a time of modern sea level when the shoreline was close to its present position.

We also conducted brief surveys in the coastal region of Qunfudah and its immediate hinterland. The prospects for the discovery of sites of Palaeolithic age are limited in this region, at least within a radius of 10–20 km of the coast, because of the very extensive cover of Holocene sediments. Cemented dunes of probable Pleistocene date were recorded in places along the coast, but all the archaeological material observed was much later in date and some of it is clearly of recent historical age. Of particular interest are sites used during the pilgrimage to Mecca (Figure 13), and some modern shell mounds used within living memory, in which the dominant shell species is the triton shell (*Strombus tricornis*), which is the main mollusc species sought after as food today (Figure 14).

From a consideration of all the above evidence, we conclude that none of the sites with Palaeolithic artefacts that have been found along the present-day coastline can be associated with coastal settlement in the sense that they represent sites formed on the contemporaneous coastline by people who consumed marine resources. Palaeolithic sites of presumed Acheulean or Middle Stone Age type are all surface finds, and therefore cannot be dated with any precision. The main attraction for settlement at these locations could have been the local sources of basalt suitable for making stone tools, rather than marine or coastal food resources. Many may have been used when sea level was lower than the present and the coastline was many kilometres distant from the present position.

A pressing need is to find archaeological finds of Pleistocene age that are embedded in Quaternary deposits, whether these are on the coastline in beach deposits, as at Abdur in Eritrea, or in hinterland locations in wadi gravels, lake sediments, or in caves and rockshelters. Without in situ evidence of this sort, there is no prospect of obtaining more precise dates for the earlier part of the Stone Age sequence in Saudi Arabia, and no prospect of recovering associated finds of animal bones, remains of other food resources, or sediments, which can throw light on the palaeoenvironment and palaeoeconomy associated with the sites. Surveys aimed at locating such material will form a part of our future investigation strategy, but an equally important objective is to begin exploration of the now submerged landscape, which would have formed an extensive and potentially vital part of the wider territory inhabited by Stone Age people for long periods during the Pleistocene. This submerged landscape may hide important sources of information about Pleistocene palaeoenvironmental and palaeoclimatic conditions, and archaeological finds including material that bears more directly on the use of coastal resources during periods of lower sea level.

## *The Farasan Islands*

### *General Environmental Features*

The Farasan Islands (Figure 15) are composed of coral and limestone platforms uplifted and deformed by salt tectonics, resulting in a complex onshore and offshore topography, which has been subjected to considerable modification by local tectonic movements associated with uplift of underlying salt deposits (evaporites) and localised solution resulting in deep depressions (Dabbagh et al. 1984; Macfadyen 1930). The islands are composed of wave cut coral terraces along the coastal margins. Extensive accumulation of marine sediments in recent millennia, accompanied by tectonic uplift, means that many areas that were formerly shallow bays or shallow marine channels have now become filled with sand, extending the area of dry land and leaving the original shoreline and its undercut coral terraced marooned some distance inland. This is typically the case on the east side of Janaba Bay (Figure 16), and in western Janaba (Figure 17). In a small number of places there are uplifted coral terraces comprising much older coral material, most probably relating to much earlier episodes of high sea level, which rise to a maximum height of approximately 80m above modern day sea level (Figure 18).

Naturally-occurring resources include a species of gazelle, a rich inshore and intertidal marine environment with great variety of fish and marine molluscs, turtles and sea mammals, and migratory birds. The gazelle presumably reached the Islands during periods of lower sea level when they were connected to the mainland, and are still present in considerable numbers as a protected species. The gazelle on the islands have been classified as a sub-species of gazelle, *Gazella gazella farasani*, based on their smaller size, the smaller size of the horn cores in the females, and a rounded upper tooth row (Thouless and Al Basri, 1991), presumably as a result of isolation on the Islands following the postglacial sea level rise.

However, studies of mitochondrial DNA do not support this sub-specific status, indicating shared haplotypes with mainland species (Torsten Wronski, pers. comm. 2009). Bird life is especially abundant in April and May, because the Islands (especially Qumah) are on the flight path of birds that migrate between Africa and Europe (Muftah 2005). Here bird traps are still in use and can be found scattered across the landscape in some numbers (Figure 19). Occasional traps of this type have also been observed near the coastline on Farasan Island, though here they are less numerous.

The Islands are also famous for the Harid Festival, which takes place on Farasan Island during March or April of every year, and is named after the longnose parrotfish, *Hipposcarus harid* (Gladstone 1996). This is a reef fish, which is present throughout the year around the Islands. During the spawning season it aggregates in large numbers in one of the inner bays of Farasan Island (Figure 15). For several days during this period the fish school in large numbers and move into the shallow water of the bay, where people can easily harvest them in large quantities by wading into the water with nets.

All of these resources would have been present during the prehistoric period, at least from about 6000 years ago onwards, when the Islands took approximately their present configuration after the postglacial sea level rise. They would have made an attractive variety of resources for non-agricultural people dependent on hunting, fishing and gathering.

Probably the major limitation on prehistoric settlement on the Islands would have been the limited supplies of surface water. Annual rainfall today as elsewhere in the Red Sea coastal regions rarely exceeds 180 mm, and most of it occurs in the winter months, when a flush of green vegetation spreads more widely across the landscape. For the rest of the year, vegetation is mainly confined to areas where ground water is close to the surface. The traditional villages of the Islands, such as the village on Qumah, and the now-abandoned village of Gsaar on Farasan Island, have wells, with standing water visible at a depth of about 3 m. Many natural fissures and cracks in the coral bedrock, resulting from minor tectonic deformation, are present in the wider landscape, and standing water is visible at about 3m at the bottom of some of these fissures. They are often visible at a distance because of the concentration of shrubs and other vegetation along the line of the fissure (Figure 20). Isolated clumps of palm trees occur sporadically on flat coastal plains where former marine bays have filled with sediment to create dry land, but where water is present close to the surface. Springs also occasionally emerge at the shoreline at the base of wave-cut coral cliffs.

### *Archaeological survey in 2006*

Little previous work on the archaeology of the Islands had previously been undertaken. The Comprehensive Archaeological Survey Program of Saudi Arabia visited the Islands briefly in the late 1970s, and reported a number of upstanding remains made of blocks of coral or faroush (beach rock consisting of a cemented breccia comprising fragmented coral, shell and sand) and a small number of sites including shell middens in the vicinity of Janaba Bay and on the opposite island of Qumah. Discoveries included potsherds of the South Arabic Civilization dated to the first centuries AD, and some prehistoric material described as ‘Neolithic’ (Zarins et al., 1980). A test excavation in a shell mound in Janaba Bay produced a sequence of radiocarbon dates as follows: Level 3: 5235 ± 225 BP; Level 3: 4810 ± 170 BP; Level 2: 2410 ± 100 BP (Deputy Ministry of Antiquities and Museums, 1990). However, no further details were published about the location of the shell mounds, the stratigraphic provenance of the dates, the materials used for dating, or the stratigraphy of the site. More recently Rashad Bantan, from the College of Marine Sciences at King Abdulaziz University, undertook some geological survey on the Farasan Islands, during which he obtained a radiocarbon date from near the base of a shell mound on the eastern side of Janaba Bay of 5400 ± 200 BP (UCL–435) (Bantan, pers. comm., 2004).

During the 2004 field season, we paid a brief visit to the Farasans and identified some small shell mounds in the central area of Janaba Bay, northwest of the boat jetty, and a wider range of shell mounds on the island of Qumah. Accordingly, Janaba Bay was the starting point for our 2006 land survey. Janaba Bay and the waters around Qumah Island, particularly off Slick Point, were also the initial focus of the diving work (Figure 15).

The general strategy of the 2006 work was to combine survey on land with exploration underwater, so that the search for underwater evidence could be informed and guided by the archaeological evidence of shell middens and other coastal evidence on land. Examination of the associated topographic and geological context of these sites could then served as clues to the sort of evidence to be found under water and where to look for such evidence. The field team therefore comprised two separate groups, the diving team, and the land team, with the intention that the two groups should work alongside each other and learn from each other’s findings and expertise.

### *Land survey*

In 2006 the field survey had two key objectives: to record the locations of shell middens around the Islands; and to explore a range of different land types for field survey, with particular attention paid to coastal areas and locations that appeared to have been areas of standing water or water courses at some time in the past. During this season the team surveyed areas on Farasan Island (especially around Janaba Bay and around the southern and eastern part of the Island, on Saqid Island (along the south-western coast and north eastern coast), along the southeastern shore of Qumah Island, and along the central and western area of Dumsuq Island. Brief visits were also made to the Islands of Solubah and Zifaf (Figure 15). On Farasan and Saqid Islands, field survey was usually conducted by accessing survey areas by four-wheel-drive vehicle and walking in transects radiating out from the vehicle. On the islands of Qumah and Dumsuq, the survey party arrived by small boat, and survey proceeded by walking along transects radiating out from the place where the boat had been beached. It should be noted that the high temperatures and strong sunlight present when the field survey was undertaken in May made long episodes of field survey impossible. On the other hand, the survey for shell mounds and shell middens was greatly facilitated by their visibility in a landscape largely devoid of vegetation, in which the white or light gray colour of the shell stood out from the red-brown or yellow-brown background colour of the natural land surface. The larger shell mounds are easily detectable from a distance and form an impressive sight, sometimes stretching out in a row as far as the eye can see. Along some lengths of coastline, these features allowed large areas to be covered quite rapidly by vehicle, with limited requirement for extensive survey on foot. Most of the shell mounds appeared to be intact, but there was occasional evidence of site disturbance and bulldozing, to remove either the shell material or the surrounding sand for building purposes, particularly on the north side of the central narrow section of Farasan Island, facing Saqid Island.

Along many sections of coastline, the land surface comprises a gently sloping coral platform, which represents an ancient and now elevated coral terrace, and ends abruptly at the present-day shoreline, with undercutting of the coral bedrock by the chemical and physical action of seawater to create a terrace behind the beach that is typically up to 3m above present sea level, although the height is variable in different parts of the Islands because of tectonic distortion. This 3m coral terrace appears to represent the same feature observed along the coastline of the mainland, namely a coral platform created during the period of high sea level at about 125,000 to 130,000 years ago. The undercut notch visible today is the result of erosion by modern sea level.

Many shell mounds are located directly above this shoreline feature (Figure 21). In other cases the original shoreline is still visible though now some distance inland because of infilling of the adjacent bay by sandy sediments (Figures 16 and 17). In other cases again, the original shoreline is difficult to discern because it has become masked by the accumulation of sand, accentuated perhaps by tectonic downwarping (Figure 22).

Our initial protocol for describing the shell mounds during survey was to provide a GPS reading for each site, maximum dimensions and thickness of the shell deposit, the main types of molluscs visible on the surface, and the surface presence of any other cultural material such as potsherds or stone artefacts. Any artefacts recovered in a brief inspection were bagged and labelled. Samples for dating purposes, mostly samples of shell, were also collected from a number of sites However, we had to modify and simplify this procedure because of the large number of sites discovered. After the first day we had observed 69 sites, and by the end of the first week over 400 sites, comprising a mixture of shell mounds and surface deposits. This concentration of sites was far in excess of what we had expected and could survey during this first season in comparable detail. We therefore adopted a simpler procedure, involving the measurement of GPS position as before, but with simple descriptions of sites according to whether they were mounds forming discrete features on the land surface or surface deposits with limited thickness of shell accumulation, and more selective use of more detailed descriptions. Where shell mounds formed an almost continuous line of deposits, GPS readings were taken of the mounds at either end but not at any of the intervening ones.

First impressions of overall characteristics are that the shell-rich sites form at least three distinct categories. First, there are mounded shell sites, reaching up to a maximum height of at least 4m and forming substantial and impressive features in the local landscape (Figure 22). These almost always occur on the original shoreline, directly adjacent to shallow intertidal bays that would have provided rich and extensive habitat for marine molluscs. Secondly, there are sites that represent thin deposits or scatters of shell. These are of variable extent and may be as small as 5 m in diameter or extend over quite large areas (Figure 23). Often they are closely associated with mounded sites but situated a short way inland, sometimes up to several hundred metres back from the shoreline. Some of these shell scatters are associated with the remains of structures built from blocks of coral and with signs of hearths composed of burnt material visible on the surface. The result is clusters of shell deposits of different sizes and types, some large, some small, some directly on the shoreline, others situated further away from the shoreline.

A third category of site is small shell deposits, often scatters of shells or mounds of limited thickness and extent, which are associated with open coastlines, rather than the shallow bays where the large mounds occur. These sites are invariably located directly on the shoreline, often above a wave-cut coral terrace, like the larger mounds, but adjacent to a shoreline with a smaller area of shallow, sheltered intertidal habitat, and therefore with fewer molluscs available for collection and consumption.

The species of shells present include reef and sand-dwelling shellfish. Shell composition varies somewhat from area to area, and according to local ecological conditions, but there is considerable uniformity in the shell species that are most commonly present, with the small conch *Strombus fasciatus* forming the dominant species in most cases, especially in the larger mounded deposits. The pearl oyster (*Pinctada* cf. *nigra*) is also well represented, as are species of larger conch shells.

Whether any or all of these sites were used as specialised sites primarily for preparation and consumption of molluscs, or whether it is simply the case that the discarded shells are the most durable and most visible by product of a human presence that included many other subsistence activities, remains to be established. Fishing, the hunting of sea mammals, and hunting and gathering of resources on land, are all possible activities, and the variability of the shell middens and shell mounds in this respect can only be established through excavation.

Ceramics are often present on the inland shell scatters and in association with the stone structures. The ceramics we have so far recovered include Islamic and pre-Islamic material, and most probably prehistoric material that is older than the period of the South Arabic Civilization. A fairly consistent pattern seems to be emerging in which the large shell mounds invariably lack ceramics. At this stage we believe that this is because they are much earlier in date than the other sites, but it might equally reflect differences in the function of different locations in the landscape. For example, the shell mounds might reflect shell dumps close to the water's edge where mollusc shells were prepared and consumed by people who then moved a short distance away to locations more conveniently situated for other purposes or for activities conducted at other periods when molluscs were not being collected and prepared for consumption. Many of our inland shell scatters are located near fissures in the coral bedrock that trap water and support vegetation in an otherwise barren-looking terrain. However, radiometric dates will be needed to distinguish between these alternative hypotheses.

Small test excavations were carried out at the site of Janaba 4, in the central part of Janaba Bay (Figure 24), and on the southeastern side of Saqid Island, close to its connection with Farasan Island (Figure 25, see also figure 15 for locations). These sites were chosen because of ease of access and their contrasting characteristics and locations. In both sites narrow step trenches 50cm wide were excavated into the steeper side of the mound – in both cases this is the side facing the shoreline (Figures 26 and 27).

Both mounds consist of numerous layers and lenses of shell, typical of deposits that have built up over a long period of time as the result of numerous successive episodes of use and deposition. There is considerable variability in the composition of the individual layers. Some are quite loosely packed layers of pure shell. Other layers contain more sedimentary matrix including ashy sediments and pieces of charcoal, representing the remains of camp fires. Again this is typical of shell middens in other parts of the world. No certain artefacts have been recovered from these small test trenches, and the artefact content of the mounds generally seems quite low, judging by the absence or rarity of artefacts on their surfaces. But this probably reflects the large volume of shells and their relatively rapid rate of accumulation relative to the rate of discard of other materials. Fish bone is present in Janaba 4, but not in the samples so far excavated from the Saqid mound.

One notable artefact find is a complete ground-stone axe made from a fine-grained greenstone, a material that is not naturally available on the Farasan Islands (Figure 28). This artefact was found on the surface of a shell mound that had been disturbed by bulldozing activity.

## Underwater Survey

Fieldwork was conducted from the MV Midyan during May 2006 (Figure 29), and included inspection of features on land and under water. The objectives of this phase of the fieldwork were: to describe and interpret coastal geomorphological features; to locate areas with potential for the preservation and discovery of archaeological material in underwater locations associated with periods when sea level was lower than the present; and to carry out trials with exploration at depth using mixed gas diving.

The discovery under water of archaeological remains depends on two factors. The first is an understanding of the types of locations in the landscape that would have been attractive places for human settlement and activity. The field survey on land, described above, identified wave cut shorelines associated with shallow bays as significant features associated with the rich record of late prehistoric shell middens. The first step in underwater survey was, then, to see if similar geomorphological features could be identified under water.

The second factor to be considered when conducting underwater archaeological survey is the processes that have impacted on the landscape as sea level rose. This will help indicate the areas where preservation potential is greatest and areas where features are most likely to remain visible to discovery on the seabed. During and immediately after inundation by rising sea level, terrestrial features and archaeological materials at the shore edge are vulnerable to the force of waves and shallow-water currents. These can remove or destroy anthropogenic remains particularly in exposed locations open to the full force of wave action. Alternatively, in more sheltered and depositional conditions, archaeological material will be protected where it becomes buried under marine sediment. Both scenarios will remove material from sight; therefore, the best chances of discovery are in locations where artefacts have been protected but the sediment cover is thin. This can happen at the interface of sedimentary and erosive regimes or at a site where a sedimentary deposit has been eroded in more recent times. An example would be in bays either side of an isthmus which breached as a result of rising waters. The shelter afforded by the bays would allow marine sediments to build up on old land surfaces as sea level rose. If rising waters continued to overtop and erode the isthmus, this would introduce new currents that could remove the deposits laid down during the marine transgression. In turn, this could reveal the land surface beneath and any surviving archaeological artefacts on it.

Another area that has increased potential for the survival of robust artefacts is in locations where material could have become trapped in the back of caves, wave cut notches or crevices. The possibility for survival would be increased if the transgression was relatively fast, thereby minimizing the amount of time a deposit is exposed to attrition.

The above factors informed the choice of locations for diving activity and the methods used. Diving work was conducted both in shallow water conditions using conventional compressed air and at greater depth using mixed gas techniques, including nitrox (combination of oxygen and nitrogen) and trimix (combination of oxygen, nitrogen and helium). Although it is theoretically possible for divers using compressed air with normal air mixtures to reach considerable depths, the risks of narcosis, impairment of mental acuity and nitrogen-related decompression sickness increase with depth. The deeper a diver descends, the greater the toxicity of the gases breathed. These risks can be reduced by adjusting the proportional mixture of oxygen and nitrogen. At greater depths, to dive safely, helium can be added to the gas mixture in order to reduce the proportion of oxygen and nitrogen in the total gas volume, and hence the quantity of these gases absorbed by the body. This gas mix is known as trimix and can be blended to suit the safety requirements of the dive. It enables deeper diving and enhances mental awareness at depth while reducing the risk of nitrogen-related decompression sickness. In short, it enables divers to reach depths safely and investigate features there that would otherwise be inaccessible. Single beam acoustic survey was also used to help target underwater features and targets for diving reconnaissance, and to provide information on depths.

### *Slick Point*

It was decided in the early stages of the project to identify a site to use as a model against which other sites could be compared and evaluated. The site chosen was Slick Point, located off the south east tip of Qumah Island (Figure 15, 30). Slick Point is at the southern end of a long peninsula with relatively steep drop offs seawards but also with relatively sheltered conditions on the western side of the peninsula, and proximity to shallow water conditions within Qumah Bay. It therefore provides access to a variety of underwater geomorphologies and potential preservation conditions and to varying depths of water.

Preliminary scuba dives off the south west tip of Slick Point identified a submerged fossil reef with a vertical face that measured up to 10m in height. The top of the fossil reef dipped from a few metres below sea level in the north to over 25m below sea level at the most southerly point before it became covered by sand. The fossil reef was observed to have a series of wave cut platforms, notches and terraces etched into its west facing wall. The reef clearly represents a prolongation of the headland underwater, and the whole structure has then undergone tilting with uplift to the north and submergence to the south as a result of tectonic movement associated with the Farasan salt dome. The uppermost wave cut notch visible in the underwater reef was formed at present sea level and was then submerged as a result of this tectonic movement, and thus provides a terminus post quem for recent tectonic activity. A second line of wave cut notches and undercuts was observed at a lower level in the reef, running parallel with the upper wave cut. This represents a shoreline formed at a period when sea level was lower than the present. This initial exploration showed that undercut features formed during periods of lower sea level can easily be identified under water in the Farasan context, and can also provide a marker for tectonic movement in a tectonically active environment.

A series of dives was carried out using nitrox and trimix gas mixtures to map and measure these underwater features in more detail, to follow the underwater shorelines to the greatest possible depth, to obtain photographic coverage including video footage, and to collect samples. Distances and heights along the fossilised reef were surveyed and recorded. Particular attention was paid to wave cut terraces, notches and large structural features. The depth of the cliff face was measured where it met the seabed at points along its length, and additional observations were made on land to measure the varying height and inclination of the emerged reef visible in the headland.

Dives were designed to explore the upper and lower wave cut notches, to make tape measure surveys, to collect samples of the coral reef (Figures 31, 32, 33), to trace the extent of the underwater shorelines as far south as possible, and to obtain video footage of geomorphological features and divers at work. The reef was traced for a total distance of 180 m south of the headland and to a depth of 30 m (Figures 34 and 35). The divers observed that the reef sloped sharply down towards its southern end, and ran below the seabed at a depth of 25m with occasional outcrops visible down to 30 m depth. It was apparent that the rock formation that made up the reef continued below the silt as occasional exposures of the reef were present with outcrops visible down to 30 m depth. Beyond this point, the flat sandy seabed dipped gently to the south and west. The lower wave cut notch is a deeply incised notch at a depth of between 10 and 14m and dips at an angle of 1 in 20. It measures up to 3m high with a maximum distance of 4.5m from the edge of the wave cut platform at the mouth of the notch to the back of the undercut. This feature is very similar to those observed on the present-day shoreline.

For the final dives on Slick Point we turned our attention to the submerged cliffs within Qumah Bay. The objective was to track the terraces and wave cut platforms northwards into shallower water as sheltered shallower sites would have a greater potential for the discovery of archaeological material. The location selected lay on the west face of the eastern peninsular approximately 500m to the north of Slick Point. A small beach formed by a break in the cliff line was protected by a promontory that faced south along the same alignment as Slick Point. Immediately offshore from the promontory, the cliff dropped to over 20m.

Inspection of the submerged cliff identified and recorded a number of features that confirmed marine erosion of when sea levels were lower. These included a wave cut notch that dipped 18.5m to 22m below sea level over a length of 30m to the south, beyond the extremity of the promontory. There was a laterally consistent solution or wave cut notch with overhang at a depth of 21m immediately below the promontory. To the north of the promontory a 30m long wave cut notch extended for 30m in 13m of water, rising 0.5m. Approximately 100m to the north of the promontory a large wave cut notch was located (Figure 36). The floor of the notch lay in 11.5m of water and the upper lip was in 8m of water. The notch measured 13m wide and was 4.5m deep, taking on the appearance of a small cave. The notch was of a similar type to those found along the current shoreline at modern sea level (Figure 37).

### *Qumah Bay*

A number of shell middens are present around the edges of the wave cut terraces that skirt the bay and a large embayment spread across the centre of the western peninsular. The embayment is now above sea level and is dry. However, it is surrounded by remains of a wave-cut fossil platform which also hosts shell middens. These would have been built when the bay was at a lower level and supported a tidal marine system. Investigations around the eastern end at the back of the bay also identified a number of shell middens sitting on the edge of the wave cut platform, above notches etched out by the sea.

Inspection by divers identified a fine silty seabed in 8m of water a few hundred metres from the back of the bay. Exposures of soft mineral-rich deposit were evident along the shore where wildfowl including flamingos were feeding. The tidal range is about half a metre and large expanses of bay are exposed when the tide is out. In addition to wildfowl, the bay is home to turtles and rays, both of which were spotted in the shallow water.

### *Dumsuq Island*

Reconnaissance of the inlet on the north of Dumsuq Island was conducted from the dive boat. Terrestrial inspection along the west side of the inlet revealed a barren landscape. The island is currently unpopulated and there were no signs of shell middens like those found on Farasan and Qumah. However, a large mound of fossilised coral rocks had been piled up to form a pyramid c.8m high. A second such structure was visible to the south. On the beach in the inlet, temporary modern structures had been abandoned and rubbish including scatters of oyster shells could be found in clumps along the shore. Underwater, the sandy beach shelved quickly to a depth of 10m (Figure 39).

### *Zufàf Island*

Zufàf Island was targeted as a dive site by merit of the steep offshore topography visible on existing bathymetric charts along the east coast, which appear to represent an extension of the steep hillsides that rise directly from the water's edge (Figure 40). Echo sounding transects at different points along the coast demonstrated that the steepest drop-off was next to Doewa Reef off the south east corner of the island. The echo sounder recorded a steep incline averaging about 33°, which levelled off at 56m below sea level to form a gently sloping terrace, inclined at 6° for 165m to the east until it reached 82m. At this point it dropped vertically to below 100m levelling off again at c.140m. This site was selected for diver investigation both because of the steep offshore profile and because it was several hundred metres offshore in a position where the seabed was less likely to be masked by material eroding from the cliffs along the shoreline.

The diving operation used Trimix to access the wave cut terrace in 60m of water (Figure 41). Divers dropped directly onto the sand-covered terrace in 55m and swam to 60m inspecting the seabed. They then turned and swam west back up the slope, which steepened markedly to approximately 30º at a depth of 53m. The ascent up the slope recorded little change in the seabed type although the occasional outcrop of rock rising from under the sand was noted. In 30m of water, the angle steepened again to about 40º, still with no change to the sandy seabed. At 10m below sea level, the number of rock outcrops increased and at 6m the slope was terminated by a wave cut platform and notch running north to south (Figure 42). Coral growth was concentrated around the 6m terrace although much had been smothered by sand.

### *Conclusions*

Survey on land has demonstrated an extremely rich onshore archaeological record comprising many hundreds of shell mounds, often in dense clusters that include large deposits up to 5m high with smaller mounds or scatters in the vicinity. Other sorts of archaeological features are distributed more widely across the landscape including structures of many different types made from blocks of coral or faroush, and open-air hearths. The time depth of this record is at least 6000 years, corresponding to the period of modern sea level. The largest concentrations of shell mounds are located on or close to the edge of a coral platform that has been undercut by marine erosion adjacent to shallow intertidal bays, where marine resources, particularly shellfish, would have been most easily accessible and available in greatest abundance. Coastal sites earlier than this, if they existed, must now be deeply submerged under water. Future work will focus on: more detailed survey and excavation of the shell mounds on land to better characterise associated patterns of settlement, social organisation and economy; inland survey for Palaeolithic artefacts that would have been deposited at periods of lower sea level when the Farasan Islands would have been in the centre of an extensive coastal landscape forming an extension of the mainland; and continued investigation of the submerged landscape.

Geomorphological assessment of the submerged landscape within the Farasan archipelago is helping to identify changes in the landscape over the past 125,000 years and areas that would have been suitable for human habitation during periods of lower sea level. The Islands have been subject to isostatic and eustatic fluctuations of relative sea level, and localised tectonic movements caused by the mobility of underlying salt deposits. A record of this change can be extracted from the geomorphological signatures etched into the terrestrial and submerged landscape in the form of wave cut platforms, terraces and undercuts. Submarine archaeological fieldwork has demonstrated that these features exist under water and can be readily interpreted.

Mixed gas diving has enabled the project divers to remain underwater for longer than with normal compressed air, with increased awareness and an increased safety margin, and an ability to investigate wave cut features that would otherwise have been inaccessible. The effective use of selected tools underwater has enabled the acquisition of survey data, samples, a photographic record and video.

A well defined, laterally consistent terrace has been identified between 80–55m below modern sea level immediately east of Zufàf Island, a wave cut notch in 10–14m of water below Slick Point, which corresponds to a sea level still stand at 20m, taking into account recent tectonic uplift, and a wave cut platform at a depth of 6m at both sites. A number of other wave cut features have been identified although lateral consistency has yet to be confirmed. The wave- or solution-cut features would have been incised during periods of lower sea level and reflect the sea level at the time of their formation. The 20m shoreline below Slick Point corresponds to a stillstand in the time range from 90,000 to 120,000 years ago, although it could have been reworked at about 10,000 years ago during the final stages of postglacial sea level rise (Figure 3). The undercuts and terrace platforms would have been accessible to human exploitation for many tens of thousands of years when sea level was lower. The potential for archaeological remains associated with these sites is therefore significant.

Underwater investigation in Qumah Bay has demonstrated that a shallow bay environment, comparable to that which we see today, existed when sea levels were at least 20m lower than the present, and is likely to have offered similar attractions to those that were exploited during the postglacial period by the people who created the many shell mounds of recent millennia visible along its margins.

The identification of a deep wave cut platform off Zufàf is both an indicator of sea level change and an area with potential for archaeological material. When sea levels were at their lowest during the glacial maximum, such an elevated plateau would have provided an ideal vantage point for early humans to scan the plains or water-filled depressions below.

The seabed in the areas investigated is covered by thick and extensive layers of sand and silt. The elevated coral terraces are the source of this material, and visibly eroding cliffs are evident wherever coral terraces are exposed to the sea. This suggests that the waters adjacent to the main Islands act as a trap for the accumulation of eroded sediments, which cover the seabed and fill bays, and this thick covering of sediments will have obscured many features of the original landscape and any associated archaeological materials. Sandy bay environments with raised coral terraces are attractive for humans and it is anticipated that they will harbour prehistoric archaeological material remains. However, the type of environment that attracts humans and is able to preserve artefacts, once it has been submerged by sea-level rise, can also accumulate a thick covering of later sediment that masks the evidence deep under sand. There is then a need to identify locations that have a high potential for archaeological material in areas where access to the palaeo-landscape is still possible.

This can best be achieved with a combination of the following procedures:

Identify patterns of human exploitation of the marine resources around the current coastline and use these patterns to predict the location of comparable landscapes and archaeological sites in areas that are now inundated.

- Conduct a geophysical survey in selected areas, using techniques such as swath bathymetry, sub-bottom profiling and side-scan sonar.
- Deploy divers or a remotely operated vehicle to visually inspect promising sights.
- Deploy divers to inspect, survey and sample potential archaeological sites or other landscape features, including use of mixed gas for work at depth.
- Exposed outcrops such as those recorded in Qumah Bay and Slick Point present an opportunity to access the landscape in areas where the sand has been removed. Further work in this area may result in the discovery of archaeological evidence underwater and has a high priority in the future search for underwater landscapes and archaeological features in the Farasan Islands.

### *Acknowledgements*

Thanks are due to the following organisations and individuals for their support and contribution to the success of this project: the Natural Environment Research Council (NERC), UK, through its EFCHED programme (Environmental Factors in Human Evolution and Dispersal), the British Academy, and the Leverhulme Trust, and Saudi ARAMCO, the Saudi British Bank (SABB) and Shell Companies

Overseas for additional funding and assistance in kind for the underwater work. For the issue of permits we are grateful to the following Saudi governmental organisations and individuals: HRH Crown Prince Sultan Bin Abdul Aziz Al Saud, Minister of Defence and Aviation; HRH Prince Sultan Bin Salman Bin Abdul Aziz, Secretary General to the Supreme Commission for Tourism; the Deputy Ministry of Antiquities and Museums; the Military Survey Department of the Ministry of Defence and Aviation; the Saudi Border Guard; Prof. Saad Al-Rashid and Dr. Ali S. Al-Moghanam, former Deputy Ministers of Antiquities and Museums; Dr. Ali Al-Ghabban, Supreme Commission for Tourism; Major General Muraya Al-Sharani and Admiral Abdulrahman Al-Shihiri, Military Survey Department, Ministry of Defence and Aviation; and Dr. Dhaifallah Al-Talhi, Deputy Ministry of Museums and Antiquities. We also gratefully acknowledge the help of the British Ambassador to Saudi Arabia, Sir Sherard Cowper-Coles, Dr. Ali Al-Muhana, Public Relations Advisor to the Minister of Petroleum and Mineral Resources, the Governor of Farasan, Abdulrahman Mohammed Abdulhak, the Captains of Saudi ARAMCO's oil vessel, the Midyan, Yusuf Dukak, Al-Amin Gizani and Salem Enazi and their crew, and Captain Ahmed Mirdad and Mohammed Saber of Saudi ARAMCO, Jeddah. We thank all our team members for their contributions to the fieldwork and especially Faisal Al-Tamaihi, Deputy Ministry of Antiquities and Museums, Sabiya, and Lt. Cdr. Abdulla M. Al-Ahmari, Ministry of Defence and Aviation, General Staff Headquarters, Military Survey Department, Riyadh, who acted as our official representatives in the field as well as contributing to the fieldwork. We also thank the Hampshire and Wight Trust for Maritime Archaeology for provision of survey equipment and additional support, and Mark Hoyle for the artefact drawings in Figures 8 and 10.

Project team members in 2004 were: Geoff Bailey, Abdullah Alsharekh, Nabiel Al-Shaikh, Nic Flemming, Geoffrey King, Lawrence Moran and Claudio Vita-Finzi; in 2006: Geoff Bailey, Abdullah Alsharekh, Saud Al-Ghamdi, Abdullah Al-Ahmari, AlHusain AlFaquih, Abdarrazzack Al Ma'amary, Khaled Alwassia, Abdullah Al-Zahrani, Abdu Aqueeli, Ali Hakmi, Trevor Jenkins, Simon Maycock, Garry Momber, Lawrence Moran, Michael Pratt, and Hans Sjoeholm.

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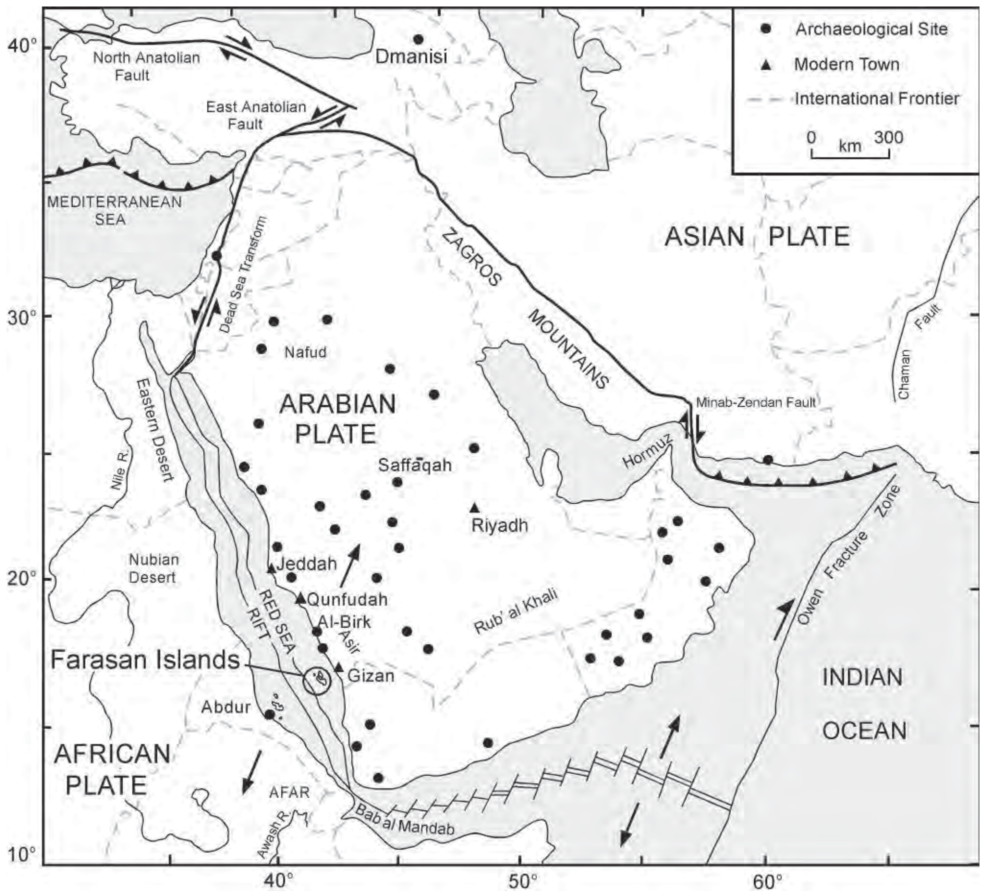


**Figure 1.**: General map of the Red Sea and adjacent regions, showing principal tectonic features, a simplified distribution of Lower and Middle Palaeolithic archaeological sites in the Arabian Peninsula, the location of the Farasan Islands, and key sites on the Southwest coastline. © C. Vita-Finzi and G. Bailey.

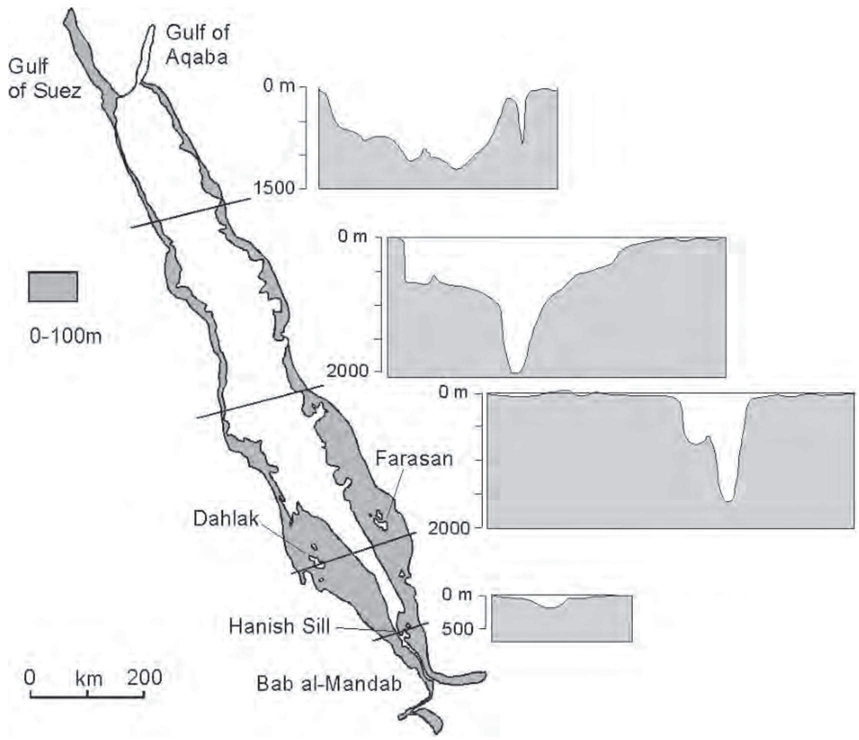


**Figure 2.**: The Red Sea, showing the amount of land exposed at the –100 m bathymetric contour (which approximates the position of sea level at the maximum of the last glacial period). At this time the southern end of the Red Sea would have been reduced to a long narrow channel not more than 3–4 km wide and extending for over 100 km from the Bab al-Mandab to the Hanish Islands. Information from Head 1987. © G. Bailey.

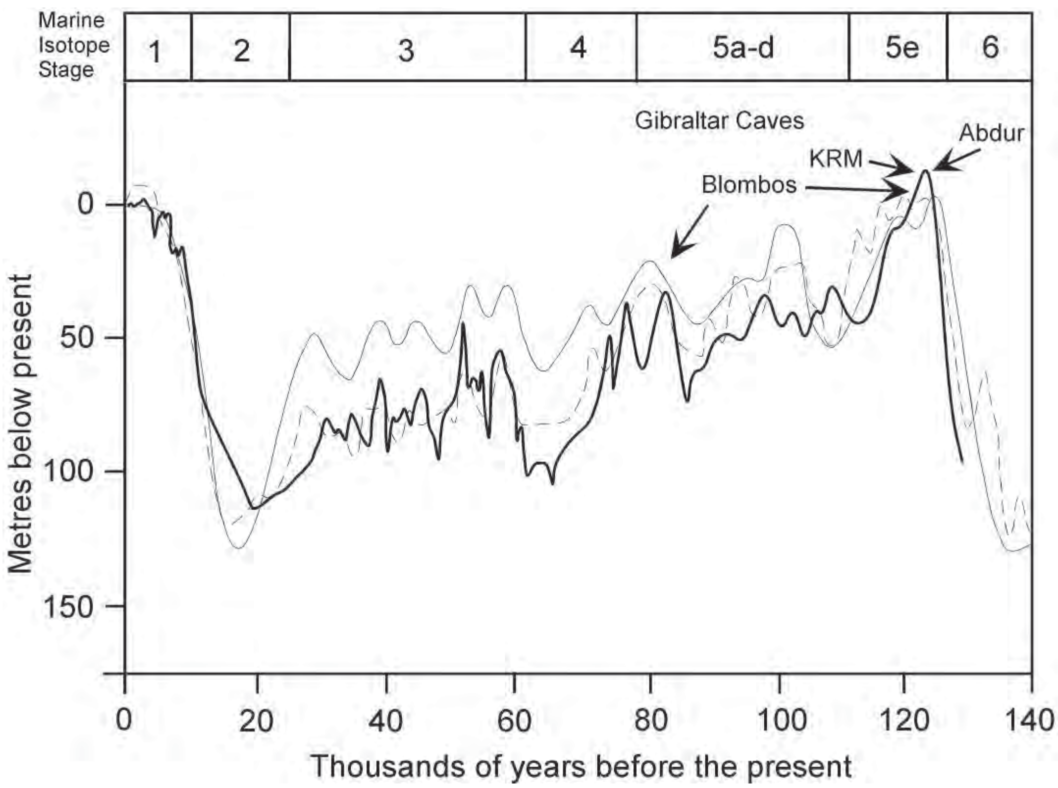


**Figure 3.**: Global sea-level change over the past 140,000 years. The dashed grey line is based on deep-sea oceanic oxygen isotope records of planktonic and benthic fauna. The solid gray line shows the same curve corrected for temperature effects using dated and elevated marine terraces in New Guinea. The dark solid line is based on oxygen isotope records from the Red Sea. MIS refers to Marine Isotope Stage. Coastal archaeological sites in Africa and the Mediterranean dated to MIS 5 with archaeological evidence and marine indicators are also shown (Blombos and Klasies River Mouth (KRM) are coastal caves in South Africa, and Abdur is on the Red Sea coastline of Eritrea). Sea level data are based on Chappell and Shackleton 1986, Lambeck and Chappell 2001, Shackleton 1987, Van Andel 1989, Siddall et al. 2003. © G. Bailey.

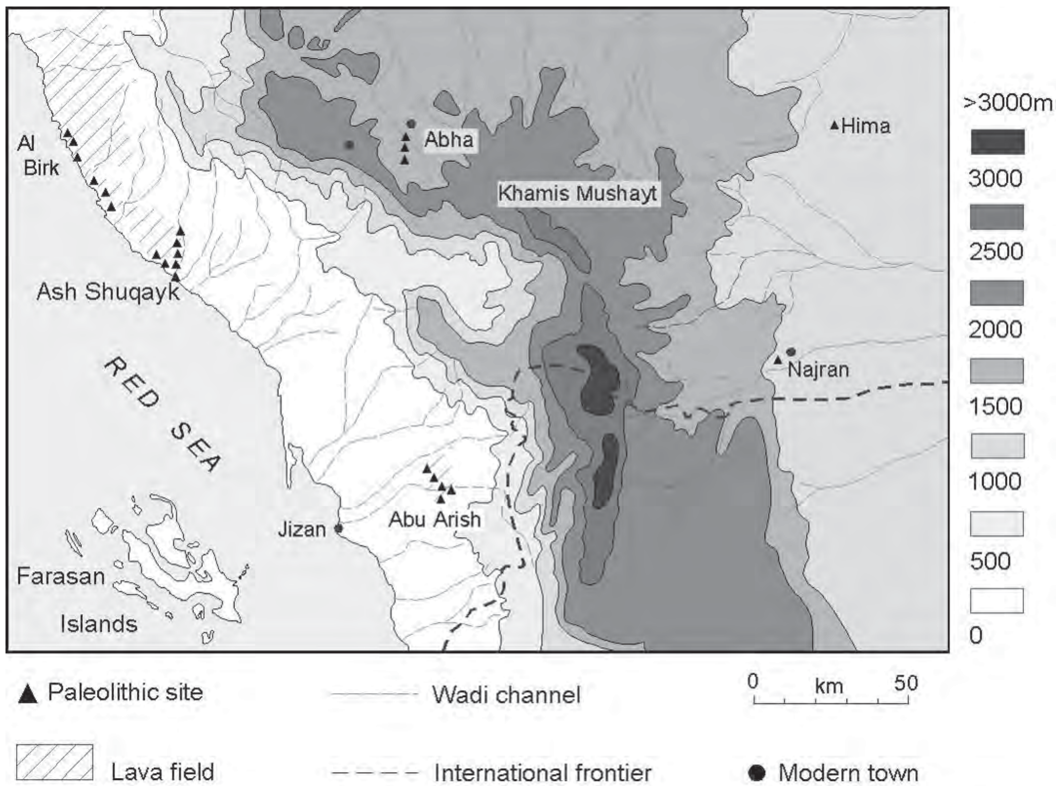


**Figure 4.**: The Arabian escarpment between Al Birk and Jizan showing simple relief, wadis, major lava fields and main concentrations of Paleolithic sites. © G. Bailey.

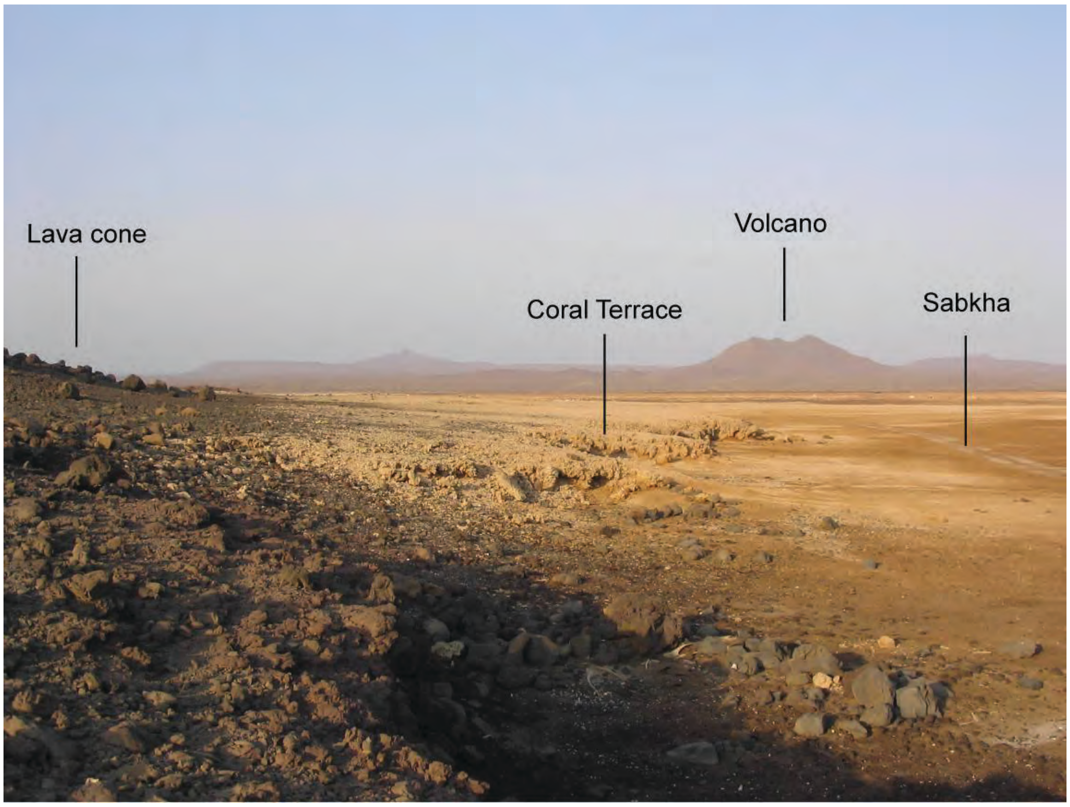


**Figure 5.**: Geological features in the vicinity of site 216-208, looking north. Extinct volcanoes are visible on the far horizon. The lava cone on the left is dated at 1.3 Mya and the sea is to the left on the other side of the lava cone. Banked up against the lava cone is an elevated coral terrace believed to be of Last Interglacial data with Middle Stone Age artefacts on the surface. Photo by G. Bailey, March 2004.

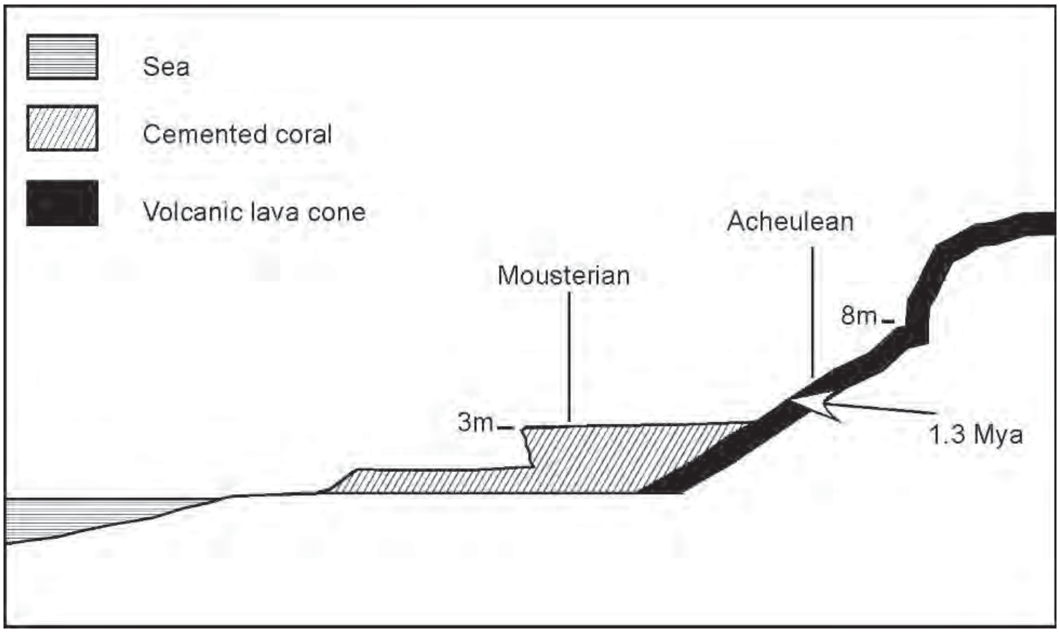


**Figure 6.**: A cross-section of the deposits at site 206-218. Data from Zarins et al. (1981, plate 5) and from personal observations in 2004. The section is viewed looking north with the lava cone on the right and the elevated coral terrace and sea on the left. The photograph in Figure 5 shows the same pattern of relationships on the eastern side of the lava cone. © G. Bailey.


**Figure 7.**: Photographs of flakes of Middle Palaeolithic type made on basaltic lava and found on the surface of the elevated coral terrace at Al Birk. Upper row, dorsal surface, lower row, ventral surface. Photo by G. Bailey.

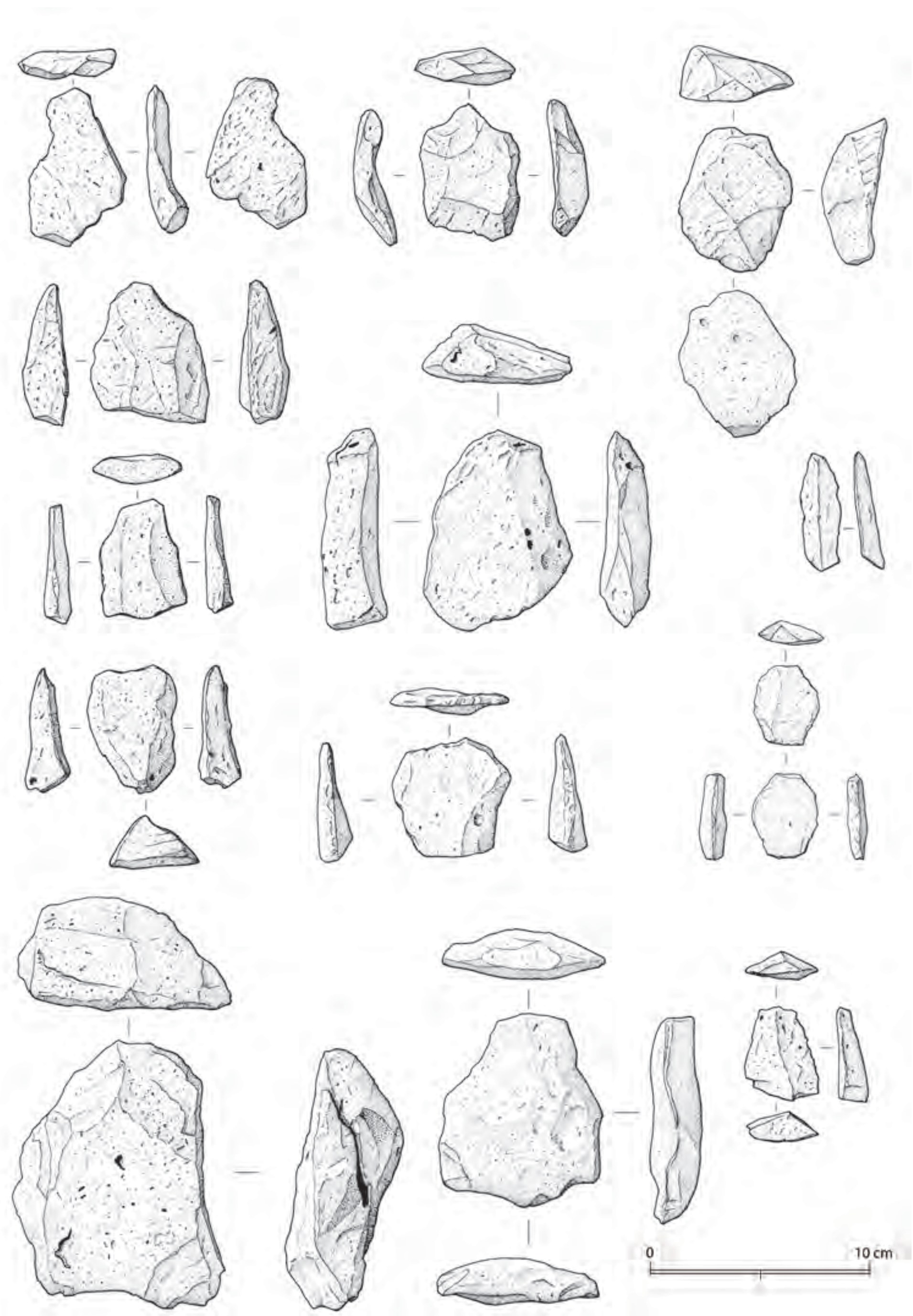


**Figure 8.**: Drawings of Middle Palaeolithic artefacts made on basaltic lava and found on the surface of the elevated coral terrace at Al Birk, including flakes shown in Figure 7. Drawn by Mark Hoyle.

**Figure 9.**: Photographs of bifacially worked flake of basaltic lava found on the surface at Al Birk. Left-hand image shows the dorsal surface. Right-hand image shows the ventral surface. The stepped longitudinal flake scar forming the point of the flake is clearly visible on the right, and visible in profile on the right hand edge of the dorsal surface in the left hand image. Scale in centimetres. Photo by G. Bailey.

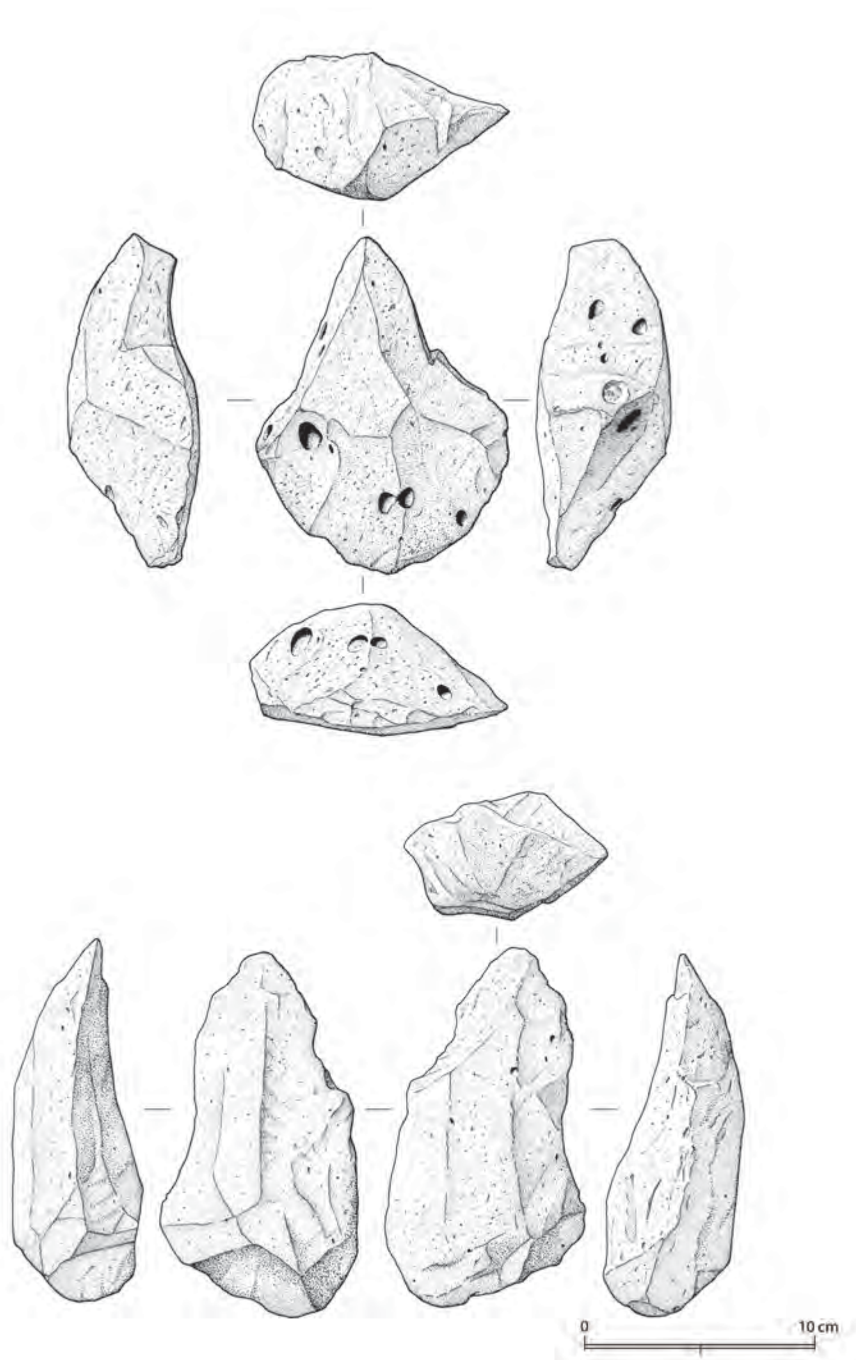


**Figure 10.**: Drawings of bifacially worked flakes of basaltic lava found on the surface at Al Birk. The upper artefact is the specimen shown in Figure 9. Drawn by Mark Hoyle.

**Figure 11.**: General view of shell midden north of the town of al Birk, 2004. Photo by G. Bailey, March 2004.

**Figure 12.**: Close up of shells and basalt artefacts on surface of Al Birk shell midden. Photo by G. Bailey, March 2004.

**Figure 13.**: Close up of coins and potsherds at the pilgrimage site of Mogesher Balahsbah, north of Qunfudah, 2004. The blue pen is for scale. Photo by G. Bailey, March 2004.

**Figure 14.**: View of recently formed shell mounds at Sahel Mogesher on the coastline north of Qunfudah, looking northwards. The sites were in use about 40 years before the photograph was taken. The dominant shell species is *Strombus tricornis*. There are four main mounds, each about 10m in diameter and 1m thick. Each forms a U-shaped mound with an opening to the south. According to local information, the fresh shells were left in the open sun to kill the animal and release the meat from the shell. The meat was used as bait for fishing, or dried and eaten elsewhere or traded to Jeddah. Photo by G. Bailey, March 2004.

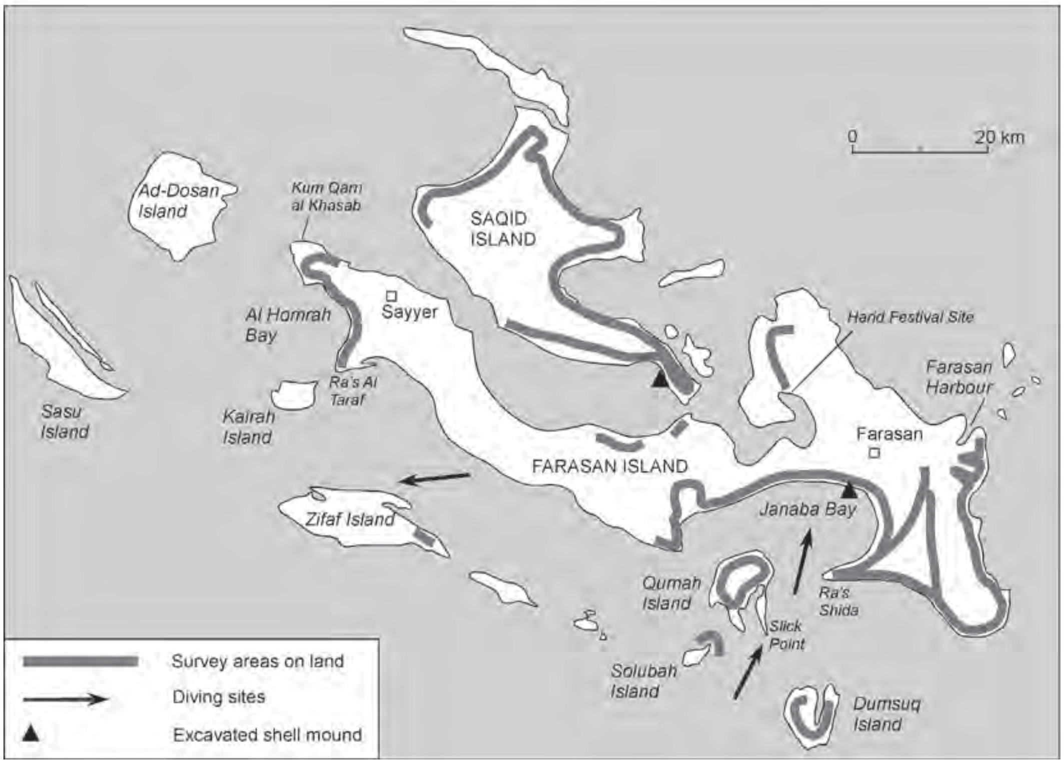


**Figure 15.**: Map of the Farasan Islands, showing areas of survey on land and under water, and other places mentioned in the text. Farasan Island is also known as Farasan al Kabir. Drawn by G. Bailey.

**Figure 16.:** Coastline on the east side of Janaba Bay, looking north, showing large shell mound in foreground and extensive infilling of sandy sediments beyond. To the right is a line of shell mounds located on the former shoreline, which is now some distance inland from the present-day shoreline. Arrows indicate selected shell mounds. Photo by G. Bailey,

**Figure 17**: Shell mounds on a former shoreline in West Janaba, looking south. The shell mounds are sitting on the edge of a coral platform that has been undercut by marine action, clearly visible in the centre of the picture. To the left is a shallow bay that has now filled with sand, and the sea and the modern shoreline are clearly visible in the far distance. Photo by A. Al Zahrani, May 2006.


**Figure 18.**: Google Earth image showing older raised coral terraces on the Northwest coast of Farasan al Kabir.

**Figure 19.**: Bird trap on Qumah Island. Photo by G.C.P. King, 2004.

**Figure 20.**: View of landscape north of Farasan town, showing vegetation clustered along the edge of fissures in the coral bedrock, where roots can easily reach subsurface water. Photo by G. Bailey, March 2008.

**Figure 21.**: Shell mound in Janaba Bay East showing location of mound directly above a deeply notched coral terrace. Photo by G. Momber, May 2006.

**Figure 22.**: Shell mound in East Farasan, showing how the surface that extends behind the mound grades gently into a sandy deposit in front of the mound with no clear line of demarcation marking the position of the original shoreline. Photo by A. Sinclair, May 2006

**Figure 23.**: Shell scatter situated inland of shell mounds in Janaba Bay East. Photo by G. Bailey, May 2006.

**Figure 24.**: General view of the Janaba 4 shell mound, looking south. Photo by G. Bailey, May 2006.

**Figure 25.:** Shell mound on Saqid island showing 50cm-widestep trench after excavation. The mound is 3m high. Photo by G. Bailey, May 2006.

**Figure 26.**: View of Janaba 4 excavation, looking north. Scale shows 10 cm subdivisions. Photo by G. Bailey, May 2006.

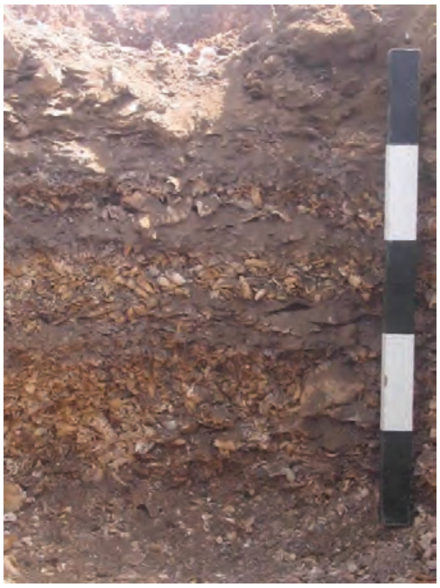

**Figure 27.**: Close up of section of the Janaba 4 excavation trench. Photo by G. Bailey, May 2006.

**Figure 28.**: Ground stone axe from shell mound surface on Farasan Island. Photo by G. Bailey, May 2006.

**Figure 29.**: MV Midyan off Qumah Island. Photo by G. Momber, May 2006.

**Figure 30.**: Slick Point from the east. The white line indicates the approximate position of a stratigraphic break which continues underwater as a wave cut platform, and which has been tilted by subsequent tectonic uplift. An equivalent feature has been identified at a lower level, from a depth of 9.6m below sea level, recorded to a depth of 20m in a north–south direction, believed to relate to a period when sea level was 20m below present. Photo by G. Momber, May 2006.

**Figure 31.**: Measuring underwater geomorphological features below Slick Point. Photo by T. Jenkins, May 2006.

**Figure 32.**: Diver collecting a sample from a wave cut platform in 16m depth of water. Photo by T. Jenkins, May 2006.

**Figure 33.**: Diver removing rock sample from wave cut terrace 10m below sea level at Slick Point. The undercut and overhang (which can be seen in the top right) was formed by the sea when it was at the level with the lower terrace. Photo by T. Jenkins, May 2006.

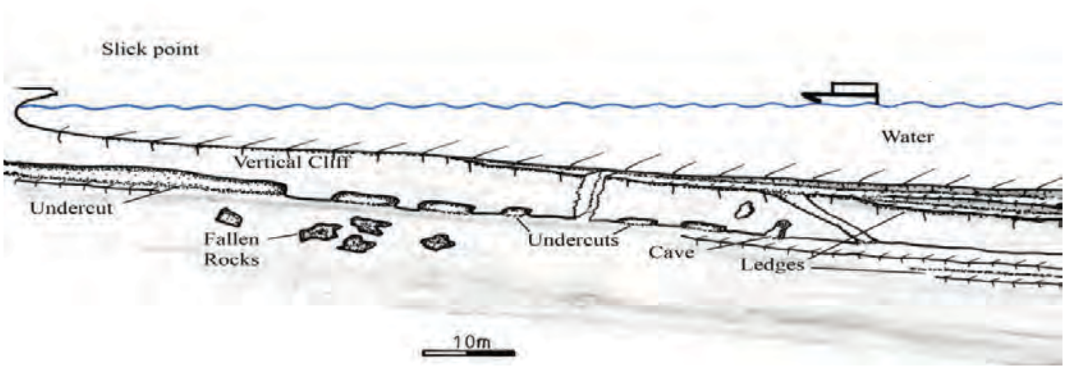


**Figure 34.**: Plan of submerged cliff, terraces and wave cut notches off Slick Point. The laterally consistent linear features are clearly indicated with red lines. Extrapolation of the upper wave cut platform carries the notch above the sea level about 90m north of Slick Point (see Figure 30). Drawn by G. Momber.

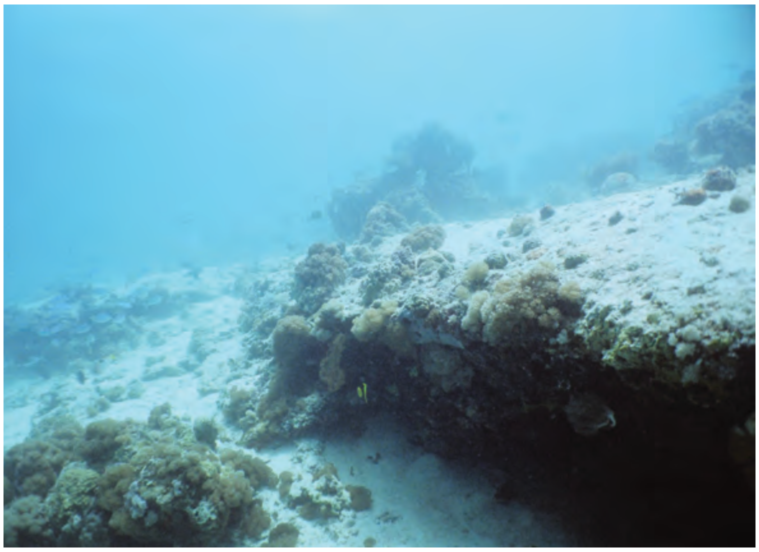

**Figure 35.**: Solution/wave undercut in Qumah Bay, representing a now-submerged palaeoshoreline. Photo by T. Jenkins, May 2006.

**Figure 36.**: Wave cut notch located below Slick Point. It lies in 11m of water and stands over 3m high. Photo by T. Jenkins, May 2006.

**Figure 37.**: Wave cut notch in Qumah Bay, of similar proportion and dimensions to that discovered under water. It should be noted that a large number of the overhangs support shell middens on their roofs. Photo by G. Momber, May 2006.

**Figure 38.**: Sandy beach at the mouth of the main inlet on Domsok Island. The beach shelves steeply under water limiting the area of shallow water suitable for exploitation. Photo by M. Pratt, May 2006.

**Figure 39.**: The craggy hills on the east coast of Zufaf Island reach down to the water's edge. Photo by H. Sjoeholm, May 2006.

**Figure 40.**: Trimix gas diver inspecting sandy seabed on possible wave cut terrace in 60m of water. Photo by G. Momber, May 2006.

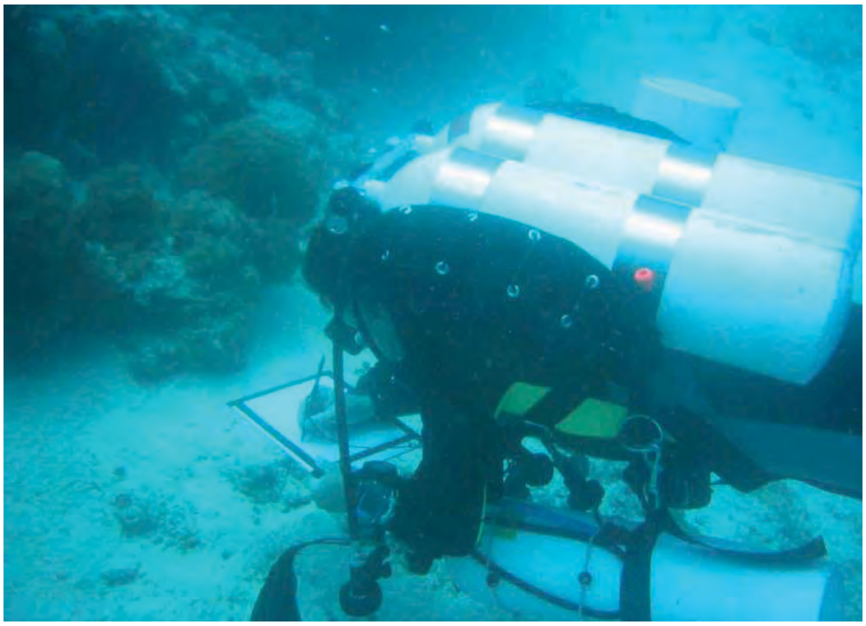

**Figure 41**: Trimix diver recording depth of wave cut platform in 6m of water off Doewa Reef, Zufaf, following 60m inspection dive. Photo by S. Maycock, May 2006.

***Report on the 2008 fieldwork of the joint Saudi-UK Southern Red Sea Project***

# *Report on the 2008 fieldwork of the joint Saudi-UK Southern Red Sea Project*

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### *Fieldwork Objectives*

In this report we describe the fieldwork undertaken in the Farasan Islands during March 2008, with an outline of key results and a preliminary assessment of their significance. This work builds on the first season's fieldwork undertaken in 2006 (Bailey et al. 2007a, 2007b, Bailey et al., this volume) and covers survey and excavation on land, and offshore exploration of the submerged landscape in inshore waters at depths down to about 20m. Our primary objectives in 2008 were to:

- Continue the systematic survey, location, mapping and description of the numerous shell mounds located in 2006
- Undertake excavation of selected shell mounds to obtain a better picture of their chronology, mode of formation and cultural contents
- Conduct geoarchaeological observations of the coastal environments associated with the shell mounds to clarify the relationship between the history of the shell mounds and the dynamic changes in local shoreline environments in recent millennia
- Survey more extensively the hinterlands of the Islands for evidence of archaeological sites and materials, with particular emphasis on prehistoric lithic and ceramic material
- Explore the underwater landscape by diving in order to extend knowledge of underwater geological conditions and likely locations for the preservation of the ancient landscape and archaeology formed when sea levels were lower than the present

We discuss the fieldwork methods and results under three headings:
(1) shell mound survey, geoarchaeology and excavation;
(2) hinterland survey;
(3) underwater survey.

### *Shell mounds: survey, geoarchaeological context and excavation*

In 2006, we established the extraordinary abundance of shell mounds and shell sites distributed throughout the islands, particularly on the main Islands, Farasan al

Kabir, Saqid and Qumah, and began a programme of systematic investigation. In 2008 this programme was extended with new surveys and excavation of selected sites.

### *Survey aims and methods*

The ultimate aim of the shell mound survey is to locate and describe all the surviving shell mounds on the Islands, and the particular objective this year was to provide more accurate and complete records of some of the areas visited in 2006, to examine areas not previously visited, and to provide more detailed information on the relationship between shell mounds of different types, and on variations in the physical topography and geology of the associated shorelines. This year we continued the survey with the use of satellite imagery and more accurate global positioning data. Many of the larger shell sites are easily visible on satellite images, and we used SPOT and Google Earth images to aid in the location of sites and the identification of areas to be surveyed, and GPS measurements to record the location of individual site locations. The general distribution of shell mounds is shown in Figure 1, together with other areas surveyed (Figure 1).

As in 2006, sites are described according to a systematic recording system, in which each site has a letter prefix describing the geographical sector, followed by a unique four-digit number. The sequences of numbers assigned to each sector are non-overlapping in order to avoid ambiguities. The main sectors are JE (Janaba East), JW (Janaba West), Khur Maadi (KM), Qumah Bay (QB), North Farasan (NF), East Farasan (EF), Saqid North (SN), and Saqid South (SS). Finds bagged and retained for later study or analysis include the year prefix, F08, indicating a Farasan find for the year 2008. In total, 93 surface or sub-surface samples were recovered from surveyed shell mounds. Most of these are small samples of shell taken for purposes of dating or shell identification, together with occasional finds of artefacts found on mound surfaces. For the hinterland survey, 83 locations generated samples of cultural material, mostly worked stone or ceramics. Most of these samples involve small quantities of material (<20 specimens), and some comprise only a single specimen. All artefacts have been placed in the care of the Museum authorities in Gizan.

Sites were located on satellite images and inspected at close hand by vehicle and on foot. Observations include description of shell species present, other surface features of note, estimates of mound size, and collection of samples as appropriate.

Estimates of smaller deposits were made by eye and by pacing out the main dimensions. Larger mounds were additionally measured using differential GPS. The differential GPS uses local coastguard beacon signals to plot a position with up to 10cm accuracy. By taking multiple GPS readings along a ‘track’, it is possible to obtain rapid high resolution data for the dimensions of a mound. We use the term ‘shell midden’ to refer to any concentrated deposit of shells that has been collected and accumulated by human shellgatherers. For purposes of descriptive recording of large numbers of sites we classify shell middens into one of three categories:

1. Scatters: These are concentrations of shells that appear to be little more than the thickness of one or a few shells and show no evidence of forming a deposit that rises significantly above the level of the surrounding surface. Scatters typically fall in the size range of 5 to 10 m in diameter and are usually roughly circular or oval in plan, though they may sometimes be more extensive

2. Low mounds: These are mounded deposits that are less than 1m thick but with more depth of deposit than that implied by a scatter. Typically the depth of deposit is estimated to be about 0.5 m.

3. Mounds: These are deposits that are estimated to be at least 1m thick.

These are, of course, arbitrary subdivisions and there is probably some overlap, especially between scatters and low mounds, which are difficult to tell apart in some cases without excavation, test-pitting or augering to establish the true depth of deposit. Some deposits turned out to have thicker deposits after test pitting than appeared to be the case on first inspection. Thus some of the ‘scatters’ as defined above and recorded during surface survey may in fact be low mounds. In total, we systematically recorded 767 shell mounds, 467 by a single GPS point (accurate to 10–30 cm) and 300 by differential GPS survey. We concentrated our most detailed survey work in the Janaba and Khur Maadi sectors of Farasan Island, on the east side of Farasan Island and around the southern bays of Qumah Island. Elsewhere we recorded only GPS point locations for shell mounds and more summary descriptive information, notably on the southern side and western end of Saqid Island. This survey work supplements the shell mound surveys undertaken in 2006 and in some sectors provides more accurate and more detailed information than that obtained previously.

A brief comment should be addressed here to the question of whether any of the shell midden deposits we have examined are piles of dead shells accumulated by natural agency rather than by human action. The description of the Farasan shell mounds in the geological literature as ‘shell banks’ (e.g. Jado & Zötl, 1994) carries the implication that the shells are natural beach deposits, and the hypothesis of natural accumulation is frequently proposed for shell mounds in other parts of the world, usually in the belief that the quantities of shells are just too large to be accounted for by human shellgathering activities. These issues have been exhaustively discussed elsewhere (e.g. Bailey et al., 1994), and the criteria for distinguishing natural and artificial deposits of shell are well understood and can usually be applied in the field without ambiguity.

In brief, natural shell banks typically take the form of linear features, usually in association with thick or extensive sediments of marine sand, show clear evidence of water action in the form of erosion of shell surfaces and rounding of broken edges, high proportions of fragmented shell ‘shingle’, a wide range of shell sizes and ages typical of a natural death assemblage, and often a wide and non-selective range of mollusc species. Humic sediments or cultural materials such as artefacts, animal bones and ash layers, typical of human activity, are rare or absent. In the Farasan Islands, there is no known natural process that would account for the presence of neatly mounded and discrete shell deposits comprising edible-sized molluscs. Most of these deposits including the large mounds are located on a land surface of fossilised coral that forms the predominant bedrock on land, and show no evidence whatsoever of marine sediments or water action in the immediate vicinity. Many mounds, as discussed below, are discrete deposits of shell located some distance inland from the shoreline on the coral bedrock. Excavations, detailed below, also demonstrate the presence of a variety of indications of human activity. As for the large quantities of shell, detailed measurements on similar concentrations of shell mounds in other parts of the world demonstrate that even quite small human communities can generate huge quantities of discarded shells during the course of day-to-day subsistence activities extended over periods of hundreds of years. Moreover, once the time span of shell midden deposits and the likely size of the resident human population are taken into account, the amount of food represented by the discarded shells is not sufficient to support all the food needs of the human group, and indeed represents only a relatively small proportion of the total food intake, just one of a range of food resources that supported the overall subsistence economy (Meehan, 1992; Bailey, 1975; Bailey et al., 1994).

Detailed measurements of this type are yet to be carried out on the Farasan shell deposits, and will not be possible until we have a more extensive chronology for the sites, but there is no reason to suppose that the results will differ substantially from those obtained in other parts of the world.

### *Survey results*

The great majority of the mounds are distributed in a linear fashion along the shoreline, typically on the edge of an older fossilised coral platform that forms the present-day land surface, and which has been undercut by chemical and physical erosion of seawater at the shore edge to form a distinctive overhang. The largest mounds and the largest concentrations of mounds are found on shorelines close to large shallow embayments, which would have offered extensive habitat for large numbers of intertidal molluscs. On open rocky shorelines, where the extent of the mollusc habitat was presumably much less, only low mounds or scatters are present.

As noted in the 2006 survey (Bailey et al. this volume), these larger mounds that are present on the shoreline are often complemented by smaller mounds or shell scatters located up to several hundred metres inland, and sometimes at other points along the shoreline. Often this combination of shoreline and inland mounds and scatters takes the form of discrete clusters of sites, with one or more mounds forming the focus of the cluster, suggesting that each cluster represents a coherent settlement system involving the use of different locations for different activities, perhaps at different times of year, by the same group of people. On this interpretation the shell mounds might have been used as short term sites for the processing of large numbers of shellfish close to the source of supply during periods when conditions were especially favourable for shellgathering, while the sites further inland might represent the main areas of habitation, better suited to a range of local factors, which might include better shelter from the weather than that available on the immediate shoreline, or better access to other resources such as water supplies and terrestrial plants and animals. It is even possible that the shell mounds were reserved for use at certain times of year associated with the gathering together of people from a wider territory for ceremonies and feasting, with intensification of shellgathering to feed the larger numbers of people present on such occasions, much in the manner described for the Anbarra people of northern Australia (Meehan 1982). People might thus have moved to and fro between different sites in response to a variety of practical and social factors.

An alternative possibility is that the mounds and the inland scatters refer to two or more different settlement strategies belonging to different time periods in the overall sequence of occupation of the Islands. On this interpretation, the mounds might represent an earlier period when settlement was focussed on the shoreline and on marine activities including intensive collection of molluscs, and the inland scatters might refer to a later period with a more diversified pattern of settlement and economy including more emphasis on hinterland as well as marine resources and less emphasis on the collection of shellfish.

The fact that potsherds are often present on these inland shell scatters but almost never in association with the shell mounds might be seen to support this idea of a chronological separation between a ‘pre-ceramic’ and a ‘ceramic’ phase of settlement on the Islands. However, the absence of potsherds on the shell mounds might equally well be due to the different nature of the activities carried out there compared to the inland locations, and does not necessarily have chronological implications. Only a systematic programme of dating will help to discriminate between these alternative hypotheses.

### *Geoarchaeological context*

A striking pattern in the overall distribution of shell mound distributions is that the largest mounds and the largest concentrations of mounds are found in association with extensive, shallow bays, many of which are now silted up. These shallow bays must originally have been shallow marine and intertidal inlets with extensive sand flats and coral reefs capable of supporting very large numbers of molluscs. Now they are filled with more recent deposits of sand, and the original undercut shoreline and its associated mounds are up to a kilometre or more inland from the present day shoreline. This is the result either of accumulation of marine sand by longshore drift and progradation of the shoreline, or of tectonic uplift of the land surface. Given the history of tectonic movements associated with salt doming, the latter process is quite likely to be involved in some if not all cases. Some of the most dramatic examples of this effect are to be found in Janaba West, in the Southeastern sector of Janaba East, in the central sectors of Khur Maadi and Saqid Island, and on the south side of Qumah Island. In certain areas, recent tectonic effects are clearly visible in the tilting, warping or displacement of the original shoreline, especially on Qumah.

A more detailed insight into these factors is offered by the site groupings in the centre of Farasan al Kabir on the Khur Maadi and Janaba West shorelines, which are opposite each other in the central part of the Island (Figure 2). On both sides of the Island there are deep embayments that are now filled in with sand, leaving a fossil shoreline in the form of a low undercut coral cliff to mark the original position of the sea shore. Large numbers of shell mounds are distributed along this ancient shoreline, and many of these are big mounds, especially on the west side of the Janaba West Bay, where there are some 40 discrete shell mounds forming an almost continuous line of sites. These sites are easily visible on satellite images and similar concentrations are visible on the east side of the Janaba West Bay and on both the western and eastern sides of the infilled Khur Maadi Bay. In both areas smaller mounds or shell scatters are present somewhat inland of the shoreline representing site clusters as discussed above.

In addition it is possible to identify small clusters of shell scatters and small shell mounds situated between the two bays of Khur Maadi and Janaba West, as if there was once a continuous marine channel connecting the two opposite shorelines, which divided Farasan al Kabir into two islands separated by a narrow stretch of shallow water. Satellite images show fault lines in this area, suggesting that uplift has occurred and that this is the main reason for the closing of this narrow strait. This process has probably contributed to the infilling of the adjacent bays, either because of increased run off from land or because the closing of the channel cut off the flow of water that previously helped to keep the bays clear of sediment. A similar process of infilling is visible in the eastern part of the Farasan al Kabir, which appears once to have had a narrow inlet extending inland from the present-day port of Farasan in the north, and a similar shallow inlet extending inland from the coastline in the south between R’as Shida and Ra’s Abrah. It is possible though not certain that these inlets were connected, forming a single, continuous, shallow sea channel. At any rate, these inlets are now filled in and form sandy corridors flanked by fossil shorelines with shell middens on them.

During the course of survey a number of sedimentary basins were noted and three of these were sampled in detail to provide a sequence of soil and sediment samples that might throw light on changes in coastal geomorphology and palaeoenvironmental changes more generally (see Figure 1 and Figure 2 for locations). Two of these locations are in the infilled shallow bays adjacent to the major shell mound clusters at Khur Maadi and in Janaba West respectively. They comprise small oases with date palms where water-laid deposits have accumulated to provide a stratified sequence of sediments recording the transition from marine to terrestrial conditions. These offer the opportunity to date the sequence of events associated with the infilling of these large shallow bays and their transformation from productive marine bays full of marine molluscs to dry land. In both areas eroded sections in the deepest part of the infilled sediments were exposed, and these were cleaned back and a series of samples was removed in stratigraphic sequence through the full depth of the sedimentary sequence.

At Khur Maadi (KM1367) a 1.5m deep section was exposed to the bedrock and revealed a sequence of sediments comprised mainly of sand but with two layers of organic silt. At the base of this sequence were large numbers of *Strombus fasciatus*, the small gastropod that forms the dominant species in the shell mounds (see below). Here the shells represent a natural death assemblage, and a radiocarbon date was obtained on one of the shells (Table 2). Allowing for correction and calibration (discussed in greater detail below in relation to the radiocarbon dates from the excavation of the shell mounds), the date at the base of this sequence is 1375 cal BC. The implication of this date is that this part of the bay was still home to marine shellfish at that time but that the process of progressive infill and drying out of the bay took place some time after that date. This is an important date when considering the chronology of the shell mounds located around the original shoreline of this bay.

A third sequence of soil samples was recovered from Homer at the eastern end of Farasan Island, a shallow depression inland from the shoreline and at higher elevation. Analysis and dating of soils, sediments, shells and other organic materials from all these locations will provide palaeoenvironmental information to relate the history of mound formation to the geomorphological and palaeoecological evolution of the adjacent shoreline.

### *Excavation*

Excavation of shell mounds is a notoriously labour intensive process, which can generate large quantities of material in need of careful sorting and analysis even from quite small excavation trenches. With such a large number of sites at our disposal (over 1000), the question of excavation poses formidable challenges of sampling.

### *Site selection*

As a first step, we decided this season to concentrate our efforts on two major clusters of mounds, with excavation of the major mound within each cluster and more limited test excavations of smaller shell deposits in the near vicinity within each cluster. We have chosen two such clusters for detailed examination, each in a contrasting location, one in Janaba Bay (Janaba East) and the other in Khur Maadi Bay (Khur Maadi) (Figure 1). In each cluster we have selected one of the larger mounds for detailed excavation, with more limited test pitting of some of the smaller adjacent mounds. The two areas have contrasting coastal settings. The Janaba East group of sites comprises 8 small mounds spaced out along the present-day shoreline, located on an open coastline, dominated by a 2–3m high fossilised terrace that has been undercut by marine erosion (Figure 7). The Khur Maadi group is situated on a low undercut coral terrace about 1m high on the inner edge of a large shallow bay now dry and filled with sand, with a number of low mounds and clusters at varying distances inland from the shoreline (Figure 13). The total number of individual mounds and scatters in this cluster is 112. The different settings of these two clusters of sites should highlight the influence of local ecological variations on shell mound formation as well as the long-term impact of tectonic movements.

The choice of sites was further determined by considerations of easy access and because of evidence of actual damage or the potential threat of such damage. The Janaba Bay cluster is close to harbour and industrial facilities where the risk of future damage is high both from industrial development and from natural erosion. The largest mound in this group (JE0004) is a low intact mound c. 2m high, and it is located on the edge of an old coral terrace which has been deeply undercut by marine erosion (Figure 3). Part of the overhang has already collapsed immediately in front of the mound. Continued erosion will eventually result in the collapse of the mound, or part of it, into the sea, and some deposit from around the seaward edge of the present mound may already have been lost in this way. This mound was sampled with a narrow test trench in 2006, and this trench was widened and extended to provide a transverse section across the full width of the mound in 2008 (Figure 4). The aim of the excavation was to examine the full depth and stratigraphy of the mound, to reconstruct the chronology and pattern of mound formation, and to recover detailed samples of artefacts, shells, animal bone and other cultural material. Excavation will resume in 2009 to extend the investigation.

In the Khur Maadi cluster, we selected one of the largest shell mounds in this group for excavation (KM 1057) because it is a tall mound and was already partially damaged by bulldozing activity, offering the opportunity to clean back to a vertical section and obtain samples through the full stratigraphic sequence without the need for extensive excavation (Figure 5).

### *Excavation strategy and methods*

At JE0004 our main objectives were to establish a continuous section through the mound across its full width on a shore-to-hinterland axis and from the top to the base at its thickest point, in order to give an insight into overall mound stratigraphy and processes of formation, and to use the section as a known starting point from which to excavate in selected areas to provide samples of well-provenanced shells and other materials. We re-opened the step trenches excavated on the south side of the mound in 2006, and opened up a new trench with the aid of a mechanical digging machine to expose a section through the northern half of the mound.

The rationale for this approach is based on the fact that reading stratigraphy in shell middens is very difficult to achieve when coming down on top of deposits during the course of excavation, especially in small trenches. Also, unconsolidated midden deposits are vulnerable to slumping and collapse. Quite large trenches have to be dug even to expose relatively shallow sections no more than 1–2m high. Step trenches can be used to mitigate these effects, as in the 2006 excavation, but the resulting sections give only an incomplete window into the stratigraphy. They also fail to capture lateral variations in the composition of particular layers, which may be a very significant variable in understanding processes of shell mound formation. Moreover, there is no a priori guarantee that the basal deposits immediately above bedrock at the outer edge of a mound are necessarily the earliest deposits in the sequence. A mound can grow outwards over time as well as upwards, with the result that the basal deposits at the edge of a mound may be quite late in the overall sequence.

Another factor that guided our excavation strategy is the extremely time-consuming nature of excavation and post-excavation analysis involved in processing even small volumes of shell-midden deposit. A trench at least one or two metres wide would be required to expose safely a vertical section up to two metres in height through loosely consolidated shell deposits. A hand-excavated trench of this width excavated through the mound at its narrowest point – about 20m – would represent a total volume of excavated deposit of, say $30m^3$, and require many years of labour-intensive activity to excavate and process, even with ruthless sampling of deposits for detailed processing and consequent discard of the remainder. A machine-excavated trench necessarily destroys much of the information obtainable from the deposit so removed. But it is better to sacrifice a small amount of deposit in a large mound in this way in order to provide a clean section from which complete and stratigraphically well-provenanced bulk samples of any desired volume can be removed, than to spend the many years of excavation and post-excavation analysis that would be required to hand-excavate a large hole, only to end up, in any case, with poorly provenanced samples of variable integrity and completeness.

With these factors in mind, we used a mechanical digging machine to open up a trench measuring about 10m x 2m in the northern half of the mound, aligned on the same axis as the 2006 step trench. As expected, the deposits turned out to be quite loose and unstable, and we stopped the digger and continued clearance of the trench by hand, using progressively more careful techniques and smaller tools to approximate a vertical section along the desired horizontal axis.

We established a new metre-square grid with its central north-south axis aligned slightly west of north at 339 degrees to align it with the trenches opened in 2006. Each square has a number and letter. Gridlines on the x axis are lettered from west to east, and gridlines on the y axis, north to south, are numbered. Each metre square is labelled according to the gridlines intersecting in the northwest corner, resulting in a unique letter-number identifier for each metre square. Each square is further subdivided into four 50cm x 50cm quadrants to facilitate excavation and provenancing of material, and these are labelled A B, C, D, beginning in the northwest corner and working from left to right. Vertical sections are labelled according to the adjacent quadrants and the direction in which they are facing. The main section through the mound is a west-facing section aligned on gridline G (Figure 4).

Excavation at JE0004 proceeded according to stratigraphically discernible layers defined by changes in shell and ash composition or sediment colour, with a local sequence of numbers to identify layers within their respective quadrants and squares. Where undifferentiated stratigraphic units appeared to be particularly thick, these were subdivided into arbitrary layers of 5 cm or 10 cm thickness. Samples of shell or charcoal for radiocarbon dating were removed directly from the exposed sections, after measuring and photography, in order to ensure stratigraphic integrity and to minimise contamination or use of materials that had been displaced during excavation (Figure 6).

Initially, all shell deposits recovered from each stratigraphic layer were sorted in situ by using hand held sieves with 2mm and 1mm mesh to remove the larger fraction of shell debris and facilitate sorting of small material such as fish bones. Samples of sediment and shell retained by the 1mm sieve, and sediment passing through the 1mm sieve, were retained and bagged separately for later analysis. A bulk sample of shells (c. 1–2 kg) was also bagged from each layer after sieving in the above manner and retained for later analysis. For subsequent layers we took a 1–2 kg bulk sample from the unsieved deposit, that is a sample of everything including shells, sediment and other materials, and strewed the rest of the material on a large plastic sheet placed next to the mound in order to search for rare items such as artefacts and animal bone. Subsequently, we bagged all material in large bags (15–20 kg in weight) and transferred these to a compound in Farasan town with running water where we could experiment in a more systematic way with sieving methods including water sieving.

After experimenting with several different methods, we found that the most efficient technique was limited dry sieving to remove the largest shells or other items, and sorting of the remaining dry material on a plastic sheet. Wet sieving was found to add no significant advantage in sorting and identification of small specimens such as the spines and vertebrae of small fish, but simply imposed the additional disadvantage of slowing down the process while the material was allowed to dry. Dry sieving through a 2mm mesh was also found to offer no advantage in the separation of shell fragments from rare finds. Bulk shell samples (1–2 kg) and smaller samples of sediment were retained from most layers.

Three small mounds (JE0001, JE0002 and JE0003) extending over a distance of about 100 metres to the east of the main mound were also test pitted (Figure 7). Sections were drawn and bulk samples (1–2 kg) were retained from stratigraphically distinct layers. Samples of shell or charcoal for dating were recorded and collected from the exposed sections in the same way as at JE0004 (Figures 8–10).

At KM 1057, the damaged part of the mound was cleaned back to a vertical section about 1m wide and 3m tall through the highest part of the mound (Figures 11 and 12). Because the shell deposit is quite loosely packed and liable to collapse, the section was cleaned in stages beginning from the top of the mound. Each stage was cleaned through a depth of about 50 cm to provide a vertical section and then photographed and sampled. The next section down was stepped out by 10–20 cm, so that any collapse of shell from the upper section would be retained by the step. Bulk samples of shell (each sample comprising a bag of about 1–2kg in weight) were collected from successive stratigraphic levels, at approximately 10 cm intervals, following stratigraphic layers where discernible or otherwise at arbitrary 10 cm levels. Smaller samples of shell for dating purposes were recorded and collected from the exposed sections as with the Janaba sites. Sites in the immediate vicinity were test pitted (Figure 13), with the drawing of sections and collection and retention of bulk samples and dating samples in the same way as with the Janaba mounds (Figures 14–16).

The excavation work at all sites resulted in the recovery of 108 bulk samples, 186 dating samples, 32 sieve residues, and 22 samples of small finds (fish bones, artefacts etc.). A majority of these were freighted back to the UK for more detailed study in the York laboratories, with the exception of the small number of artefacts recovered from excavation, which have been placed with the Museum authorities in Gizan.

### *Stratigraphy and dating*

The main mound at Janaba is c. 20m in diameter, and 1.5m deep in the centre. The combined north and south trenches exposed a continuous section through the mound along a north-south axis (Figure 6). In the northern half of the trench, excavation reached to bedrock, while the steps excavated into the southern trench in 2006 were extend and deepened to a depth of 0.5m and have not yet reached bedrock except at the shallow southernmost edge of the mound. Nevertheless, some distinctive patterns in site formation are clearly apparent. There is a clear overall stratigraphic sequence of deposits but with a complex pattern of lenses, interleaving layers of different deposits and considerable lateral variation within particular stratigraphic horizons. This pattern of variation is largely determined by variations in the activities carried out in different parts of the mound and variations in the shell and ash composition of the different deposits. On the southerly, seaward facing side of the mound stratigraphically distinguishable deposits form relatively thin layers, 2–5 cm in thickness, consisting of alternating shell and shell mixed with ash, often in a grey-brown or red-brown sedimentary matrix. The shells are predominantly *Strombus fasciatus*, a small gastropod 2–3cm long, with occasional lenses of larger shells of other species. *S. fasciatus* is the dominant species in the mound and indeed the dominant species in very nearly all the mounds we have recorded. The relatively high quantities of ash, small shells and shell fragments suggest that this area of the mound was a processing and living area where camp fires were placed and food prepared. In the northern part of the mound, by contrast, the layers are thicker, and show an alternation between layers dominated by *S. fasciatus* and layers dominated by larger shell species, particularly the large, bulbous gastropods *Pleuroploca sp* and *Chicoreus sp*, the largest of which can exceed 10 cm in length, and the large bivalve *Spondylus marisrubri*. Other species are present in this area, often highly fragmented, and there are pockets of ashy material. The large shells appear to have accumulated relatively rapidly with voids between the shells to form quite steeply sloping layers. This pattern suggests a dump behind the main processing area at the front of the site, where larger shells were thrown away together with deposits of smaller shells, shell fragments and ash, periodically cleared out from the activity area.

At present we have only two radiocarbon dates from the site (Table 1), from the top and base of the sequence so far exposed (Figure 6). The date from the basal sample of the Janaba sequence appears to be slightly younger than the date near the surface, although the difference is probably not statistically significant. Further corrections have to be made to both dates to account for the offset between radiocarbon years and calendar years (calibration), and for the fact that shell carbonate includes older carbon from the marine reservoir and gives dates that are older than those obtained from terrestrial carbon (see Table 1 for details). Taking the mid point of the calibrated dates gives a date of 3310 cal BC for the top of the mound, a date of 3503 cal BC for the base, and an average for the two figures of 3407 cal BC. However, given the statistical uncertainties of measurement, notably the fact that the two dates overlap at two standard deviations, the dates at top and bottom should not be taken as significantly different within the range of error of the measurements. This may indicate that the mound has accumulated relatively rapidly, perhaps over a period of no more than several hundred years and possibly much less. An alternative possibility is that the piece of charcoal from which the basal date was obtained belongs to a later phase in the deposition of the mound, but has slipped through the deposits to a lower level. Given that the composition of the mound in this area includes deposits of larger shells with voids, such a possibility cannot be ruled out. Only a larger sample of radiocarbon dates will allow a more refined estimate of the chronology and duration of the mound. For the moment the total date range at 2$\sigma$ indicated by the two radiocarbon measurements is 3373–3561 cal BC, giving a mid point of 3503 cal BC.

The Khur Maadi mound shows an interesting contrast in overall composition. Here the deposits are dominated by shells of *S. fasciatus* as in the *Strombus*-dominated layers at JE0004. The *Strombus* shells are broadly similar in terms of their degree of fragmentation but are somewhat larger on average than at JE0004. The deposits have less sedimentary matrix, usually of a yellow-orange colour, and only a very small number of shells of other species. There are just two lenses of larger shells, both comprising *Chama reflexa*, one near the top of the sequence at c. 50 cm below surface and the other near the base at c. 275 cm (Figure 12). There is also very little ash material in the deposits with the exception of one layer near the top of the sequence. The total depth of the mound at its highest point is 3m and the extent of the exposed section indicates a uniform composition without the variability noted at the Janaba mound. This suggests a relatively rapid accumulation of shells and perhaps a more specialised function of the site compared to the Janaba mound. The radiocarbon dates (Table 1), treated in the same manner as at Janaba, again indicate a date for the base of the mound, of 3020 cal BC, which is slightly younger than the date at the top of 3070 cal BC. As at Janaba, the difference between these two dates is not statistically significant, suggesting rapid accumulation within the resolution of the available radiocarbon dates, a total date range at two standard deviations of 2880–3300 cal BC, and a mid point in that range of 3090 cal BC, which is closely similar to the results from Janaba. If we take the dates at face value, they suggest a more rapid accumulation of deposits than at Janaba, but this remains to be checked against a larger sample of dates.

Of the three small mounds test-pitted at Janaba, *S. fasciatus* formed the key constituent. One mound has a layer of *Chicoreus* and *Pleuroploca* shells at the base, overlain by a *Strombus*-dominated layer in an ash matrix, possibly mirroring the pattern at JE0004.

At Khur Maadi, the three small mounds test-pitted in the vicinity of the main mound were predominantly composed of *S. fasciatus*, with some shells of *Chama reflexa*. Visual inspection of surrounding mounds showed surface indications of what appear to be traces of hearth complexes lined with small blocks of coral, and these are targets for future investigation.

### *Marine molluscs*

The mollusc species so far identified include a range of bivalve and gastropod species typical of coral reef habitats. The dominant species in both excavated sites is the small gastropod *Strombus fasciatus*, while the next most common species are the pearl oyster *Pinctada* cf. *nigra*, and *Chama reflexa* (Table 2). The large carnivorous gastropods *Chicoreus sp* and *Pleuroploca sp* are also present in some quantity at JE0004, where they often form concentrations in particular layers. Other species are present only in very small numbers. At JE0004, *S. fasciatus* accounts for an average of 60 per cent by weight of all shell in samples measured so far, with a range of 38–88 per cent. At KM1057 the average is 95 per cent with a range of 38–100 per cent. The dominance of *Strombus fasciatus* at KM1057 confirms the visual impression given by inspection of the sections that this is a more specialised site, at least as regards shellgathering activity.

*S. fasciatus* is generally found grazing in the shallow water of well sheltered sandy bays where the water is calm and sea grass is able to grow on the seabed. It can be found in large numbers and is easy to collect while wading in shallow water. Most of the other species are found only on hard rocky or coral surfaces, which is generally the case with the bivalve species. The gastropods can be found on both sandy and hard substrates. Some of the species can only be found at some depth and would most probably have required diving to collect them, most probably *Pinctada*, *Spondylus*, *Chicoreus* and *Pleuroploca*.

The wider range of species present at JE0004 may be due in part to sampling bias; a larger volume of material has been excavated and sorted in the laboratory and species that are absolutely rare are more likely to show up in larger samples. But the higher proportion of species other than *S. fasciatus* suggests that there is a genuine difference between the two sites. Either KM1057 was a specialised site focussed mainly on the collection of *S. fasciatus*, as noted above, and JE0004 was used for a wider range of activities, perhaps for longer periods at a time, than KM1057, or the local shoreline environment at Janaba was more varied, with less extensive areas of *S. fasciatus* habitat and a greater extent of rocky substrates underwater. Possibly both factors were at work. KM1057 is located next to what would, at the time of its accumulation, have been an extensive, shallow sandy bay. It is likely, therefore, that there were more extensive areas of productive *Strombus* habitat nearby than at Janaba Bay, and the habitats of the other species were more distant from the site. Conversely, the offshore environment adjacent to JE0004 is likely to have been more exposed to incoming waves when the site was occupied, and there is a more limited extent of shallow water (see Underwater Survey below), both factors that would have restricted the area of suitable *Strombus fasciatus* habitat in the near vicinity of the site.

### *Vertebrate faunal remains*

These are relatively few and mainly comprise fragmentary fish bones, with one or two fragments of mammalian bone. The fish bone material is most abundant at Janaba, and comprises mostly vertebrae and spines and occasional jaw bone fragments. Most of the fish caught were small to medium in size, perhaps little more than 10cm in length, suggesting the use of nets for capture. Preliminary identifications suggest that the following are represented:

- Myliobatidea, Eagle Ray
- Serranidea, Groupers
- Sparidea, Sea Bream
- Scaridae, Parrot Fish
- Chondricthyes sp., probably from the Ray family

The fact that very nearly all the fish bone comes from the Janaba excavation reinforces the impression that this site was used for a wider range of activities.

### *Other small finds*

Artefacts are extremely rare at either site and consist of 'manuports', irregular lumps of material, made from a type of hard white-yellow limestone or fossilised coral. Most of these are from JE0004, and are formless pieces, sometimes with occasional flake scars, ranging in size from about 5 to 15 cm in length. One or two similar pieces were also recovered from the disturbed deposits at KM1057. The material from which they are made is not available in the immediate vicinity of either site, although it can be found elsewhere on the Island, and these specimens must have been brought onto the site from elsewhere, presumably for use as expedient tools for a variety of heavy duty tasks. Artefacts often occur in relatively low densities in shell middens because of the relatively rapid accumulation of the shells in comparison with other types of deposits. In this case the rarity of artefacts is compounded by the rarity on the Islands of suitable fine-grained stone materials for flaking. Only two other pieces of worked stone have been clearly identified in association with shell mounds, a piece of ground greenstone (illustrated in Bailey et al., this volume), and a flake of volcanic material found on the surface of another shell mound in the Khur Maadi area. Both artefacts were made on materials that must have been imported from the mainland.

No ceramics have so far been found at all in excavation. Ceramics are commonly present on the surface of shell scatters elsewhere on the Islands, but are notably absent from the surfaces of the larger mounds, and their absence from the excavations at Janaba and Khur Maadi reinforces the belief that these sites pre-date the introduction of ceramics to the Islands, or else that they had specialised functions that did not require the use of pots. The latter explanation seems plausible for the KM1057 site but less so for JE0004 given the wider range of activities indicated there. The radiocarbon dates also indicate that the sites were in use at a period when we know that pottery was in use on the mainland.

### *Evaluation and conclusion*

The survey data demonstrate a considerable variety in the size and location of shell middens, and a wide range of mollusc species present on the middens, judging from surface observations, though *Strombus fasciatus* appears to be the dominant species in very nearly all cases, especially in the larger mounds. Many of the middens form clusters that include sites of different sizes ranging from large mounds to surface scatters. The larger mounds are usually located along the shoreline with smaller sites situated some way back from the shoreline, suggesting the use of different localities within a localized area for different activities or at different times of the year, with the most shellgathering activity and shell processing focussed on sites on the shoreline immediately adjacent to the littoral zone where the majority of molluscs are to be found. The largest shell mounds and the largest clusters of shell middens are found around the edges of very shallow bays that would formerly have provided an extensive habitat for *S. fasciatus*, but which are now filled with sediment and transformed into a dry land environment with sand dunes.

Excavation of two sites, one in Janaba Bay (JE0004), the other in Khur Maadi Bay (KM1057), confirm that there are considerable differences in mound composition despite superficial similarities. KM1057 is composed almost exclusively of *S. fasciatus* shells with little other sedimentary matrix or cultural content, whereas JE0004 comprises a wider range of shell species and evidence of hearths, displacement of material during site maintenance, more evidence of fish bone and some fragments of mammal bone, suggesting more prolonged periods of occupation and greater variety of activities. It is not yet entirely clear whether the greater variety of materials at the Janaba site is largely a sampling issue due to the greater volume of shell deposit investigated, or reflects genuine differences in the way in which the two mounds were used, but the latter interpretation seems highly likely.

The duration of both excavated sites is surprisingly short, at least on the evidence of the small number of radiocarbon dates currently available. In both cases the dates for the top and the base of the sequence are statistically identical, suggesting relatively rapid accumulation within the margins of error of radiocarbon dating, though that duration might be as much as several hundred years. In both cases the dates centre around 3000 cal BC. It is not yet clear whether the similarity of date and duration of the two excavated sites is a coincidence, or representative of a wider pattern in which the accumulation of shell mounds was a relatively short-lived phenomenon. Nor is it clear whether this apparently short-lived occurrence of the shell mounds reflects a limited period when shellfish were unusually abundant, an increase in population density or intensity of human activity on the coastlines of the Islands, or simply an increased visibility of human activity during a period when unusually large quantities of shells were being collected and accumulated in one place. In the case of KM 1057, where there are 30 mounds of varying size within 200m, and a larger number within 1km, it may well turn out to be the case that other shell middens within the cluster have different and non-overlapping sequences of dates, and that in their totality the sites within this cluster represent a much longer sequence of occupation than any individual site. Investigation of these various possibilities will require more extensive sampling and excavation and a more detailed programme of dating. Similarly, questions about variations in subsistence economy, the place of shellfood within the wider economy, and the possible ritual or ceremonial function of some of the mounds remain to be investigated in more detail.

### *Hinterland site survey*

There is a great abundance of other archaeological material on the Islands. Much of it takes the form of structures of various types, usually made of blocks of coral or faroush, probably of pre-Islamic or early Islamic date, and some of these may be burial cairns, often in close proximity to the coastline. Traces of hearths are also sometimes visible in flat areas with some accumulation of sediment. Some of these features may be of quite recent date, and we have not attempted a systematic survey of this material, since it represents a major project in its own right, but we have recorded some of these features during the course of survey. The primary objective of our own surveys was to locate flaked stone material that might indicate evidence of activity on the Islands during the Palaeolithic period, and other materials of prehistoric age including ceramics that might indicate hinterland sites or settlements related to the shell mounds.

### *Archaeological and geological context*

We know from the evidence of sea level change and local bathymetry that the Farasan Islands were connected to the mainland for long periods during the Pleistocene and would have been accessible to people travelling on foot over large territories without the need for boats. In addition, we know from the surveys that have been conducted by the Comprehensive Survey Program on the mainland that there are numerous occurrences of Palaeolithic material. Petraglia (2003), and

Petraglia and Alsharekh (2004, and see references cited therein) have documented extensive evidence for both Lower Palaeolithic (especially Acheulean) and Middle Palaeolithic archaeology on the mainland. These reviews note that the Comprehensive Survey of the Kingdom, as well as other projects in the Yemen and Oman, have identified a number of surface archaeological sites of Lower Palaeolithic age. A slightly higher number of Middle Palaeolithic surface sites have been found in Saudi Arabia and the Yemen. Within the Arabian Peninsula, sites have been found in a number of different topographical settings including inland basins, coastal margins and in mountainous areas (Petraglia & Alsharekh 2003: 67). They have been most commonly found along stretches of the Red Sea coastal plain to the west of the Asir mountains, further inland, and in the Rub' al Khali (Zarins et al., 1980, 1981). Along the Red Sea coast, in particular, artefacts have been found lying on the surfaces of corral terraces close to lava outcrops along the Wadi Fatimah and in the coastal region of Al Birk (Bailey et al. this volume). With such clear evidence of hominin occupation of the Red Sea coastal plain during both the Lower and Middle Palaeolithic, and with evidence of similar aged material on the other side of the Red Sea in Eritrea (Walter et al. 2000), there is every possibility that at times of lower sea level there could have been some hominin use or occupation of the Farasan islands. Previous archaeological survey work on the Farasan Islands (Zarins et al. 1980) makes no mention of any Palaeolithic finds, although it is not clear whether a deliberate attempt was made to look for materials of this age. If survey were directed towards the specific objective of finding Palaeolithic artefacts, it should be possible to discover such evidence, given favourable geological conditions for the preservation and exposure or relevant material.

It needs to be remembered, of course, that because the majority of sites identified during field survey on the mainland are surface sites, the determination of their age has been made on the basis of technological form alone. Lower Palaeolithic materials have been identified on the basis of their Acheulean (biface) technology (Petraglia 2003), and Middle Palaeolithic materials have been identified on the basis of prepared core (Levallois) technology and the form of certain retouched artefacts. While these are reasonable grounds for assigning a broad age, independent verification by radiometric dating is lacking.

The topography and landscape character of the Farasan Islands directly affects the nature of the field survey that can be undertaken. The islands are primarily comprised of old coral terraces and limestone, with wave cut coral terraces along the coastal margins. In a number of places, these terraces form bays with a sandy infilling, as noted above. In certain inland areas, there are isolated wave-cut terraces, most probably the remnant of a palaeoshoreline formed at modern sea level, which has now been marooned some distance inland by the accumulation of sand and the seawards extension of the shoreline (Figure 17). Finally, in a small number of places there are lifted coral terraces rising to a maximum height of approximately 80m above modern day sea level. An example of this form of raised terrace landscape is present close to the village of Al-Hesen in the northwestern part of Farasan Island (Figure 18). In no places on the Islands does the geology present rockshelters or other classic sediment-rich locations. However, it should be noted that wave cut notches formed at the modern shoreline provide overhangs that offer attractive shelter. These features are abundant around the modern shoreline but are obviously too young to host archaeological material from the Palaeolithic era. Submerged features formed when sea level was lower than the present are known and are potential targets for underwater survey (see the Underwater Survey section below).

Lower and Middle Palaeolithic artefacts in the Arabian Peninsula are usually made on basaltic lavas or fine-grained siliceous rocks and are found in locations that would have been close to water sources. In places where these raw materials were abundant, field survey has found sites that can be realistically interpreted as factory locations. In the Farasan Islands, however, these materials are absent or very rare. If Palaeolithic hominins came to the Islands they would either need to bring artefacts made from basalt or other materials that are exotic to the islands, or make artefacts out of the locally available materials. The Farasan Islands have very few such sources of raw material, and what is available comprises fossilised coral, and some types of limestone, particularly a hard white or yellow limestone that has been found in shell midden deposits in the form of crudely flaked manuports (see above). Observations in the field also suggest that fossilised shell, particularly the shell of the giant clam, *Tridacna*, which can reach sizes of 30–40cm, is quite massive and fine-grained and can be flaked to form sharp-edged artefacts. These shells can be found eroding out of the surface of fossilised coral terraces in various parts of the landscape in the hinterland and near the modern coast.

### *Survey aims and methods*

In 2006, only limited survey in search of Palaeolithic material was possible and focussed on areas of standing water or areas that had water courses at some time in the past, and on the location of rock outcrops that might provide suitable material for flaking stone tools. Most areas examined were covered by sand or in a few cases by soil, or were on exposed coral surfaces close to the modern shoreline (Bailey et al. this volume). In 2008, more extensive field survey was possible and concentrated on landscape forms of a different character that might be more promising for the discovery of archaeological materials of Palaeolithic age. Previous and extensive field survey experience by one of the authors (Anthony Sinclair) in Southern Africa (Namibia) has shown that the archaeological evidence for Middle Stone Age activity can often be found at considerable distance from raw material sources. This evidence usually takes the form of isolated flakes (sometimes made from prepared cores) and occasional heavily-reduced cores. There is little evidence of flakes produced in the earlier stages of core reduction or other waste by products of tool manufacture that one typically finds close to raw material sources.

Therefore the 2008 survey targeted areas of higher elevation with good views of the surrounding landscape, with particular attention directed to: (1) raised outcrops of rock with little superficial sediment cover and flat surfaces where discarded artefacts would have remained in position undisturbed for long periods; and (2) exposed areas of flat ‘gravel terrace’ on which a thin covering of sand and sediment lies over the top of the underlying coral platform. Areas of raised rock outcrop also offer the best source of materials suitable for knapping. It should be emphasised that we do not assume that these were the preferred places for human habitation or human activity. Rather, we assume that these locations offer the best possibility of discovering Palaeolithic age materials in a landscape where outcrops of suitable raw material sources are rare or absent, and where thick sediments such as fluvial gravels or slope sediments that have been partially eroded to expose in situ cultural material are also rare.

Raised rock outcrops are present in two main areas on the Islands, in the northern and western part of Farasan al Kabir close to the modern settlements of Sair in the far north of the island and Al-Hesen to the north west, and in the central part of Saqid island where large rock outcrops rise out of a flat plain. Flat gravel terraces can be found on Farasan al Kabir, especially to the south and southeast of Farasan Town and to a limited extent north of the town of Sair. All of these areas were targeted for survey. A trip was also made to the island of Zufāf, where an uplifted coral-terrace landscape similar to the Northwest of Farasan al Kabir is also present. Work was conducted in March with lower temperatures than during the field survey season of 2006, and this made it possible to undertake extended episodes of field survey, and to explore areas of different topographic and surface character to those examined in 2006.

Areas targeted for field survey involved walkers separated from one another by approximately 25 to 50m following transects over distances of 1000 to 1500m across the landscape. All archaeological material was recorded by location using a handheld GPS device (Garmin GPS III, or Garmin eTrex) with brief descriptions of the location. Photographs were taken of all locations, and where appropriate, a sample of artefacts was collected for later analysis.

### *Survey Results*

Survey in 2008 was successful in locating flaked stone artefacts, some of which may date to the Lower Palaeolithic or (more likely) the Middle Palaeolithic. Others almost certainly relate to later occupation. The artefacts found, however, are relatively small in number, and the majority are isolated finds. The materials recovered include basalt, lava and a small number of obsidian artefacts. There are also a number of finds that are made of the local fossilised coral or limestone and a chert-like material, and it is these finds that would appear to be the oldest in date from their shape and technological characteristics.

The most convincing Palaeolithic-age artefacts have been found in the northern part of Farasan Island on the raised coral terraces close to the villages of Al-Hesen and Sair (Sayyer). The artefacts found are few in number, and are not classic examples of Lower or Middle Palaeolithic artefact types, but they do have a clear Palaeolithic look to them. The most convincing artefacts of this type are made on the locally available fossilised coral, which varies from a clearly fossilised coral preserving fossilised plant materials and shells, through to a compressed homogeneous rock that both feels to the touch and fractures like dolomitic limestone. Flaked edges are not particularly sharp and are brittle. It is notable that a small number of artefacts made on basalt or lava were also recovered during survey in other parts of the Islands, but these are probably much later in date since they do not have the characteristic technological features that one would associate with earlier material.

The largest and most convincing artefacts of early type have been found on the Jabal Tayyar to the northwest of the village of Al-Hesen, with a smaller number of isolated artefacts found further to the north on the north side of the town of Sair. At Jabal Tayyar, a series of coral terraces has been lifted and tilted at an angle to present a series of parallel ridges aligned in a northwest-southeast direction (Figure 18). Here, there are exposed areas of fossilised coral as described above, separated by narrow valleys, some of which are filled with sediment and have walled field systems in a few places. The artefacts were found on the top of the highest ridge, which is about 50m above sea level and about 2km inland from the modern coast on the western side of the Island. The ridge is comprised of a fossilised coral that fractures into large angular boulders of homogeneous material. On the uppermost terrace, there are a number of broken fragments of rock, amongst which the survey located some clear examples of flakes (Figure 19), as well as one large retouched, elongated flake, similar in form to pieces described as Middle Palaeolithic retouched blades on sites on the mainland (Figures 20 & 21). This particular artefact, 16cm long and 8cm wide, has a clearly preserved striking platform (Figure 22), clear evidence of a bulb on the ventral surface next to the platform (Figure 23), and a series of large negative flake scars creating a central ridge. There is also clear evidence of direct retouch around the margins of the piece (Figure 24). The remaining artefacts are large flakes. There are no classic examples of cores found at this site, although one chunk preserves negative flake scars. It seems likely that these early human visitors made opportunistic use of naturally occurring rock faces as striking platforms and associated flaking surfaces.

To the north of Sair in a context similar to the finds from Jebel Tayyar, we found a small number of artefacts as isolated finds. They were located during survey of raised coral surfaces in the northernmost part of Farasan al Kabir. The pieces are small flakes (Figure 25). One artefact is made on a locally available fossilised shell and has the features of a Middle Palaeolithic convergent point.

Finally, even though none of the artefacts described above is made on either lava or basalt, as was thought likely for Palaeolithic materials on the Farasan Islands, the survey has located a number of lava fragments on Farasan al Kabir itself (Figure 26), as well as a large basalt cortical chunk on Saqid Island (Figure 27), and a larger assemblage of pieces on the southeastern peninsula of Qumah Island. There is, therefore, some evidence for limited transport of these materials to the Farasan Islands at some period.

In addition to the small quantity of Palaeolithic finds, the surveys in both 2006 and 2008 have found an extensive array of evidence that almost certainly relates to the largely maritime adaptations of Islanders in recent millennia, which perhaps complements the abundant shell middens. This evidence takes the form of hearth scatters usually with charcoal fragments, heat-fractured stones, sometimes with ceramics, and often with fragments of shell. These vary from small scatters, perhaps 50cm in diameter (Figure 28) through to scatters that are more extensive and contain larger quantities of shells. They are commonly found in areas of flat topography throughout the islands, and may occur in isolation, or in clusters of up to15 to 30 hearth scatters. When found near the shoreline these scatters have larger quantities of shells and are often associated with shell mounds in clusters of sites, as described earlier.

### *Evaluation*

Three questions need to be asked of the isolated finds from Sair and Jebel Tayyar. Firstly, are they genuinely made by human action or could they be the result of accidental flaking by natural forces at work in these upland locations? Secondly, do these artefacts actually date to the Palaeolithic? Thirdly how representative are they likely to be of Palaeolithic settlement in the area?

For the isolated finds recovered near Sair, the flakes, including the possible convergent point, all are made on local chert rather than fossilised coral. The quality of this material is still poor, but the material is ‘out of place’ in relation to the background materials. These finds are clearly artefacts. For the flaked pieces on Jebel Tayar, the situation is more complex. There are a number of large clasts of the same fossilised coral on this flat surface. A small number of these clasts have been separated from the natural rock by processes of freeze and thaw. This process, of course, produces distinctive scar patterns that are easily distinguishable from flakes produced by impact with another hard material. Otherwise, there is no evidence to suggest that the clasts on this surface have been moved or turned over by natural agencies in such a way as to produce the specific flakes, edge retouch and associated evidence that the survey team has identified as artefacts. Furthermore, these artefacts were also found on the highest surface (approximately 80m above current sea level) and have not rolled down slopes, or had other clasts fall on top of them. Indeed in the course of survey work, we have come across a small number of other similar locations with the same quality raw material and lithic clasts scattered on open surfaces. Yet despite careful examination, no pieces could be identified as artefacts. There are good reasons, therefore, to think that the flaked pieces from Sair and Jebel Tayar are genuine artefacts.

With regard to the age of the artefacts, the finds are all surface finds lacking a stratigraphic context that might provide additional confirmation of date. The size and the morphology of these artefacts would suggest a Middle Palaeolithic age, but morphology by itself is not an infallible guide to chronology. We know from examples in other parts of the world that occasional stone artefacts with a Lower or Middle Palaeolithic form may turn up in much later periods. It might be argued, then, that the Farasan examples were made by later occupants, given the large number of locations throughout the Islands that have produced ceramics of Islamic and pre-Islamic age, to say nothing of the shell mounds. However, this seems unlikely because many of these sites with ceramics are in areas where raw material comprising fossilised coral like that on Jebel Tayyar and at Sair is available, but artefacts made on this material are never present in association with these ceramics. The excavations of the shell mounds at Janaba and Khur Maadi have produced formless 'manuports' of fossilised coral or limestone, which were probably used as expedient tools, as described earlier, but none of these have the flaking characteristics or shape of typical Lower or Middle Palaeolithic artefacts.

Finally, we must consider the possibility that more abundant evidence of Palaeolithic occupation may once have existed more widely on the Islands but is now obscured or destroyed. It is clear that the coastal margins of the Islands are lacking in recognizable Palaeolithic artefacts, even though they are densely covered with archaeological material from later periods. It is possible, of course, that more recent accumulations of sand in these areas or the weathering and erosion of the extensive coral terraces along the coastline, including those that would have been available for human occupation during earlier periods of high sea level, have obscured or removed artefact material from earlier periods.

Likewise, despite deliberate prospection, no Palaeolithic evidence has been found on the gravel terraces in either the northern or southern parts of Farasan al Kabir. This geological context might be more informative of early human activity, since if humans had been active in these areas during the Palaeolithic period and discarded lithic tools or debris, we would have expected to have found some evidence of this activity. The fact that the field survey teams have always found isolated lithic evidence from later periods in these same areas indicates that the absence of Palaeolithic artefacts is not the result of observer bias.

It is in the uplifted coral terraces in the northern part of Farasan al Kabir that field survey has been successful, locating one small collection of lithic artefacts found on an exposed and uplifted coral terrace, as well as a small number of isolated artefacts in the raised terraces in the same part of the Island. None of the artefacts found could be described as classic examples of Lower or Middle Palaeolithic typology, but they are convincing artefacts. It seems reasonable to assume that the reason for the occurrence of artefacts in these places is the presence of a locally available raw material that can be worked. Although this material is certainly not as good as the lavas and basalts that can be found on the mainland, it is still the best material locally available for knapping on the Farasan Islands. As such, the location of Palaeolithic artefacts on the Farasan Islands follows the same basic principle as the location of Palaeolithic sites found by the Comprehensive Survey on the mainland, namely proximity to suitable raw materials.

### *Conclusion*

The evidence strongly suggests that people visited the Islands from as early as the Middle Palaeolithic period, and perhaps earlier, most probably during periods of lower sea level when the Islands were accessible on foot from the mainland, but not in any great number or for any length of time. The evidence reflects, at best, the movement of occasional bands of hunters and gatherers moving through the landscape and monitoring the movements of animals or possibly the occurrence of plant foods, but not staying put in any one place for long enough or with sufficient frequency to generate a more substantial archaeological record. Further land-based survey on the Islands is unlikely to augment this picture significantly. If we are to find locations that were more attractive to prolonged human activity during the Palaeolithic period, these are likely to be in areas with abundant water supplies, diversity of resources, and some form of natural shelter, together with a local supply of raw materials suitable for making artefacts. From what we currently know of the seafloor topography around the Farasan Islands, many such locations could have existed in parts of the landscape that were exposed during periods of low sea level but are now submerged, and it is to underwater investigation that we will have to turn if we are to find better evidence of Palaeolithic occupation in the wider coastal region.

### *Underwater survey*

In 2006, we carried out preliminary exploration of deeper areas of the offshore environment using mixed gas technology. This work demonstrated the feasibility of using deep-diving techniques for archaeological purposes, identified submerged palaeoshorelines associated with different sea-level stands at depths down to 60m below the present sea level, and outlined the directions for future underwater research. For the deeper areas of the submerged shelf, an essential next step is to map larger areas of the seabed using techniques of acoustic survey to identify palaeoshorelines and other relict features of the original landscape. That forms part of the longer-term strategy of the project, but we did not have the necessary equipment and logistical support to pursue this strategy in 2008. Instead, we concentrated on working in shallower water easily accessible to divers, and on focussed and intensive investigation of localised underwater features, in order to better understand the processes of landscape transformation associated with inundation, to characterise the geomorphological history of underwater features with archaeological potential, and to locate if possible evidence of underwater archaeological sites. The specific objectives of this second year of diving fieldwork on the Farasan Islands thus were to:

- Investigate the shallow waters around the fringes of Qumah Bay on the south side of Qumah Island and to assess the archaeological potential of additional locations across the archipelago
- Locate and assess submerged geomorphological features that might have been attractive for occupation prior to inundation by sea-level rise, and that might preserve cultural material

We selected diving areas so as to record a range of features that might have been attractive for human settlement during periods of lower sea level, and assessed the potential for the preservation, location and recovery of artefacts in such locations.

The diving team conducted 58 dives totalling 1934 minutes underwater during 9 days of diving, and explored and recorded 11 sites together with extensive visual inspection across large tracts of Qumah Bay (Figure 29). Here we describe the geomorphological evolution of each site, assess the likelihood that it will have retained archaeological material following inundation, evaluate its potential archaeological significance, using criteria based on known archaeological sites on land and their topographical and geological setting, and use the results to identify the need for further work. The combined results of these assessments provide a broad understanding of the dynamism of the underwater environment around the archipelago and a predictive tool for future underwater exploration.

## *Underwater geoarchaeological features*

### Wave and solution cut features

Laterally consistent incised wave cut and solution notches with sizable overhangs are visible along the modern shoreline (Figure 30). These substantial features have been formed by the physical and chemical effects of sea water. They demonstrate that the interface between the land and the sea has been consistent around much of the coastline for the last 5000 years. During this time, global sea level has been relatively constant. In addition, older coral terraces are present at an average height of 3–5m above sea level across large swaths of the main islands. This compares favourably with the elevated global ocean levels during the MIS 5 high sea level about 125,000 years ago, suggesting that there has been limited vertical movement in large parts of the Farasan Islands over this period.

In contrast to the land, the sea level has undulated considerably during the last 125,000 years. There have been times when the water level rose or fell relatively quickly and times when it was stable for many hundreds if not thousands of years. Between about 110,000 and 20,000 years ago, the general trend was for sea levels to drop, but with periodic episodes of stability. Some of the most long-lived periods of stasis occurred at c. 100,000, 80,000, 50–60,000 and 40,000–45,000 years ago, corresponding to sea level depths of approximately–10m, –20m, –30m and –45m respectively. At these times, wave cut notches and erosion platforms would have formed. When sea level dropped following these still stands, these wave cut or solution cut features would have been left high and dry, providing potentially attractive shelters for human occupation.

The maximum low stand of 130m below present sea level was reached about 20,000 years ago and lasted for about 4000 years. This was followed by approximately 10,000 years of relatively rapid sea level rise before the rate of change began to slow and ultimately sea level stabilised at about the present level about 6000 years ago. The rate of this transgression would have been sufficiently rapid to limit the formation of deep notches. It follows that the more substantial wave or solution cut notches and overhangs found underwater were fashioned during periods of stasis as sea level fell rather than when it rose.

### *Impact of salt tectonics*

In principle, it should be possible to determine the age of wave or solution cut notches found underwater by correlating their depth with the sea level curve. This would mean that a notch, cave or wave cut platform at 10m below sea level would date to around 100,000 years old. However, this assumes long term stability of the land surface. Notwithstanding the relative stability of the land as indicated by the 3-5m coral terraces mentioned above, the Farasan Islands have been subject to varying degrees of tectonic activity as a result of rising salt dome migration and collapse (Bailey et.al., 2007). The results are evidenced by localised warping of the landscape and deep circular depressions now hundreds of metres below the water. This has caused vertical movement and tilting of some marine cut notches, as land deforms around migrating salt domes.

Evidence for geological tilting was recorded at the mouth of Qumah Bay at Slick point in 2006. Here, a series of linear underwater wave cut notches dips from 12m to 30m below sea level over a distance of a few hundred metres (Bailey et al., 2007a, 2007b). The slope is mirrored on land by the surface topography, which shows a seaward tilt of 5º. A wave cut platform lies immediately offshore, which continues to descend into deeper water. The passage of the slope from land to water is only broken by a wave cut notch at sea-level; otherwise it follows a continuous line along the same inclination as the higher terrace (Figure 31)

The evidence demonstrates that the peninsula at the southeast end of Qumah has tilted on an axis centred at or near Slick Point at the end of the peninsula. Here the surface of the upper coral platform is about 3m above sea level. It rises to the north, and dips to the south, where it disappears under water. The depth of the submerged wave cut feature at the axis of movement (which is believed to be around the end of Ra’s al-Mazlaq) is about 19–20m, implying a date for its formation of around 80,000 years ago. If we were to take the depth of this lower notch below modern sea level at some other point along its length, and attempt to date it by correlation with a general sea level curve without reference to the subsequent tilting effect of localised tectonics, we would end up with a date that was seriously in error. This case highlights the need for caution when using sea level curves to calculate the date of submerged geomorphological features within the Farasan Archipelago.

### *Sea level change and locations of archaeological potential*

The significance of wave cut notches to human populations is their potential as shelters. Accessible marine cut notches along the palaeoshoreline would have been the places used for shelter from sun, wind or rain. The overhangs would have provided attractive places for cooking food, making tools and other human activities. This is true in the present day as one can see by the remains of fireplaces, piles of driftwood, discarded cans and other materials located beneath such overhangs along the modern shoreline. Shelters formed by marine erosion when sea level was lower, and which were then left dry as the sea level dropped further and the shoreline retreated, would have offered good vantage points over the adjacent coastal lowland. The bathymetry of the sea bed suggests that this now submerged landscape would have had a complex topography including depressions that could have filled with freshwater, narrow valleys that would have facilitated monitoring and capture of animals, and spring lines at the foot of coral cliffs, making an attractive focus for human activity and settlement.

Given suitable physical conditions, artefacts and other cultural material accumulated on the floors of these shelters could date back to as early as 100,000 years ago, and perhaps even to earlier periods of low sea level during the Pleistocene. Accumulation of subaerial sediments would have encapsulated these finds in a stratigraphic matrix either within the shelter or in front of it.

Other site types that we have focussed on in underwater locations are shell mounds. Many of the undercut coral terraces around the bays and inlets of the modern Farasan coastline are crowned with shell mounds. These are known to date back to at least 5000 years ago and were built up over long periods of several hundred years or more, as discussed earlier. However, few substantial shell mounds of comparable type are known from earlier periods anywhere in the world, most probably because, if they existed, they are now lost beneath the sea. The absence or rarity of earlier shell mounds or coastal sites could suggest that human populations took little interest in marine resources before the establishment of modern sea level. The balance of current opinion, however, is that earlier sites are missing from the archaeological record because they have been submerged and lost to view (Bailey and Flemming, 2008). Unfortunately, locating these sites is difficult but it is necessary if the widespread use of earlier midden building is to be proved, or disproved. A major objective of the project is therefore to identify areas underwater that might have hosted earlier shell middens. To achieve this we have targeted sites that would have compared topographically to the locations on the modern shoreline where shell mounds are found.

### *The impact of rising sea level on archaeological sites*

A consequence of rising sea level is the likely displacement and dispersal of archaeological material and the sediments that enclose them. The biggest threat is physical erosion caused by swell or vertical movement in the water column as the sea transgresses a site. Degradation and deflation of deposits will be particularly acute when they are crossed by the surf zone. Traces of the original land surface are likely to be eroded away, and any artefacts dispersed and subjected to water erosion, degradation and possibly total destruction, leaving little if any recognisable physical traces of former human activity.

Conversely, where there is shelter from wave energy, sea level rise can afford protection. Here, ancient land surfaces and any associated archaeology may be left undisturbed, buried and protected by marine sediment, sealing them for many tens of thousands of years (Fischer, 1997, 2004; Momber, 2000, 2004; Maarleveld & Peeters, 2004). The problem is that the best preserved material in the most protected locations is likely to be completely covered by sediment and therefore hidden from view.

Given these circumstances, the best chances of recovering archaeological evidence are in those underwater locations which lie between the extremes of vigorous erosion and rapid sediment accumulation, or in locations where the capping of protective sediment is being cut into by submarine channel erosion to expose the underlying land surface.

In favourable conditions, for example, material which has withstood dispersion may remain undisturbed beneath thin lenses of sand or caught within crevices. If scattered material from submerged archaeological sites can be located, recovered, recorded and analysed, informed interpretations can be made. This has been demonstrated on a number of submerged archaeological sites (Muckelroy, 1978; Momber & Green, 2000; Tomalin et al, 2000).

It is also possible for material displaced during inundation to leave a faint signature at its original position. At sites where the relationship between the two forces of erosion and sedimentation is finely balanced, energy within the water may remove fines but not be sufficiently strong to dislodge heavier objects. The greatest opportunities exist where there is a gradient between the two systems at a point where areas of erosion and areas of sedimentation meet. If cover is thin enough, archaeological material is more easily accessible.

However, we also need to remember that the seabed is in a constant state of flux, especially where seas level change is altering the volume of water in a marine basin. Increased water movement or the opening of new marine channels can change the processes of sedimentation on the sea floor. Submerged landscapes that have been protected by overlying marine sediment since inundation may become subject to erosion and exposed while a previously eroded area may become covered. The challenge for the archaeologist is to identify and investigate areas with the greatest potential to reveal exposed but well preserved relic land surfaces. It is therefore very important to examine the geomorphological evolution of any submerged landscape that is a likely target for archaeological exploration.

### *Survey strategy and methods*

Given the objectives of this year's work, diving focussed on areas likely to have some or all of the features described above. The key factors assessed during each dive were the character of the outcropping geology and the sedimentary environment. Wave cut notches or caves that could have acted as pre-transgression human shelters were regarded as likely nodes of activity. This was seen as particularly relevant where the shelter overlooked an area that could have held fresh water when sea levels were lower. Other criteria considered when assessing the sites were the similarity of their locations and adjacent areas to archaeological sites on land, the balance between erosion and sedimentation, and past coastal geomorphological processes that could have influenced the preservation potential.

Inspection of the sites was visual and carried out by divers. Video and stills images were taken to record salient features. Measured survey was completed at selected sites that offered the greatest archaeological potential.

The diving was conducted on air and the depths were restricted to minimise the risk of decompression sickness. Accordingly, the searches concentrated around the –10m contour. Diving was carried out in line with the HSE (Health and Safety Executive UK) Scientific and Archaeological Approved Code of Practice. A team of five personnel was always present during diving operations. This included a supervisor, qualified skipper, assistant and two divers. Visual contact or physical communication was maintained with the divers at all times and the team was in constant communication with the Farasan Border Guard.

## *Site characteristics and archaeological potential*

### Janaba Bay

This area was selected for survey because it is adjacent to a group of well studied shell mounds including the excavated site of JE0004. Two locations were selected for underwater exploration: the first immediately adjacent to the Janaba East cluster of shell middens excavated by the terrestrial team (see above) and the second site in the south east area of Janaba Bay, off Ra’s Shida.

One hundred metres offshore from the beach at Janaba East, the sand covered seabed drops gently before a relic coral platform is exposed in two metres of water. This is a strip of exposed coral bedrock that runs parallel with the shoreline. It forms a lip, beyond which the seabed drops away into deeper water, reaching a depth of 7m within 400m from the shore. Inshore of this feature, the seabed supports a strip of coral reef that runs along the exposed relic coral platform. To the west, the sand covered seabed drops away.

The date of the wave cut platform is hard to determine. If it existed when sea levels were a few metres lower during the final stages of final sea level rise, 5000–6000 years ago, it would have formed a coastal strip around the bay. This would have been comparable to the coral platform around the islands today, which supports hundreds of shell middens. However, the lengthy fetch, which allows the build up of large waves, and the relatively steep drop off and consequent narrow width of littoral habitat, may not have been favourable to extensive habitat for large numbers of *Strombus fasciatus* at this location (see above). Equally, the low height of the platform above the encroaching sea would have made it vulnerable to erosion. It is unlikely, then, that substantial shell mounds could have accumulated on this earlier shoreline, or that they would have survived undisturbed at this point of the bay.

At the south east end of Janaba Bay, to the north of Ra’s Shida, a gently dipping slope covered in sand was recorded. Occasional rock outcrops were noted including ‘stepped’ rock features protruding from the thick bed of sand. The sedimentary environment in the shelter of the peninsula would afford protection for archaeological material although the depth of the sand would make exploration difficult (Figure 32).

The extant shell middens and archaeological remains around the current Janaba Bay demonstrate its importance to humans at some point during the last 6000 years. However, it should be noted that the largest concentration of sites and the largest shell mounds are located around the inner edge of a shallow embayment on the east side of Janaba Bay that has now been filled with sand to create a dry-land surface, rather as at Khur Maadi (see above). On the more exposed south-facing shorelines, as in the vicinity of JE0004, our currently available radiocarbon dates from this site suggest that its main period of use was for only a limited duration. Perhaps this reflects relatively unstable ecological conditions for *Strombus fasciatus*, possibly compounded by minor tectonic movements, and a relatively short-lived period when abundant supplies of *S. fasciatus* were available. The presence of an earlier shoreline in 2m of water that could have been a suitable platform for shell middens increases the potential for submerged archaeology. However, the hydrodynamic conditions were probably not conducive either to abundant supplies of littoral molluscs or to the preservation and discovery of archaeological material, although there remains the possibility that locations with the right conditions for site preservation exist elsewhere in Janaba Bay.

### *Qumah Bay*

Qumah Bay, the main inlet on the south side of Qumah Island, was first investigated in 2006. The north end of the Bay is a wide sandy beach with a shallow, gently sloping seabed. The southern end of the Bay is deeper and flanked by two rocky peninsulas. The depth of water along the edges of the outer bay at the base of these promontories is 18–20m, and the seabed is covered with sand (Figure 33).

The promontories extend beyond the mouth of the Bay, where they dip below the water, reducing in height until they become covered by the sandy sea floor. The Ra’s al Mazlaq promontory (Slick Point) was recorded underwater to a depth of –40m in 2006 after which point it became covered by silty-sand (Bailey et al., this volume). South and east of Ra’s al-Mazlaq the seabed carries on dropping into deeper water.

The diving fieldwork conducted in 2008 continued inspection around Qumah Bay to characterise the seabed and look for indications of palaeo-landscape features that might preserve archaeological remains. The floor of the inner bay is covered in sand and silty sand. Much of this derives from the adjacent cliffs or from the coral terrace (Figure 34) and was deposited following marine inundation. The cover it affords can protect the palaeo-landsurfaces and any archaeology therein, but, large quantities of sediment make exploration of what lies beneath problematic.

The archaeological evidence on land is rich with prehistoric shell middens that have been recorded all around the Bay. These are located on coral terraces next to the water. The terraces, which measure from 3–15m above sea level, are truncated by the sea to form overhangs or cliffs. Comparable wave cut features were recorded when diving underwater below the south east promontory of Ra’s al-Mazlaq in 2006 and more were recorded along the south west promontory in 2008.

The area has demonstrably been attractive to humans while sea levels have been stable over the last 5,000 to 6,000 years. To assess the potential for earlier occupation we need to consider a land with a lower sea level. The depth and contours of the palaeo-landsurface below the modern sediment are yet to be fully characterised but sufficient bathymetric information exists to define a circular depression to the south east of the bay. This lies between Qumah Island, Dumsuq Island to the south and Ra’s Shida, on Farasan al Kabir, to the east. An echo sounding survey by the *MV Midyan* during the fieldwork of 2006 recorded a depth of 115m towards the centre of the depression. This is 70m lower than the seafloor which encircles the deep water. The surrounding seabed forms a flat shelf approximately 45m below present sea level. The depression would therefore have been a basin when sea levels dropped 45–50m and it became cut off from the sea.

Given our knowledge of sea-level change, separation from the sea could have occurred for long periods between 50,000 and 10,000 years ago. It is possible then that the sea water trapped in the basin would eventually have evaporated and been replaced by fresh water, given favourable climatic conditions. Any resultant wetland or lake would have been a focal point for a range of resources and human activity.

Towards the mouth of the Bay the seabed deepens. Here, as recorded at Ra's al-Mazlaq in 2006, more of the submerged relic land surface is exposed. Approximately 300m north of the western peninsulas and Ra's al-Mazlaq, the sloping sand around the edges of the bay gives way to cliff walls (Figure 35). These are punctuated with notches and caves incised by the sea when levels were lower.

### *The western peninsula and rock shelter RS QB01*

A series of well defined marine notches and large caves were located on the western side of Qumah Bay, 200–300m north of the point. This submerged cliff contains a number of shelters, the most significant of which, recorded as RS QB01, was found in 9.5–11m of water (Figure 36).

When sea levels were lower, RS QB01 would have provided a good vantage point from which to scan the basin to the south east (Figure 37). As such, the cave has the potential to contain archaeological material. This could have survived in situ until the site was impacted by the final transgression, particularly as it would have been exposed to southerly gales. During such events, any unconsolidated archaeological material deposited within the shelter would have been disturbed and dispersed. Artefacts would have remained associated with the original site only if they were caught in cracks or ravines within or in front of the cave. In the case of RS QB01, the presence of a steep slope below the cave mouth increases the prospect of recovering artefacts. The slope drops sharply to 17m below sea level where another small undercut and cave is cut into the cliff. This feature is now full of sand, trapped shells and fine sediment (Figure 38). Any archaeological material washed from the upper cave during the transgression would have fallen into a less turbulent environment 6–7m below, where it could have been trapped in the crevices.

It is worth noting that the terrestrial cliff above RS QB01 rises close to the 10m contour (see Figures 33 and 34). It is slightly domed suggesting salt tectonic uplift. If the coral platform above the cliff dates to MIS 5, it would suggest the land has risen in the order of 10m. The distance from the base of RS QB01 to the top of the cliff is approximately 20m which would suggest it was formed during the last –20m still stand. This dates to c. 80,000 years ago. The overhang would therefore have offered welcome shelter for about 70,000 years before becoming inundated during the last transgression.

### *The Sulayn al Janub and Mundar Islands*

These Islands are surrounded by shallow tidal water (Figure 39). When sea level was 10m lower, they would have been connected to the Farasan al Kabir. The small islands and adjacent mainland contain shell middens, some of which may have been used when the landmass was joined as one (Figure 40).

The areas selected for diver inspection were sheltered from wave disturbance but subject to currents that could keep fine sediments from obscuring seabed features. The object of the diving at these locations was primarily to search for shell middens that may have grown up next to the earlier bays formed when sea levels were a few metres lower.

### *Sulayn al Janub*

The Sulayn al Janub Archipelago is situated on a large shallow plateau that would have been largely dry c. 8000 years ago. The area under investigation is a ria basin surrounded by three major islands and containing a number of smaller islets (Figures 39 and 41). There are three entrances to the basin, each at different depths, suggesting that they formed sequentially. The one to the south is widest at almost 500m and shallowest, charted at 1–2m deep. The channel to the north east is the deepest, recorded at 5–6m deep and relatively wide at around 250m. The smallest entrance leaves the basin to the north. It is the narrowest at a little over 100m wide and 2–3m deep.

As the sea level rose, the deeper northeast facing channel would have allowed the first ingress of water into the centre of the old landmass at 6000–7000 years ago. A bay would have formed around the inlet. A breakthrough in the north followed as the inlet continued to push its way through the centre of the island. Finally the wide and shallow western channel would have been overwhelmed. The process of inundation would have been steady and would have taken many hundreds of years as the bay migrated inland. The inlet was sheltered from destructive waves and the rise in water levels would have caused minimal disturbance to all but the finest materials. The basin that formed within the three islands is now blanketed with fine sand.

The scenario described above is based on a review of the current bathymetry. However, it is possible that the entrance to the north formed later than its depth implies. This channel is the narrowest and accordingly is subject to the strongest tidally induced currents. These currents have a greater capacity to scour and deepen the channel suggesting it may be deeper now than when it was first formed. Today, the floor of the northern channel is littered with exposed rocks while the seabed within the other two channels is covered in sand. It is the erosive characteristics of the northern channel that make it significant for search and investigation.

The dive search around the northern entrance identified varying depths of sand where the thickness increased away from the centre of the channel. Few scatters of shells were noted, although burrows excavated by crustaceans and small fish revealed a thick deposit of shells beneath a thin veneer of sand.

### *Mundar Island*

Mundar Island is oriented east to west and lies in an area of shallow water between Farasan al Kabir and Saqid. The head of the large bay, within which it sits, feeds into a channel that runs between the main islands. Tidal channels pass to the north and south of Mundar. The shallow, sand-dominated seabed is not dissimilar to that recorded at Sulayn al Janub, as is the proximity to shell middens on the present day shoreline, which are found on the island and ringing the larger bay. The large carnivorous gastropods, *Chicoreus* and *Pleuroploca*, are particularly abundant in the shell middens on the island.

Visual inspection of the seabed was conducted on the east side of a south facing peninsula which lies towards the east of the island (Figure 42). The peninsula itself hosts at least six shell middens on the present shoreline. Below water, a wave-cut coral platform is exposed. In a depth of 2m the relic coral surface is stripped bare of sand where it is subject to the greatest wave action. The platform is crossed with small gullies within which shells have accumulated, and grey silt is evident in depressions that run at right angles to the beach. Downslope in a depth of 4m, the covering deposit gets thicker, and shell deposits are exposed beneath a relatively thin layer of sand. No evidence of shell middens was found but the sand and fine silts suggest that stable deposits may remain protected in deeper water and in gullies.

Evidence of human occupation in the form of shell middens on and around the Sulayn al Janub Islands and Mundar Island demonstrates the importance of these areas for exploitation of marine molluscs at current sea levels. Both these areas would have presented comparable environments across larger expanses of land for many thousands of years before becoming inundated. The areas would therefore have been suitable for exploitation in a similar way during that time.

The sediments that built up within and around the bays in the latter stages of the final sea-level rise may have covered and protected sites of human activity such as shell middens. These archaeological features are difficult to identify where they are concealed in sand, but could be visible where the sand is gently winnowed from the larger shell materials.

### *Islet of Dahek, Khur Maadi Bay and the Haylar Cliffs*

The islet of Dahek, the narrows of the Khur Maadi Bay and the Haylar Cliffs of Shijajn were additional sites inspected by diving. The locations were selected because of their differing physical characteristics. Dahek is an isolated islet approximately 8km offshore (Figure 43). It would have been a distinct feature in the landscape when sea levels were lower but has no immediate association with terrestrial archaeological material. The narrows of Khur Maadi Bay opened up when sea level passed over them. Prior to this, the area would have supported a large closed bay which would have been favourable for the exploitation of marine resources. The seabed below the Haylar Cliffs of Shijajn drops into deeper water at the northern end of the 'Khur '. Within a few hundred metres offshore, a depression drops to a depth of over 100m. Like the Islet of Dahek, the Haylar Cliffs would have been adjacent to deeper water and a range of resources that differed from the shallow bays. All these three sites show evidence of earlier wave and solution cut features but the seabed at each site is dominated by thick deposits of sand masking potential archaeology.

### *Evaluation*

The dive operations targeted locations around the coastline, within bays, around headlands and near notable outcrops. The dominant feature in all locations examined was sand. Accordingly, attention was focused on areas were the sand cover might be thinnest or absent. These included promontories and the seabed adjacent to channels.

A number of sites were identified where removal of sand suggested the possibility of revealing archaeological deposits. The first is Qumah Bay where the caves and crevices below rock shelter RS QB01 would make an ideal trap for dispersed archaeological artefacts. This area warrants excavation, recording and sampling for human artefacts or evidence of a human presence.

The other areas of interest are the Sulayn al Janub archipelago and Mundar Island. The sand deposits around both have the potential to conceal archaeological evidence. Between the two, the site which presents the best opportunity to inform our understanding of archaeological potential is the northern channel that exits the Sulayn al Janub archipelago. Here, evaluation trenches should be opened across one side of the channel to characterise the internal structure, to reveal any stratigraphic gradients and sample shells or other potential evidence of human activity.

In addition to investigation by divers, geophysical survey including swath bathymetry, side scan sonar and sub-bottom profiling should be conducted within Qumah Bay. It would also be beneficial to deploy these techniques of acoustic survey in Janaba Bay and around the Sulayn al Janub archipelago across areas which would once have been suitable for human exploitation and the location of shell middens.

The influence of salt tectonics on the movement of the coastline and the variation in depths of submerged wave or solution cut features is another issue that should be addressed. Further recording and dating of material from the sites identified here would help to calibrate the dates of potential shelters that have now drowned.

### *Conclusion*

The underwater survey has provided an insight into eleven different drowned landscape locations around the Farasan Islands. Their ability to attract human activity and preserve any cultural evidence has been assessed. The research has led to the conclusion that there is potential for the deposition of archaeological material when sea levels were lower and that conditions exist where such material may remain protected. Collectively, the different site types have provided data that is leading to a better understanding of the geomorphological processes below the waterline. This in turn is providing a valuable tool to help predict the archaeological potential of locations with similar characteristics. However, more work needs to be done to develop the assessments presented in this report and there is a need to validate the results with geophysical and archaeological investigations.

### *General Summary and Conclusions*

The fieldwork so far has revealed an extraordinarily rich, little known and little investigated archaeological sequence in a key area for understanding the pattern of human dispersal between Africa and Arabia and the nature of changing coastal adaptations to changes in sea level. Much of the data is still being analysed but we have systematic information on the distribution of an unusually large and well preserved body of shell mounds, believed to be of mid-Holocene or later date, which is consistent with the small number of radiocarbon dates currently available, and many other surface finds of varying age in hinterland locations

The shell middens alone are estimated to number approximately 1000, and represent one of the largest, most concentrated and best preserved groups of mounds anywhere in the world, equivalent to the largest groups of shell mounds in northern Australia, Brazil and Japan. Their intact state is due to the relative isolation of the Islands, low population density, and lack of development. However, a rapidly expanding programme of new development and civil engineering works, including the proposal to build an airport, is already causing minor damage to some sites, and will lead to big changes in the future, so that there is urgency to investigating as much as possible, getting the sites protected, and promoting their significance to the local community.

Small-scale excavations into selected mounds have produced large quantities of shell suitable for a variety of geochemical and geophysical studies, some fish bone, and variable quantities of sedimentary and ashy matrix. Identifiable artefacts are so far very limited in number. This is probably due to the inherently low density of artefact material in rapidly accumulating shell deposits, the limited amount of excavation, and the scarcity of local stone raw material.

The dominant mollusc species in the excavated shell mounds and in the great majority of the shell middens inspected, whether tall mounds or surface scatters, is a small gastropod, *Strombus fasciatus*. This species thrives in shallow, sandy sheltered bays, where it can easily be collected in very large numbers by wading in shallow water. Other species present in some numbers are the pearl oyster, *Pinctada cf nigra*, a variety of bivalve species that attach themselves to rocky surfaces, notably *Chama reflexa*, and large carnivorous gastropods of the murex and conch families, notably *Chicoreus sp*. and *Pleuroploca sp.* Variations in the presence and proportions of these species in different middens probably reflect local variations in habitat conditions on different stretches of shoreline. But they may also relate to the function of different middens, the length of time people stayed there and the numbers of people involved. Some shell middens appear to have been the focus for collection or dumping of *S. fasciatus* shells almost to the total exclusion of any other activity, such as the excavated mound at Khur Maadi (KM1057). Other sites, such as the excavated Janaba Bay shell mound (JE0004) appear to have been used for a wider range of activities, with a greater proportion of other mollusc species, more fish bone, and evidence of hearths used in the preparation of food, and site maintenance activities involving the clearance and displacement of discarded materials.

Shorelines formed at current sea level are very dynamic both geologically and ecologically, because of local tectonic warping by salt doming and changing regimes of erosion and sand accumulation at the shore edge. This is likely to have had a significant impact on the extent of suitable habitat for *S. fasciatus*, and there are good reasons to think that these molluscs were available in much greater abundance at certain periods in the past than today. Many of the large mounds are located around the edges of extensive shallow bays which would have supplied large quantities of *S. fasciatus* but were subsequently filled in with sand, displacing the old shoreline and its associated shell mounds some distance inland from the modern shoreline. This infilling is due either to the natural process of shoreline evolution with progressive accumulation of sediments eroded from the adjacent landscape or to minor crustal movements caused by salt doming, or both factors working together. The implication is that there have been considerable variations in the quantity of molluscs available for human consumption at different periods during the past 6000 years as well as significant variations between different types of shoreline. Some uplifted areas may give us an insight into early Holocene or even late Pleistocene shorelines and associated archaeology that were actually formed when sea level was below the present. Earlier shorelines, however, are now mostly submerged.

We are pursuing both these lines of enquiry – tectonically uplifted and submerged shorelines. In particular we are building on the results of deep diving experiments in 2006, which demonstrated the presence of deeply submerged palaeoshorelines. In this year's research programme we have carried out underwater survey in shallow water depths, which are easily accessible with simple diving technology. These are coastal landscapes that we expect would have been occupied at earlier periods when sea levels were lower than the present. We are concentrating on locating areas of the seabed where the water currents are not so vigorous that they have eroded away the old land surface, nor so calm that they have allowed a thick build up of recent marine sediment. We have not yet identified any unequivocal shell middens underwater, but it is likely that even in calm underwater conditions, consolidated shell midden deposits would have undergone some degree of erosion and deflation by water action during and shortly after inundation by sea level rise. We have identified two especially promising locations worthy of more detailed investigation, and we expect to continue this work in 2009.

Other sites identified in hinterland survey include Islamic, pre-Islamic, and earlier prehistoric material. Some of the ceramics are probably prehistoric in age, and other sites appear to pre-date the use of pottery. Distinctive stone raw materials (such as siliceous or volcanic rocks) are rare on the Islands, although it is clear that fossilised coral and a hard, fine-grained whitish-yellow limestone are both workable raw materials and have been formed into artefacts. One such specimen is a large worked flake that would not be out of place in a Middle Palaeolithic or even a Lower Palaeolithic context, and a small quantity of similar material has been identified in the same general area on high ground in the north west part of Farasan Island, an important indication that the Islands were occupied at a much earlier period when joined to the mainland during periods of low sea level. However, the extent of human activity on the present land surface of the Islands during these earlier periods was probably very limited, and it is unlikely that more substantial Palaeolithic sites will be found on the islands because of the lack of suitable stone for working artefacts and the lack of abundant water supplies and diversity of resource more generally. More promising locations for such sites are likely to be found on the now submerged landscape.

Dating is of central importance to this programme, but radiocarbon dating is proving problematic. Much of the midden charcoal is finely comminuted, suitable samples are rare, and some of those have turned out to contain insufficient carbon even for AMS dating, while shell samples are subject to various errors or potential baiases. We are continuing to research this problem, developing an amino acid racemization stratigraphy for the shell mounds, having established that a number of shell species that are common in the archaeological deposits are suitable for this purpose, and looking at the possibilities of OSL dating as an additional tool.

### *Acknowledgements*

We thank HRH Prince Sultan bin Salman bin Abdul Aziz, President of the General Commission for Tourism and Antiquities, Riyadh, and Professor Ali Al-Ghabban, the Vice-President, for granting a permit for fieldwork, for their interest in our work, and for the participation of their staff. We also thank General Hussein al Amri and Lieutenant Commander Hamad al Bor of the Saudi Border Guard, Farasan Islands, for making available their staff and facilities for the underwater survey. For additional assistance we thank the Governor of Farasan, Abdulrahman Mohammed Abdulhak, and his staff, and Eng. Misfer Mohammad Alwetaid of the Farasan Municipality and his staff. Abdullah Al Zahrani acted as our official representative in the field as well as contributing to the fieldwork. Eva Laurie undertook the identification of the marine molluscs, Mark Beech the identification of the fish bone material, and Anthony Sinclair the identification of lithics. We also thank Graham Oliver, National Museum of Wales, for additional help with identification of marine molluscs. We also thank the Hampshire and Wight Trust for Maritime Archaeology for provision of underwater archaeological and audiovisual equipment. This research was made possible through grants from the British Academy (grant LRG-45481) and the Leverhulme Trust (grant F/00 224/AB).

**Table 1. :** Radiocarbon dates

| Lab No. | Provenance | Sample Material | $^{13}C/^{12}C$ Ratio | Conventional radiocarbon age BP | Calibrated age cal BC | 2σ range cal BC |
|---|---|---|---|---|---|---|
| Beta-255383 | Top JE 0004 | shell | +1.6 ‰ | 5010±50 | 3310 | 3380–3080 |
| OxA-19587 | Base JE 0004 | charcoal | -24.53 ‰ | 4709±31 | 3503 | 3373–3561 |
| Beta-255385 | Top KM 1057 | shell | +2.4 ‰ | 4880±50 | 3070 | 3300–2900 |
| Beta-255384 | Base KM1057 | shell | +1.3 ‰ | 4850±50 | 3020 | 3270–2880 |
| Beta-255386 | Khur Maadi bay (KM1367) | shell | +2.1 ‰ | 3580±50 | 1400 | 1520–1270 |

Calibrated dates are those supplied by the laboratory using the INTCAL04 dataset (Reimer et al. 2004), and taking account of the available regional offset for the marine reservoir effect (Hughen et al. 2004)

**Table 2.** Principal mollusc species. Species are listed in taxonomic order according to SMEBD 2009. Taxonomic names and other information have been checked against a variety of sources: Abbott & Dance, 2000; Bosch et al., 1982, 1995; Dance, 1992; De Bruyne, 2003; Debelius, 2003; Lieske & Myers 2004; OBIS, 2006; Wye, 2003. A: abundant; C: common; R: rare;

| Class | F | Family | Species | Common Name | Size and Habitat | JE0004 | KM1057 |
|---|---|---|---|---|---|---|---|
| **Bivalvia** | | | | | | | |
| | **R** | Cardiidae | Indeterminate | Cockle | Variable substrate, usually sandy | √ | – |
| | **C** | Chamidae | *Chama reflexa* Reeve 1846 | Reflexed jewel box | 6–8cm. Littoral (intertidal ) to 30m depth Cemented to coral or rock surface | √ | √ |
| | **R** | Carditidae | *Beguina gubernaculum* Reeve 1843 | Rudder cardita | Variable substrate | √ | √ |
| | **R** | Arcidae | *Arca avellana* Lamarck 1819 | Hazelnut ark shell | 4–7cm. Low littoral and sublittoral Byssal attachment to coral or rock surface | √ | √ |
| | **R** | Spondylidae | *Spondylus marisrubri* Röding 1798 | Thorny oyster | 6–8cm. 2–40m depth Cemented to coral or rock surface | √ | √ |
| | **C** | Mytilidae | *Brachidontes variabilis* Krauss 1848 | Mussel | Littoral. Byssal attachment to coral/rock | √ | √ |
| | A | PteriidaePinctada | cf. nigra Pearl oyster Gould 1850 | | 6–9cm. Most common at 5–25m depth Byssal attachment to coral or rock surface | √ | √ |
| | C | Plicatulidae | Plicatula plicata Linnaeus 1767 | Kitten's paw | Low littoral. Cemented to coral blocks | √ | √ |
| **Gastropoda** | | | | | | | |
| | **R** | Cerithiidae | Uncertain | Variable cerith | Sublittoral on sandy substrates | √ | – |
| | **R** | Triphoridae | *Viriola corrugata* Hinds 1843 | | | √ | – |
| | **A** | Strombidae | *Strombus fasciatus* Born 1778 | Lineated conch | 2–3cm. 1–3m depth in sheltered sandy bays with sea grass | √ | √ |
| | **A** | Fasciolariidae | *Pleuroploca* cf. *trapezium* Kiener 1840 | Horse conch | 10–20cm. Subtidal sand and reef bottoms down to 6m depth | √ | √ |
| | **R** | Conidae | *Conus ardisiaceus* Kiner 1845 | Cone shell | ~2 cm. Sublittoral. Sand beneath rocks | √ | – |
| | **A** | Muricidae | *Chicoreus sp.* | ?? | ~10cm | √ | √ |
| | **R** | Muricidae | *Rapana rapiformis* Born 1778 | | 5cm. Deep sublittoral. Sandy substrate | | |
| | **R** | Neritidae | Various species | Nerites | 1–2cm. Littoral or sublittoral. | √ | √ |
| | **R** | Fissurellidae | *Diodora singaporensis* Reeve 1850 | | | | |
| | **R** | Trochidae | *Trochus dentatus* Forskål 1775 | Knobbed topshell | 3–5cm. Shallow subtidal, sandy bottom | √ | √ |

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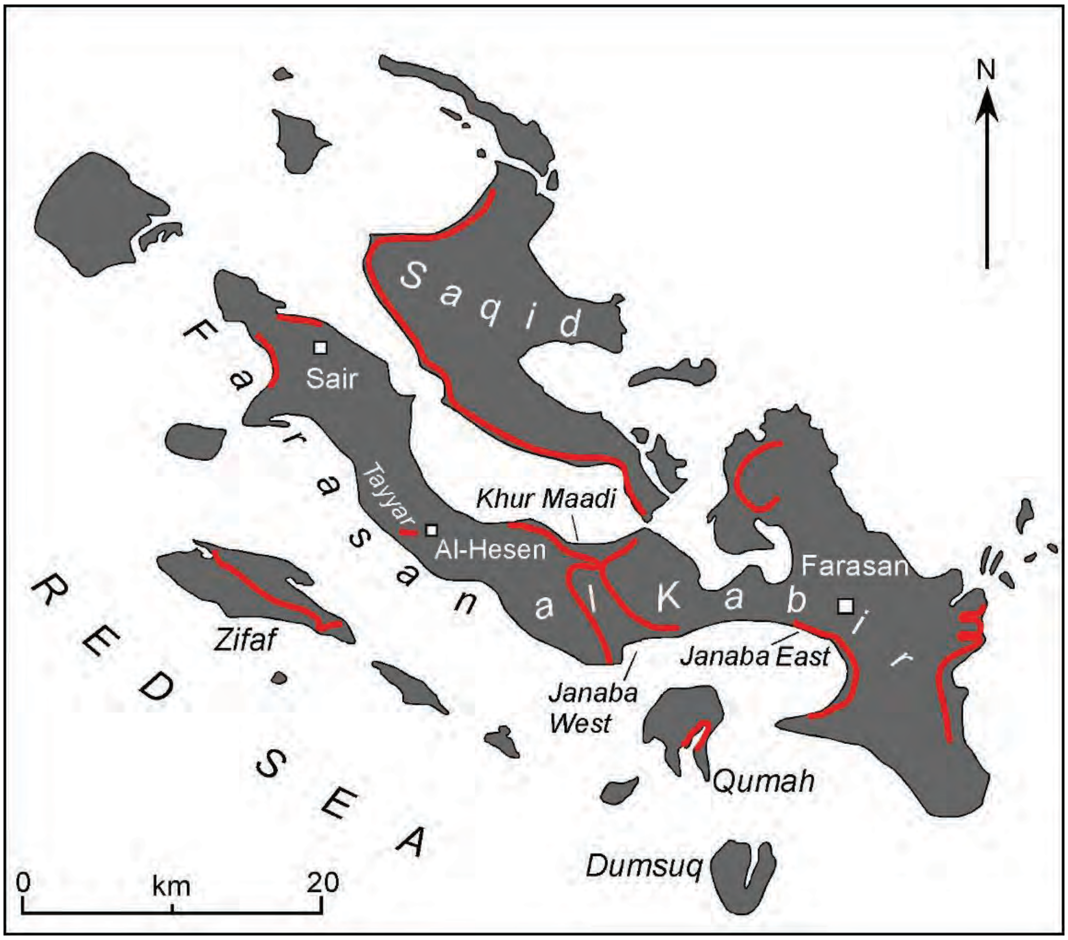


**Figure 1.**: Map of Farasan Islands showing shell mound sites and other places mentioned in the text. Red lines indicate shorelines surveyed in detail in 2008 and main areas of hinterland survey. Most shoreline areas have shell mounds of varying size. The largest concentrations of sites are in the central region of Farasan al Kabir in the Khur Maadi and Janaba West areas, and in the Southeast of Saqid, opposite the Khur Maadi group of sites. Drawn by G.N. Bailey and M.G.M. Williams.

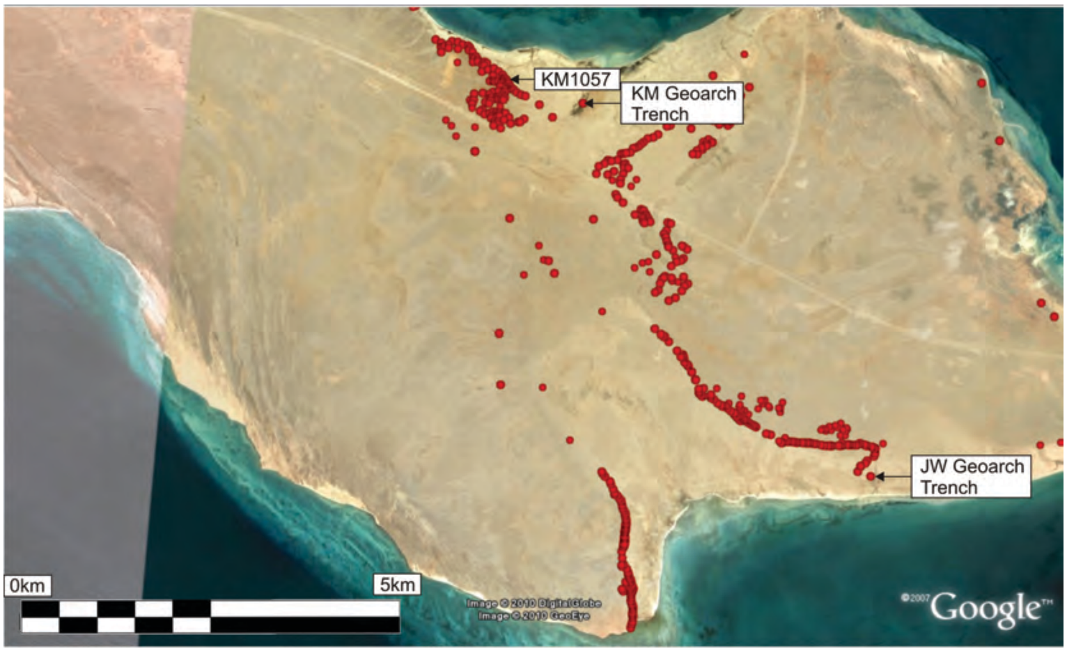


**Figure 2.**: Google Earth image of the Khur Maadi and Janaba West areas showing the large bays that once existed and that have now been filled with sediment. The original shorelines extended some distance inland and the two bays appear to have been connected by a shallow channel. Larger shell mounds are easily visible on Google Earth images. Red dots indicate individual shell mounds and shell scatters or closely related clusters of mounds.

**Figure 3.**: View of Janaba East shell mound (JE0004), viewed from the west, showing the position of the mound directly on the edge of a fossil coral terrace with a deep undercut notch resulting from chemical action by sea water. A block of collapsed overhang is visible on the right. Photograph by M.G.M. Williams, 2008.

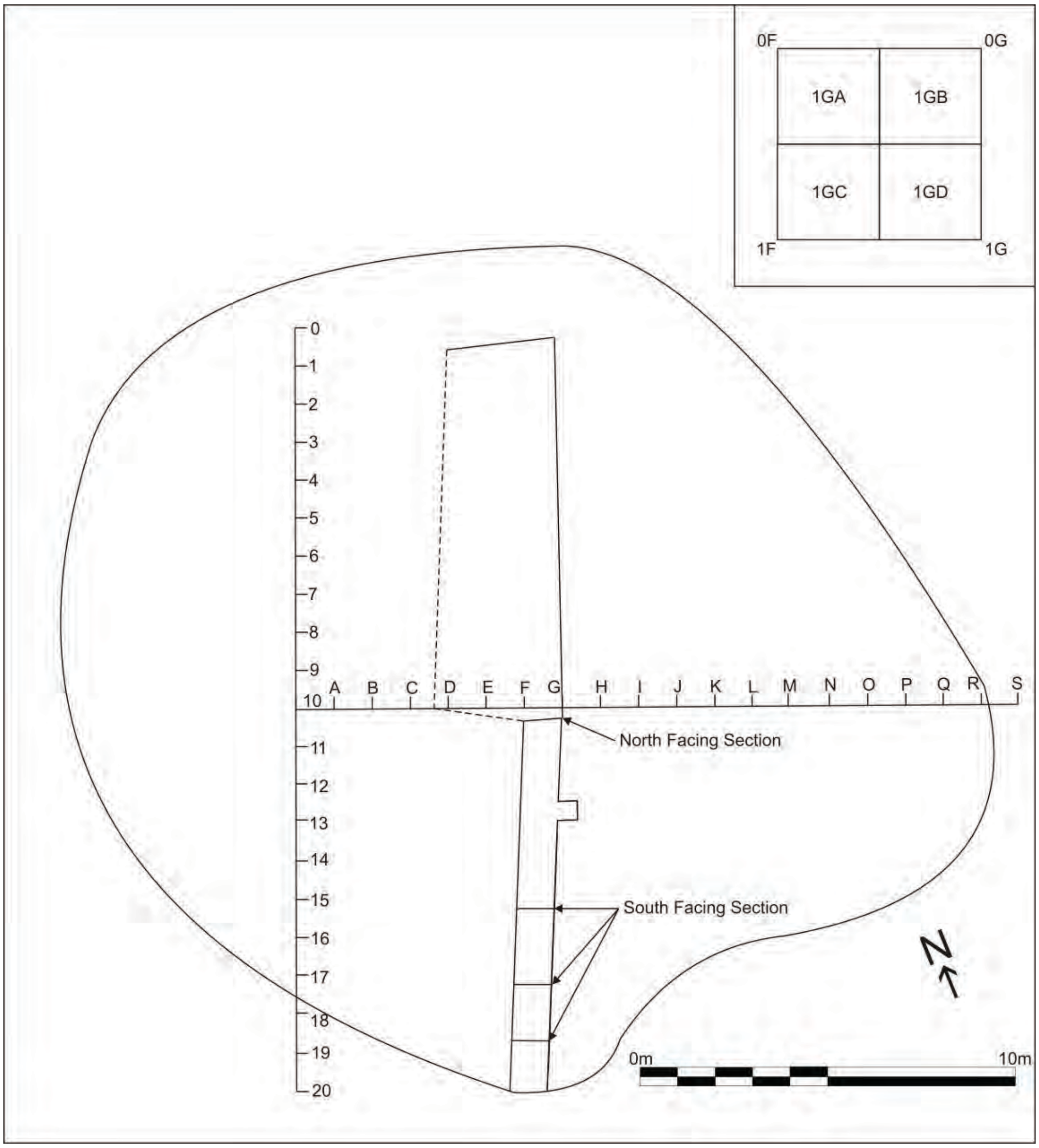


**Figure 4.**: Plan of Janaba East shell mound (JE0004), showing layout of excavation trenches. The dotted line marks the edge of the machine-cut trench, solid lines mark hand-cleaned sections. The inset (top right) shows the conventions for labelling quadrants within a given metre square of the main grid. Drawn by M.G.M. Williams

**Figure 5.**: View of the Khur Maadi mound (KM1057), looking west. The facing flank of the mound shows broad gouge marks typical of damage caused by removal of shell material by bulldozing activity. The figure on the left is cleaning back a section into the undisturbed part of the mound. Photo by M.G.M. Williams, March 2008.

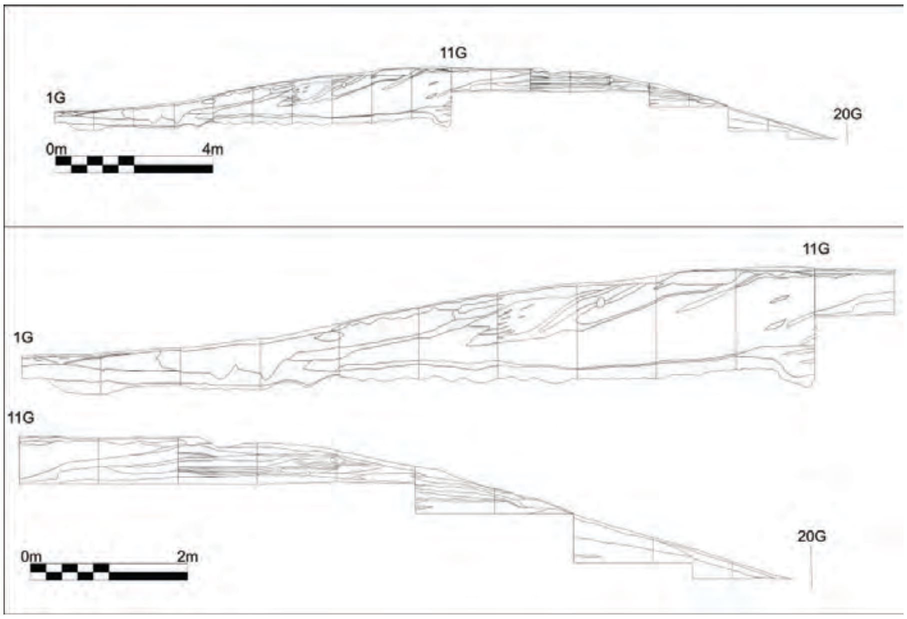


**Figure 6.**: West-facing section of main excavation trench at JE0004. Drawn by M.G.M. Williams.


**Figure 7.**: Distribution of shell mounds in the Janaba East cluster, superimposed on a Google Earth image.

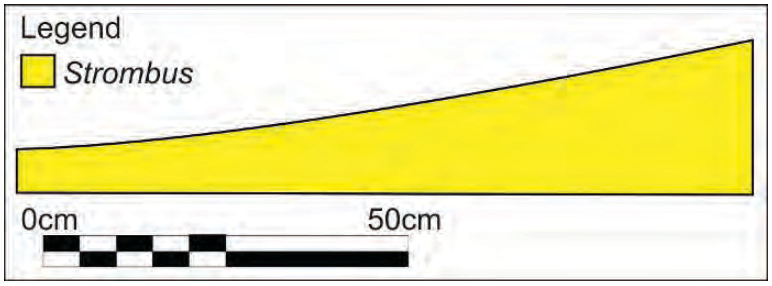


**Figure 8.**: West-facing section of JE0001. Drawn by M.G.M. Williams.

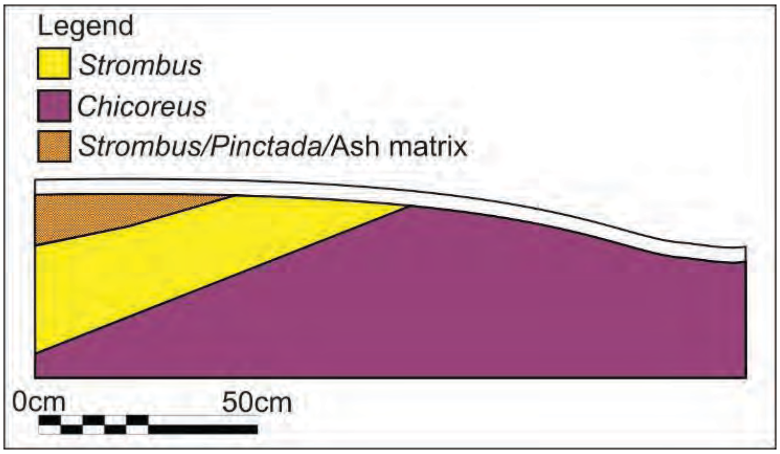


**Figure 9.**: West-facing section of JE0002. Drawn by M.G.M. Williams.

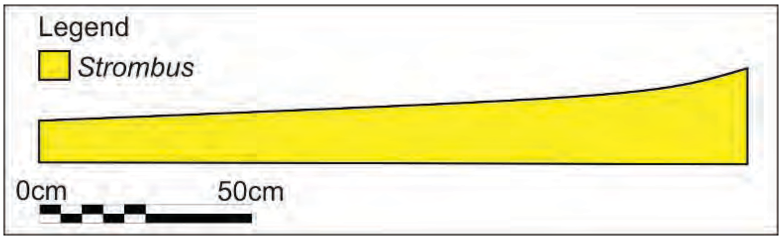


**Figure 10.**: South-facing section of JE0003. Drawn by M.G.M. Williams.

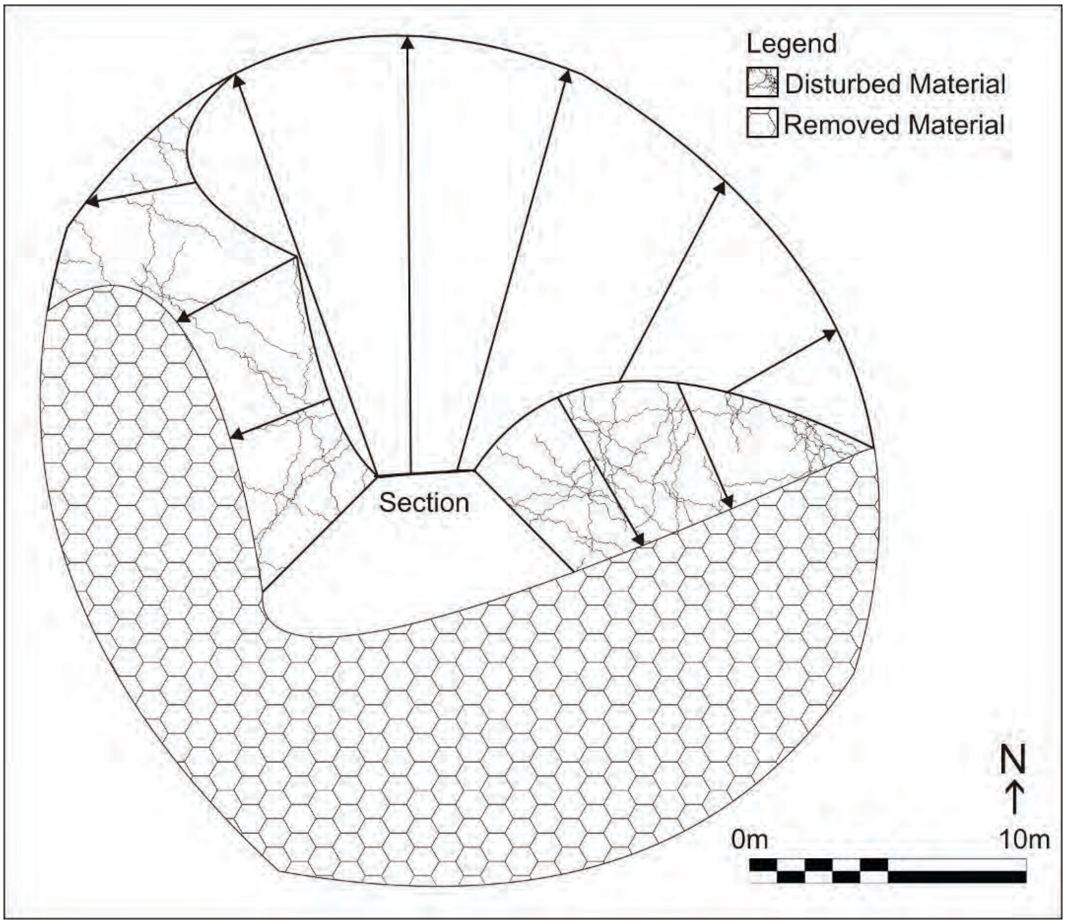


**Figure 11.**: Plan of Khur Mahdi mound (KM1057), showing the location of the section. Arrows indicate the slope direction. Drawn by M.G.M. Williams.

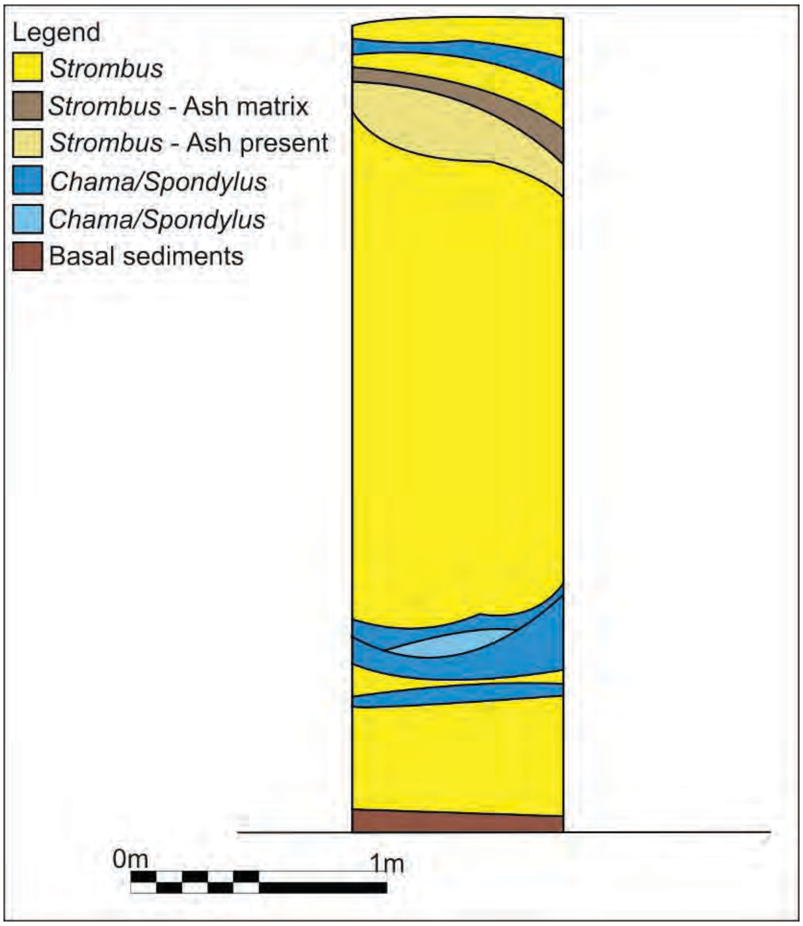


**Figure 12.**: South-facing section of the Khur Mahdi mound (KM1057). Drawn by M.G.M. Williams

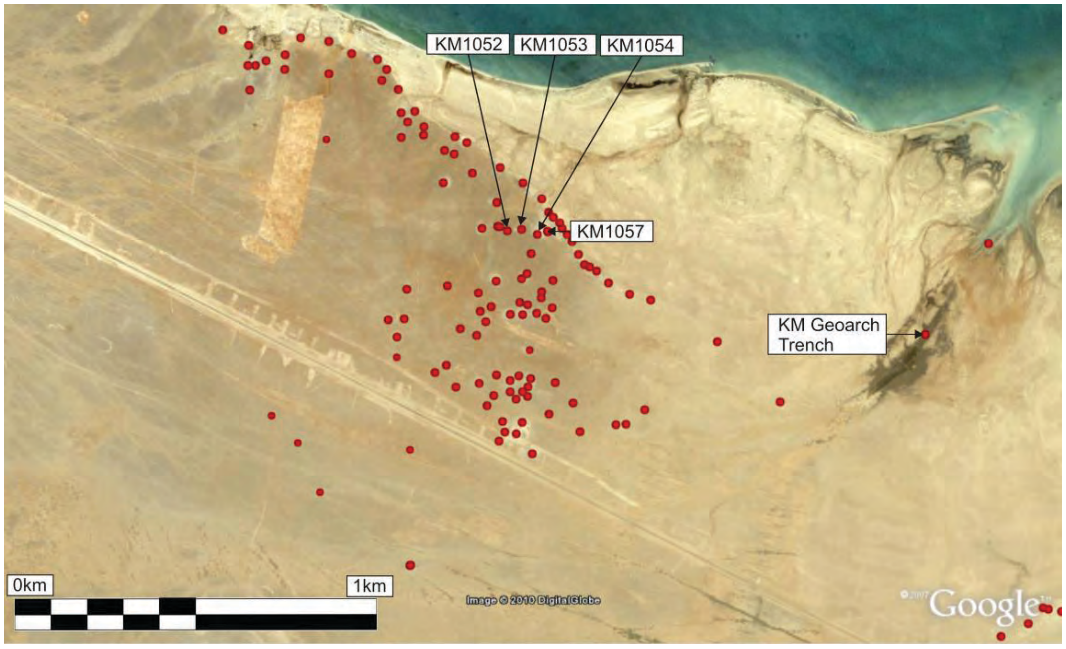


**Figure 13.**: Distribution of shell mounds in the Khur Maadi cluster, superimposed on a Google Earth image, showing excavated mounds and the location of the geoarchaeological trench.

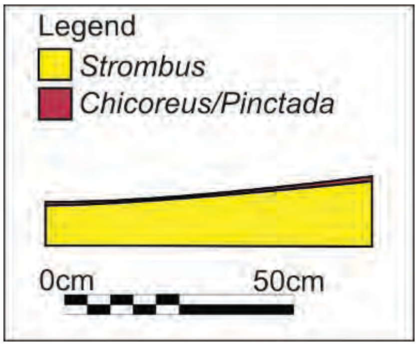


**Figure 14.**: South-facing section of KM 1052. Drawn by M.G.M. Williams.

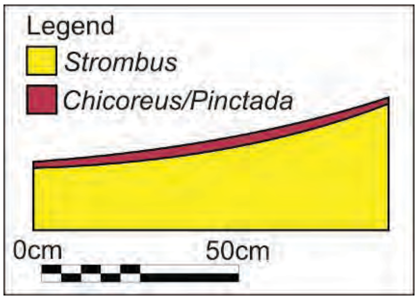


**Figure 15.**: South-facing section of KM1053. Drawn by M.G.M. Williams.

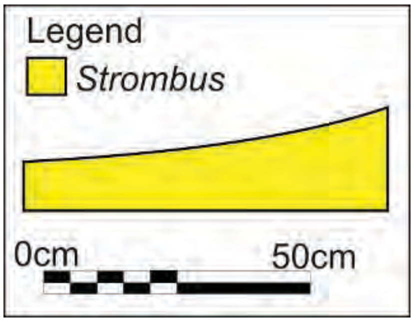


**Figure 16.**: North-facing election of KM1054. Drawn by M.G.M. Williams.

**Figure 17.**: An example of an isolated, inland wave cut coral terrace, located on the west of the peninsula extending north of Farasan town. Scale in 10cm subdivisions. Photo by G.N. Bailey, May 2006.

**Figure 18.**: A view across the uplifted coral terraces at Jebel Tayar in the Northwest of Farasan Island. These terraces are inclined downwards in a westerly direction towards the cotemporary coast. Photo by A. Sinclair, March 2008.

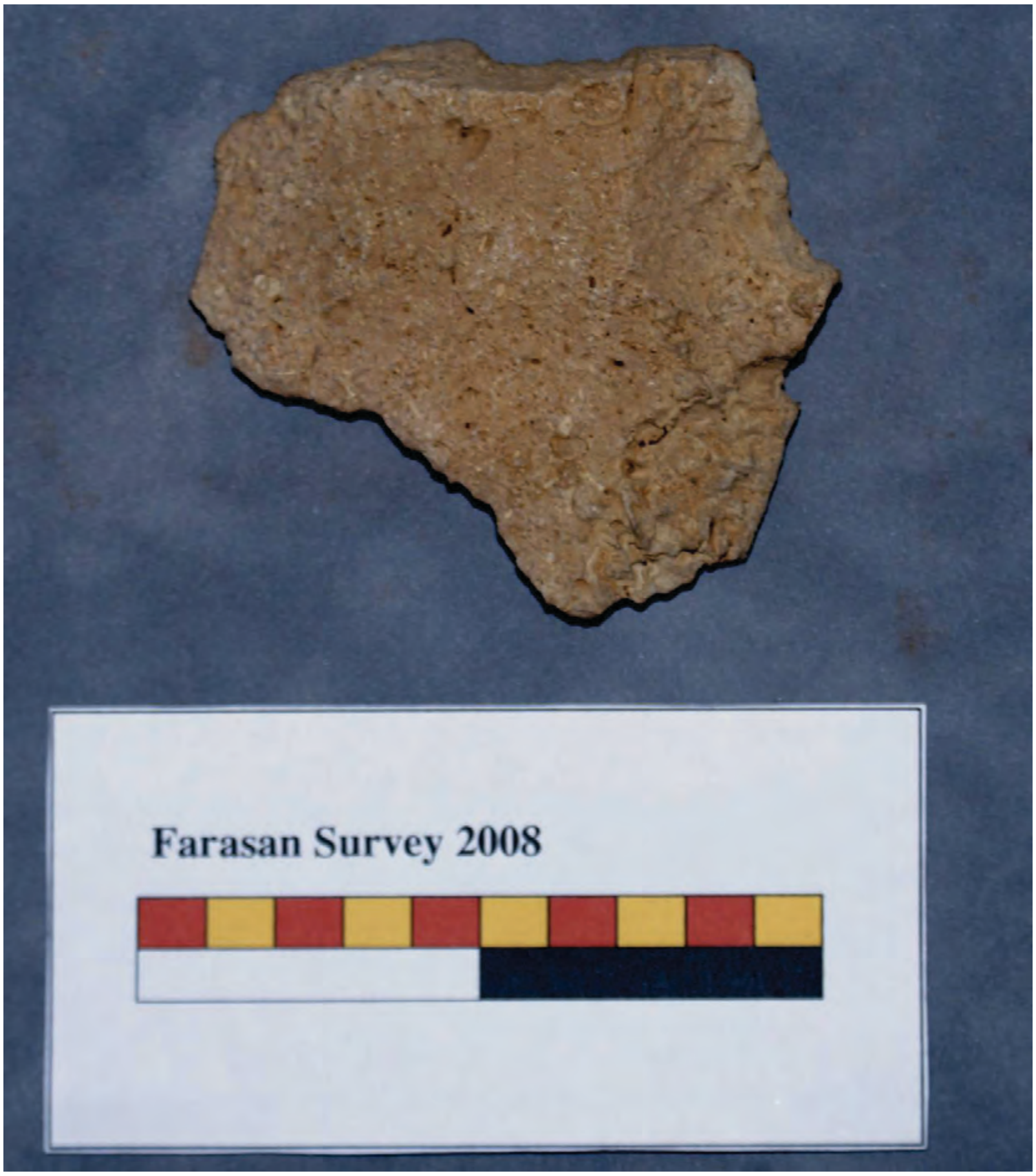


**Figure 19.**: The ventral surface of a large flake found close to Al Hesen in the Jebel Tayar. This flake is made of fossilised coral. The flat platform is visible at the top of the flake, with the bulb immediately below. Scale in centimetres. Photo by A. Sinclair, March 2008.

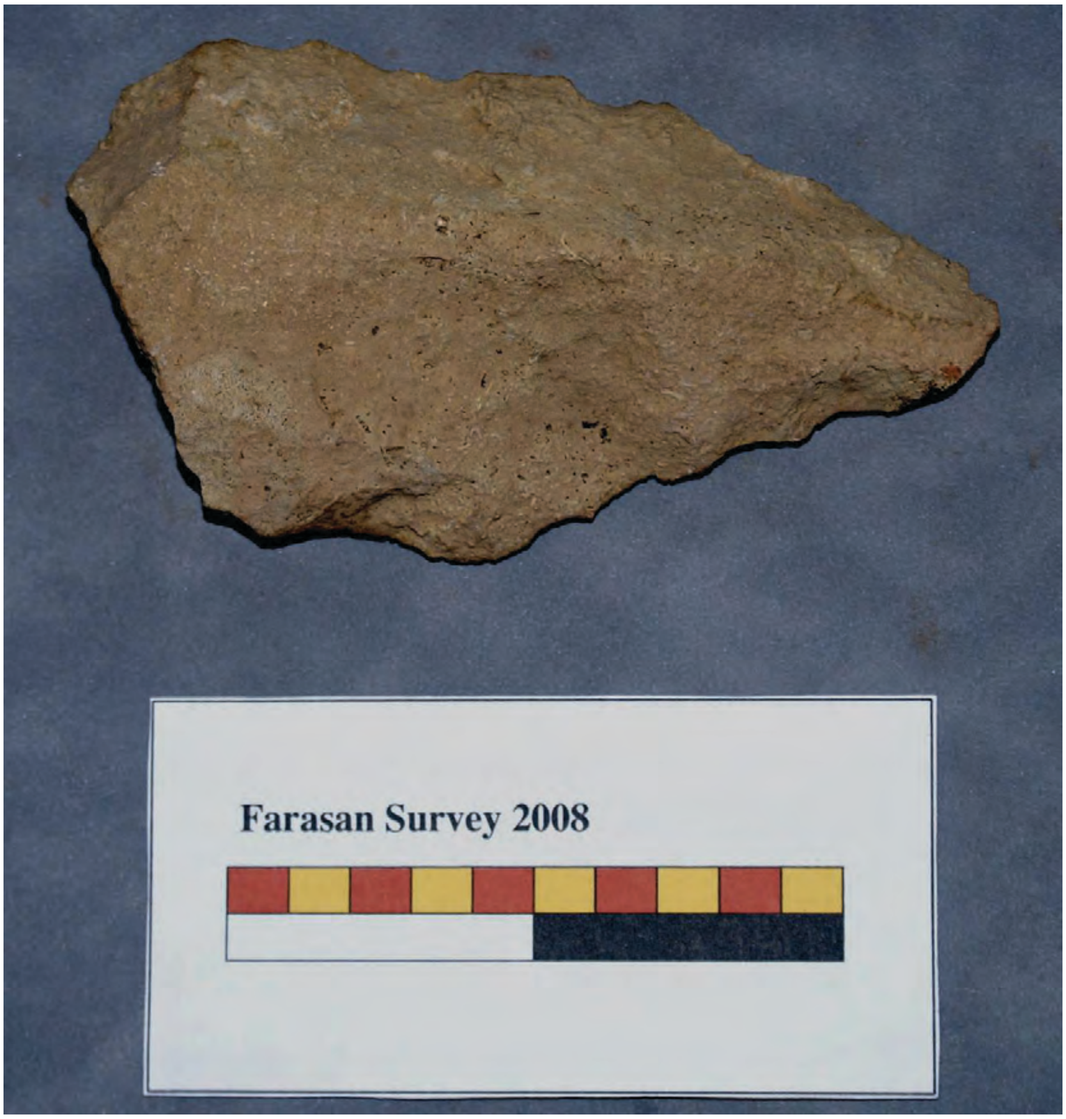


**Figure 20.**: The dorsal surface of a large retouched flake, probably of Middle Palaeolithic age. The platform of the flake is to the left. Scale in centimetres. Photo by A. Sinclair, March 2008.

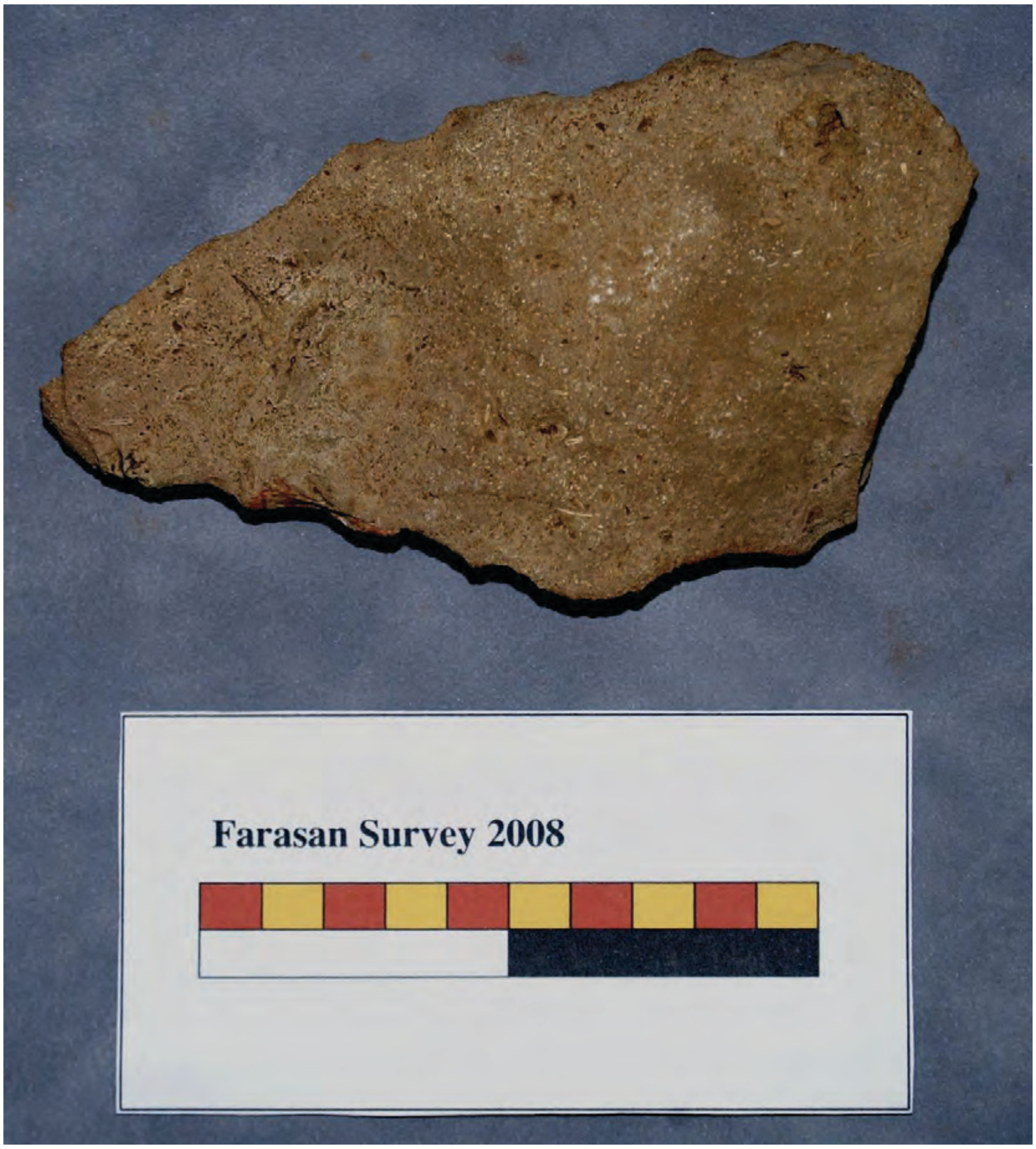


**Figure 21.**: The ventral surface of the large retouched flake shown in Figure 20. The striking platform is to the right, with the bulb adjacent. Scale in centimetres. Photo by A. Sinclair, March 2008.

**Figure 22.**: A close up view of the flat striking platform of the large retouched flake shown in Figures 20 and 21. Photo by A. Sinclair, March 2008.

**Figure 23.**: A close up view of the bulb of the large retouched flake from Figure 21. Photo by A. Sinclair, March 2008.

**Figure 24.**: A close up of the retouched lateral margin of the dorsal surface of the flake shown in Figure 20. At least four large negative flake scars from scalar retouch flakes are visible along this edge. Photo by A. Sinclair, March 2008.

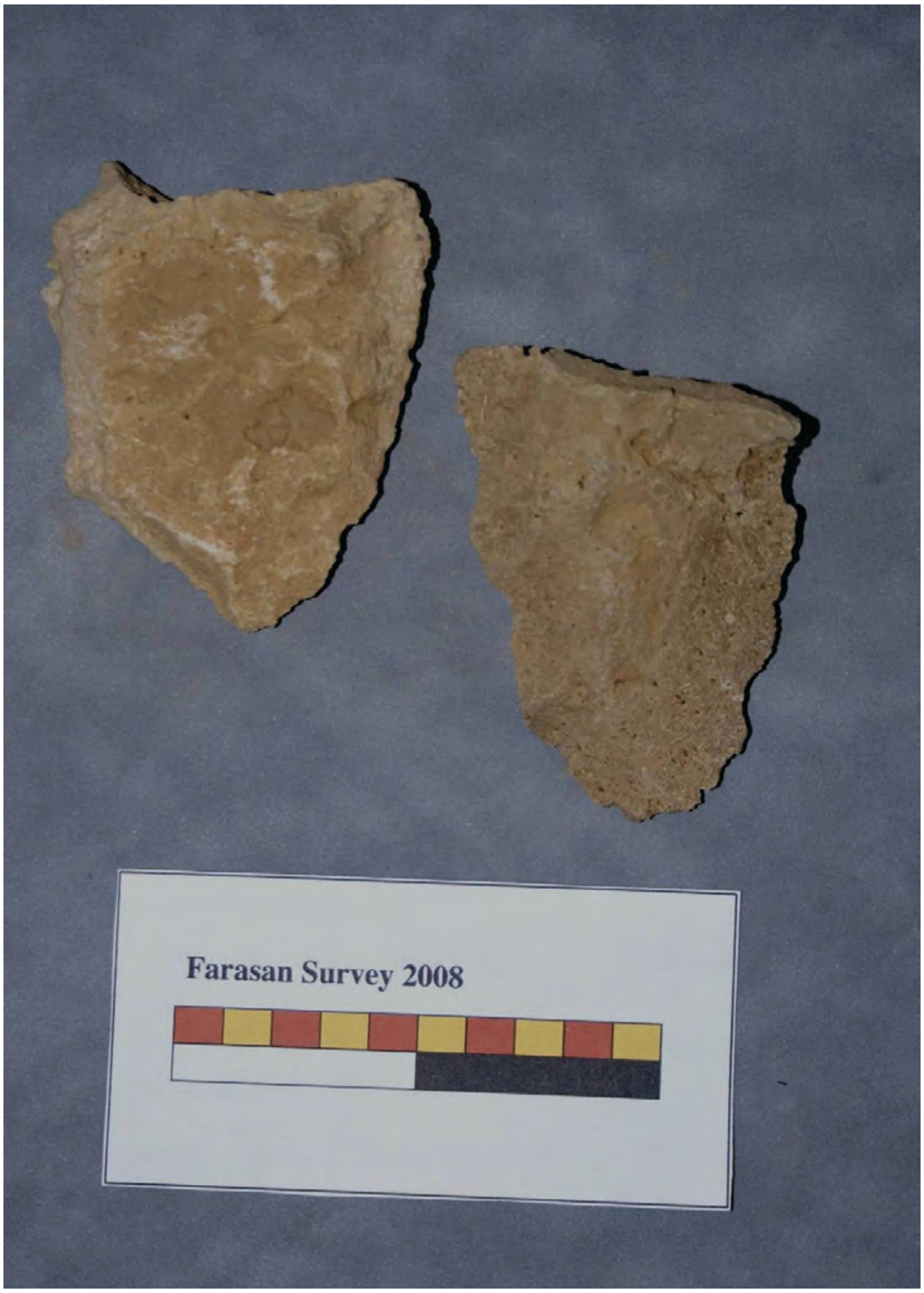


**Figure 25.**: Two flakes found in the Sair region in the north of Farasan Al Kabir. The flake on the left is made from fossilised shell, and possesses many of the technological characteristics of a middle Palaeolithic convergent point. Scale in centimetres. Photo by A. Sinclair, March 2008.

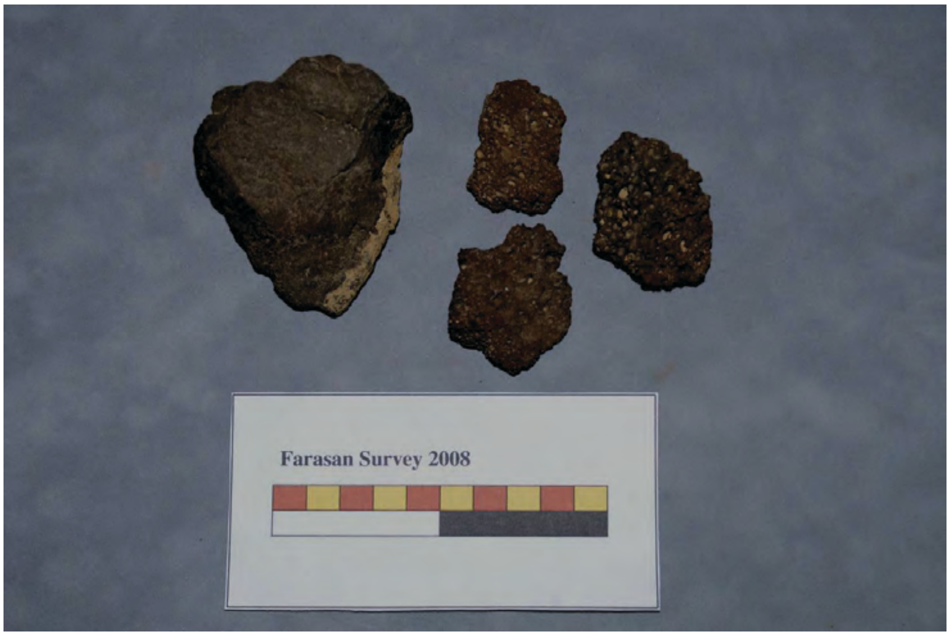


**Figure 26.**: A series of lava flakes and one basalt flake, found on the island of Farasan Al Kabir. Scale in centimetres. Photo by A. Sinclair, March 2008.


**Figure 27.**: An example of a cortical flake made of basalt. This flake was found on Saqid Island. Scale in centimetres. Photo by A. Sinclair, March 2008.

**Figure 28.**: An example of a small hearth feature containing small fragments of shell. This example is one of a number to be found in the valleys between the raised and inclined coral terraces of the Jebel Tayar in the Northwest of Farasan Island. Scale in centimetres. Photo by Nabiel Al Shaikh, March 2

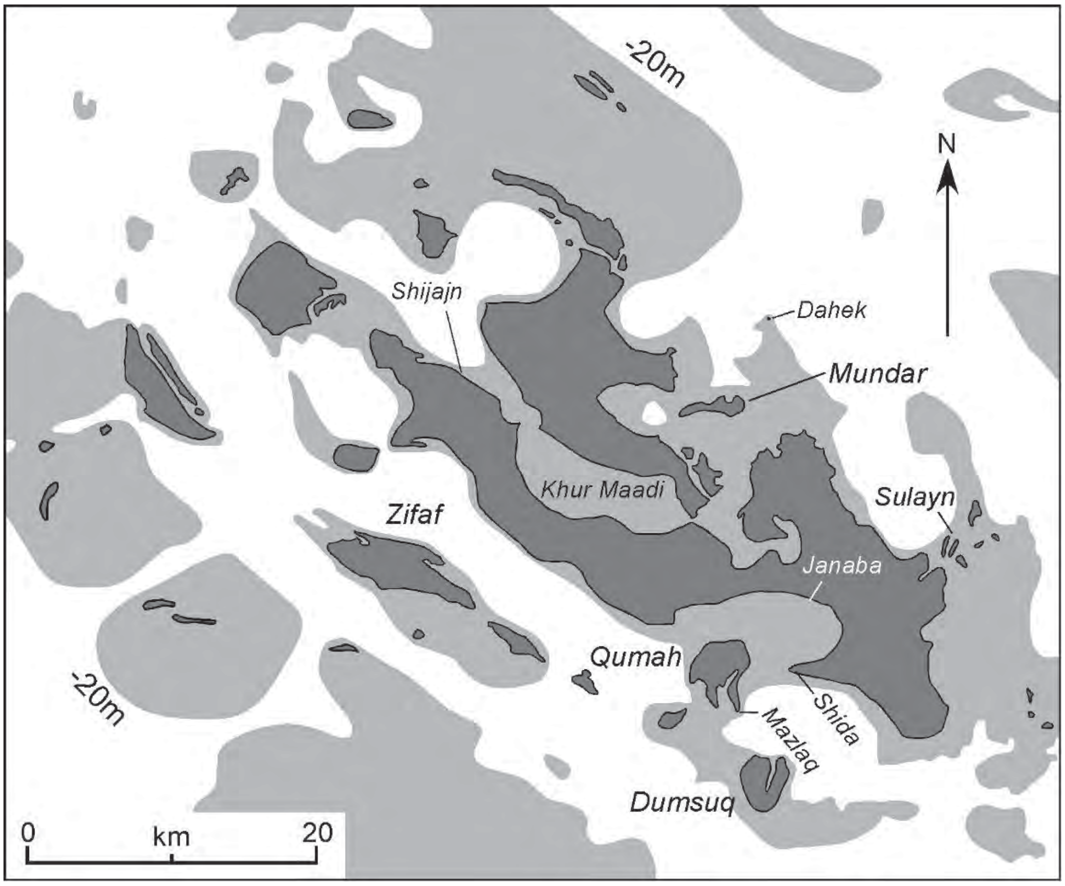


**Figure 29.**: Farasan Islands showing dive sites and other features mentioned in the text. The light grey shading shows areas of submerged landscape down to a depth of -20m. The headland of Ra's Mazlaq is also known as Slick Point. Drawn by G.N. Bailey and G. Momber.

**Figure 30**: Wave and solution cut features now elevated above sea level in Qumah Bay Photo by Nabiel Al Shaikh March 2008.

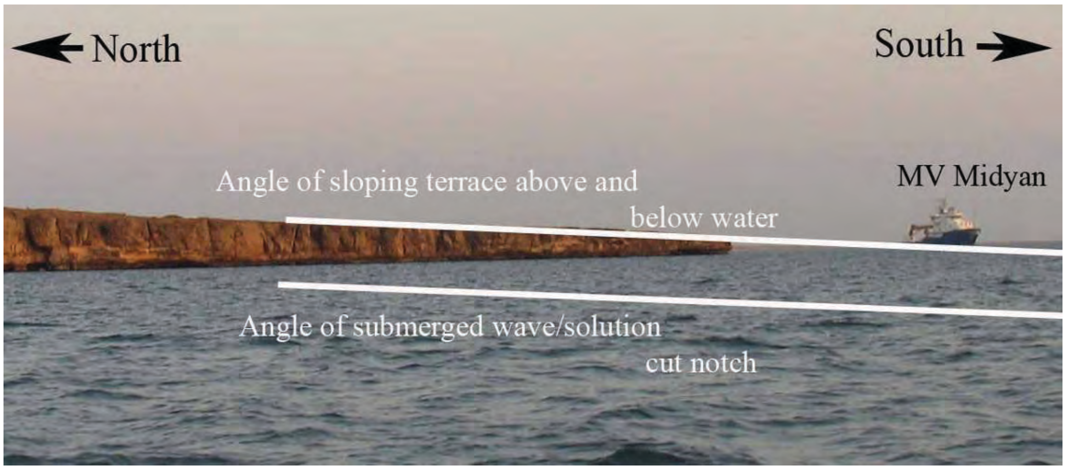


**Figure 31.**: Slick Point looking east. The white line indicates the angle of tilt brought about by subsequent tectonic uplift. The lower line tracks an equivalent wave cut feature at a depth of 9.6m below sea level and dropping to below 20m. The feature runs parallel to the terrestrial dip in a north–south direction. It is believed to relate to a period when sea level was 20m below present. Image prepared by Garry Momber, March 2008. Compare Bailey et al. [2006 report], figure 30.

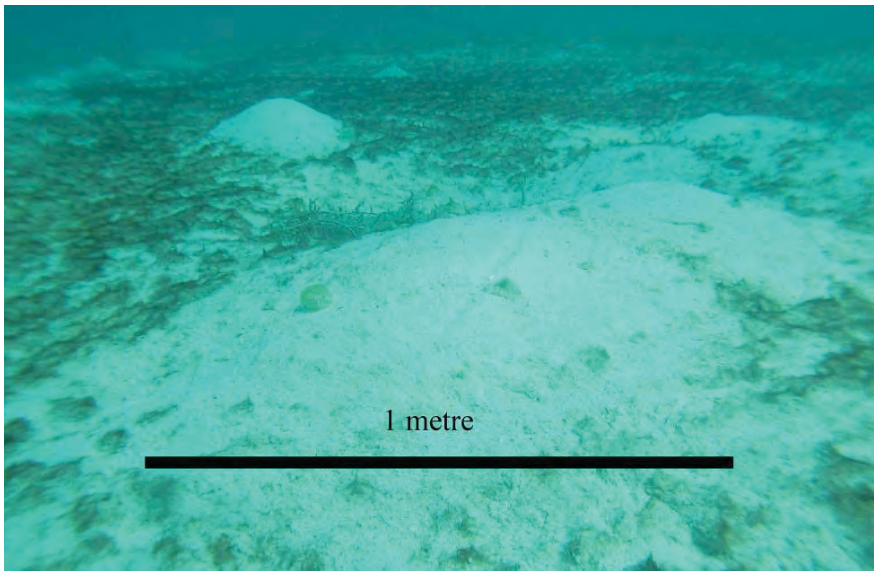


**Figure 32.**: Sandy sea floor in south Janaba Bay with upcasts produced by marine benthic communities. Photo by Garry Momber, March 2008.

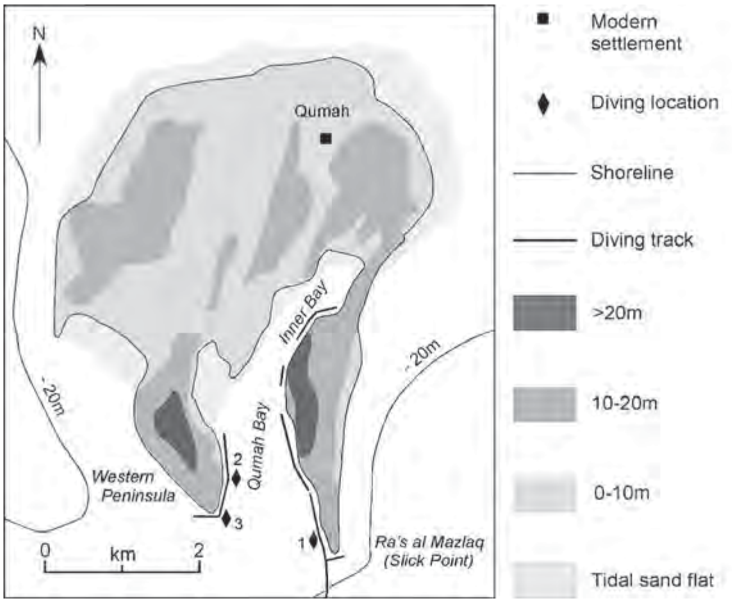


**Figure 33.**: Map of Qumah Island, showing diving locations and places mentioned in the text. Diving locations are: 1. Slick Point; 2. Western Peninsula; 3. Shark Point. The site of RS QB01 is at location 2. Drawn by G.N. Bailey.

**Figure 34.**: West peninsula cliff above submerged wave and solution cut features. Rocks and sandy deposits can be seen falling from the cliff. Photo by G. Momber, March 2008.

**Figure 35.**: Archaeologist Lawrence Moran can be seen swimming past well defined marine notches in 10m depth of water. Photo by G. Momber, March 2008.

**Figure 36 .**: Nabiel al Shaikh within RS QB01 in 10–11m of water. Photo by G. Momber, March 2008.

**Figure 37.**: Garry Momber looking south from RS QB01. When sea levels were lower this would have been a viewpoint over the basin to the south east. Photo by L. Moran, March 2008.

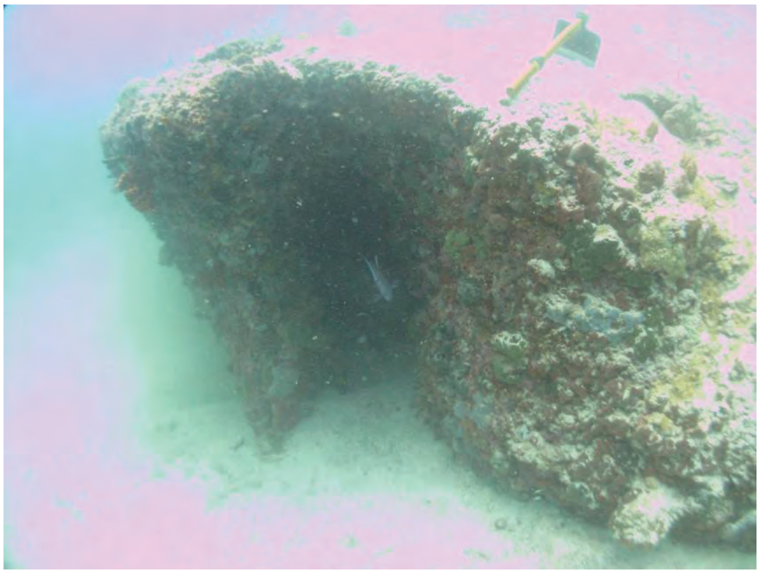

**Figure 38.**: Possible artefact traps in rocks at foot of 16m deep submerged cliff. Photo by L. Moran, March 2008.

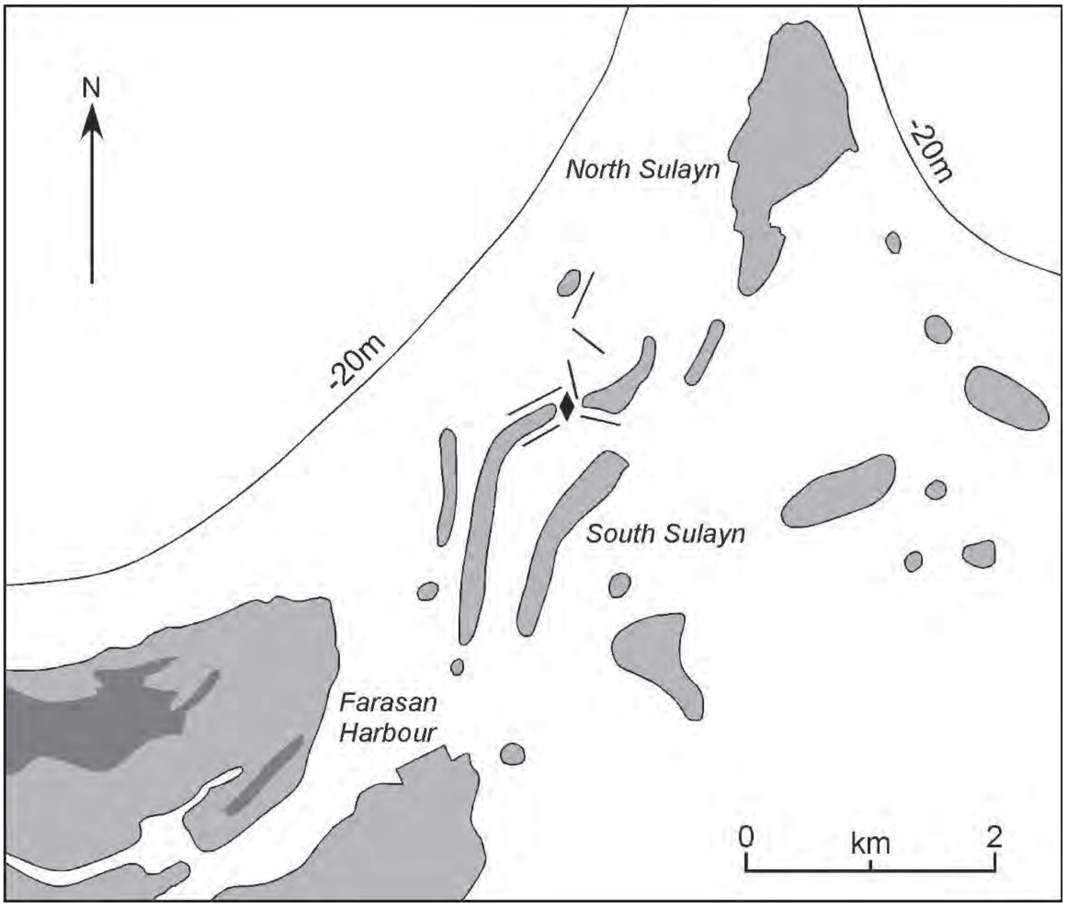


**Figure 39.**: Sulayn Islands showing diving tracks and location of underwater excavation. Conventions as in Figure 33. Drawn by G.N. Bailey.

**Figure 40.**: Substantial shell midden on south end of the Sulayn Island complex. Photo by G. Momber.


**Figure 41.**: Channel cutting north from basin within Sulayn al Janub archipelago. Photo by G. Momber, March 2008.

**Figure 42.**: Bay adjacent to south facing headland investigated on the south of Mundar Island. Photo by Nabiel Al Shaikh, March 2008.

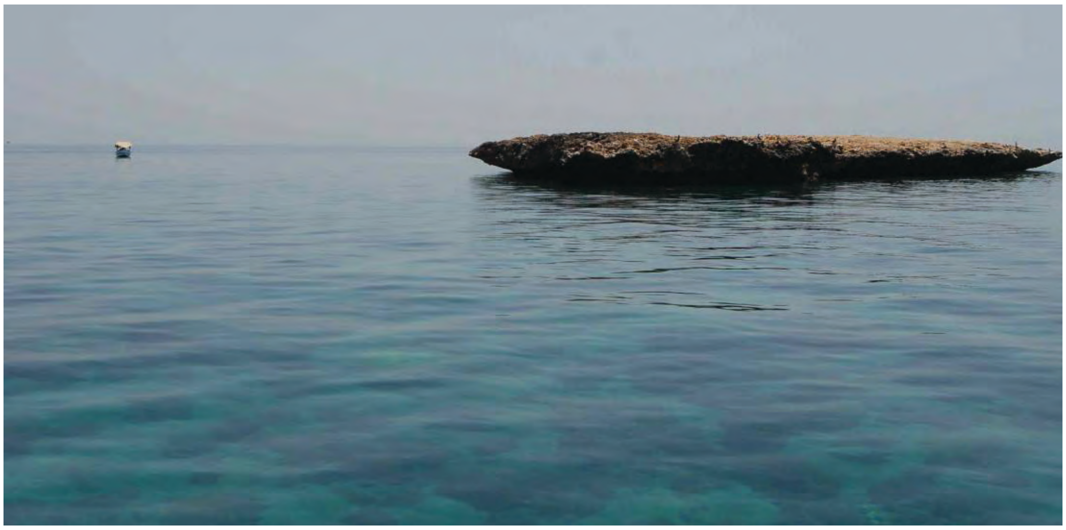

**Figure 43.**: Dahek Island 8 km from the main island. Photo by Nabiel Al Shaikh, March 2008.

***Report on the 2009 fieldwork of the joint Saudi-UK Southern Red Sea Project***

***Report on the 2009 fieldwork of the joint Saudi-UK Southern Red Sea Project***


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***Introduction***

A joint Saudi-UK team took part in fieldwork on the Farasan Islands as part of the ongoing southern Red Sea Project, directed by Geoff Bailey, University of York, and Abdullah Alsharekh, King Saud University under the auspices of the Commission for Tourism and Antiquities, Riyadh. The fieldwork took place over a three-week period in March, 2009, with the participation of a 12-strong team of Saudi and English archaeologists including a specialist team of divers. Here we summarise the key results of the fieldwork and give a preliminary assessment. This work builds on two previous seasons of fieldwork in 2006 (Bailey et al. 2007a, 2007b, Bailey et al., this volume (Alsharekh et al., this volume).

The objectives of the 2009 fieldwork were to continue with four main activities:

- Systematic survey, location, mapping, description and sampling of the numerous shell mounds identified in 2006 and 2008.
- Excavation of shell mounds started in 2006 and 2008 in order to obtain a better picture of their chronology, mode of formation and cultural contents, with particular emphasis on the Janaba 4 shell mound.
- Geoarchaeological observations, started in 2008, aimed at better understanding the relationship between the history of shell mounds and changes in the coastal environment.
- Underwater exploration and excavation of seabed features and sediments in inshore underwater locations associated with palaeoshorelines in water depths of 5–10m, carried out with the cooperation and assistance of the Saudi Border Guard in Farasan.

***Survey results***

The previous two seasons of fieldwork have demonstrated the high density of shell bearing sites (that is, culturally accumulated shell midden deposits that may range from small surface scatters to large mounds) across the Farasan Archipelago. Survey and excavation was initiated and expanded during these seasons of fieldwork, and further work was undertaken during 2009.

The survey aims and methods were largely unchanged from the 2008 season. In 2009 we focussed on locating and describing further shell middens on the central islands of the Farasan Archipelago, sampling of selected shell middens for radiocarbon dating, and additional observations of the relationship between shell middens and local topography and sediments.

We used satellite imagery (in the form of SPOT images and Google Earth data) in conjunction with precision GPS data, to facilitate survey and location of sites, and used the same recording system and descriptive categories established in previous field seasons. Finds were recorded by a unique 4 digit find number, preceded by a two character area code (Alsharekh et al., this volume). We test pitted 47 shell sites, generating 54 bulk samples for shell and sediment analysis and 53 dating samples (comprising individual shells and pieces of charcoal) taken from the sections of the test pits. In addition, we collected a further 28 surface samples of shells to provide an indication of variability in species composition.

Survey activity focused on four main areas, the coastlines of Qumah Island, particularly the northern shoreline and Qumah Bay in the south, south-eastern Saqid Island, the southernmost coastline of Farasan Island, and the Gandeel Peninsula from north of the Harid Bay in the west to the Farasan port in the east (Figures 1 and 2). Whilst low densities of new shell middens were found on Farasan Island, Qumah Island demonstrated a near continuous line of sites along those parts of the coastline surveyed, and the southern coastline of Saqid had very high densities and some of the largest shell mounds found so far.

The survey resulted in the discovery of a further 271 shell mounds bringing the total number of known shell-bearing sites to 1038. This is supplemented by 1773 shell mounds located on satellite images, raising the total number of sites to 2811 (Figure 1, Table 1). However, the sites located on satellite images still need to be surveyed on the ground.

| Area | Code | Number |
|---|---|---|
| Janaba East | JE | 144 |
| Janaba West | JW | 373 |
| Khur Maadi | KM | 230 |
| Qumah Island | QI | 77 |
| Qumah Bay | QB | 150 |
| Northwest Farasan | NF | 131 |
| East Farasan | EF | 254 |
| Northeast Farasan (Harid Bay and Gandeel Peninsula) | HB | 154 |
| Saqid North | SN | 602 |
| Saqid South | SS | 696 |
| Total | -- | 2811 |

***Table 1.*** *Distribution of shell middens*

During the course of this survey a number of other archaeological features were identified, including stone-built structures (Figure 3), and isolated stone tools and ceramics in a number of surface locations, representing a total of 141 finds from 64 locations, some of which were shell midden surfaces, while others were from other surface contexts.

Artefacts include ground stone tools made from fine-grained volcanic material not obtainable on the islands and presumably imported from the mainland, and a set of large river pebbles. With the exception of the river pebbles, the ground stone artefacts were all lightweight and small, with a diameter of no more than 20 cm, and a thickness of no more than 3–5cm. These are relatively lightweight, and it appears that the emphasis was on portability. A small number of flaked stone tools were found, including scrapers, blades, and debitage. These were predominantly made out of basalt. In addition one obsidian microlith was found. All of this material was found on the surface so that its dating and relationship to the accumulation of the shell mounds remains unclear.

Of particular interest are flaked tools made from *Tridacna* shell. This is a large species with a thick and robust shell with a texture not unlike a coarse chert. One of these specimens was found on the surface close to the JE0004 shell mound. The tool is a small flake with clear signs of having been worked to make a cutting edge. Tools such as these would have been important, since good quality stone suitable for flaking into artefacts is rare on the Island. A small cache of flaked *Tridacna* shell was also found on the surface on Qumah Island (Figure 4), close to a group of shell mounds, reinforcing this suggestion.

### *Geoarchaeological Context*

The results of the survey show a continuation of the patterns of distribution recorded in previous seasons. The majority of shell sites are located somewhat inland of the present shoreline on palaeoshorelines predominantly composed of low cliffs cut by marine erosion into a fossilised coral platform. In many places accumulation of sediments has infilled the bays around which the cliffs are located. These bays are often associated with the densest accumulations of shell sites, and the largest shell mounds. Conversely, the open coastlines of Farasan Island, with rocky shorelines, often with steeply sloping subtidal shelves, have a comparatively low density of small sites. The Qumah survey revealed two environmental settings, a predominantly open coastline in the north, and a more deeply embayed coastline in the south including Qumah Bay and a smaller bay immediately to the west. Along the north shoreline, at the eastern end, there is some evidence for shallow infilled sandy bays extending several hundred metres inland, and delimited by extensive shell scatters. To the west of this feature a palaeoshoreline emerges as a low cliff, showing the characteristic undercut formed by marine erosion, on top of which large shell mounds occur. In the south of the island, the shell-bearing sites are mostly mounds placed on top of palaeoshorelines. These extend over a considerable distance, are of varying height because of tectonic effects, and are often set back from the modern shoreline by extensive sand-filled bays.

The southern coastline of Sajid is composed of extensive palaeoshorelines, often associated with deep layers of infilled sediments 2–4m in depth. Before these bays were filled with sediment, they would have formed extensive areas of shallow water. This confirms the observations of the 2008 field season, which suggested that the largest shell sites and the highest densities of sites are located around shallow bays, many of which are now dry basins filled with sand as a result of progressive accumulation of sediment or tectonic movements.

The Khur Maadi Bay was a focus for research in 2008, and demanded further attention during this season of fieldwork. A geoarchaeological trench excavated in the centre of the infilled Khur Maadi bay in 2008 (KM1367) revealed a 1.5m sequence of sediments, showing a transition from shallow subtidal marine sediments at the base through shallow intertidal sediments to aeolian deposits at the top. A program of auger boreholes was initiated across the bay, in order to determine the extent of the infilled deposits and the line of the palaeoshoreline (Figures 5 and 6).

The auger transects revealed that the Khur Maadi Bay has been infilled by deposits up to 2m thick in places. However, thick layers of *farrush* (beach rock) exist on or just below the surface in many areas of the bay, hindering auger activity. In some places it was possible to break through the *farrush*, in others the layers were too hard and thick to penetrate. Where it was possible to break through the *farrush*, augering revealed a sequence of sediments which shows that the bay has undergone a progressive transition from a productive shallow marine bay to a subaerial deposit filled with sandy sediments.

The data from the auger holes also shows that the bay has a much more complex geomorphological history than previously thought. The cliff line is exposed at either side of the mouth of the bay, but disappears from view towards the centre. The auger transects show that the cliff is present beneath the infilled sediments and has been downwarped in the centre of the bay by tectonic movements. This downwarping would have allowed sea water to penetrate further inland, creating a very extensive shallow bay, the outlines of which can be identified from the presence of small shell deposits that are now some considerable distance inland from the present-day shore. Subsequently this inner bay, south of the cliffline, was uplifted, and the bay to the north of the cliffline was infilled with sandy sediments (Figure 6).

## *Excavations*

The excavation strategy for the 2009 field season had two main objectives: to continue the excavation of Janaba 4 (JE0004) and to extend the program of test pitting initiated in 2008 in other shell deposits.

### *Janaba Excavation*

The aim of the Janaba excavation was to open up additional areas of the site, to achieve a stratigraphic section through the full depth of the mound at its deepest point, and through the full width of the mound on a North-South axis; and to recover more charcoal samples for radiocarbon dating, and larger samples of artefacts, shell and bone material for faunal analyses.

In 2006, shallow step trenches were excavated down the southern (coastal) flank of the mound (Bailey et al., this volume). In 2008 we re-opened these trenches and extended the topmost trench northwards towards the centre of the mound. A new trench was excavated through the northern half of the mound to bedrock, and a shallow trench was excavated in the centre of the mound to provide a stratigraphic link between the southern and northern trenches (Alsharekh et al., this volume).

In 2009, a key objective was to deepen the trench in the centre of the mound in order to provide a better understanding of the relationship between the stratigraphy in the northern and southern trenches. The step trenches on the south side were re-opened and excavated to greater depth. The north trench was reopened, the west-facing section was cleaned back, and a 2m length of the trench at the centre of the mound was excavated down to bedrock (Figure 7).

## *Excavation procedures*

The 2009 excavation exposed c. 4.5 $m^2$ of new sections, involving the removal of c. 3.5 $m^3$ of deposit. This was achieved by excavating single contexts within a standard volume of deposit 50cm x 50cm x 5cm in depth. These standard units were subdivided when necessary to respect stratigraphic boundaries as indicated by changes in the nature of the shell and sediment content. The same recording system was used as in 2008 to identify individual contexts by grid square and quadrant. The sieving strategy was similar to that adopted in 2008. Initially, excavated deposit was placed in buckets and sieved on site, using a stack of two sieve trays, the upper one with a mesh size of 10 mm, the lower one with a mesh size of 2 mm. These were sorted over a wheel barrow, so that the residues passing through the 2mm sieve tray could be retained. Each tray in turn was scanned for unusual items of interest such as artefacts, non-shell material, or vertebrate bone. The residue retained in the barrow was also scanned for any small items of interest such as small fish bones which slipped through the mesh, before the remaining material was discarded (Figure 8). Subsequently, all excavated deposit was placed in bulk into large plastic bags, so that the relatively slow pace of sieving did not delay the process of excavation (Figure 9). Some of the bags were subsequently sieved on site, but the majority were taken back to the local municipal compound in the town and sorted over large tables (Figure 10). Here the material was poured through the sieve tray with the 10 mm mesh to collect any large items of interest and remove unwanted material such as large shells and shell fragments. The larger debris retained by the mesh was then discarded, the smaller materials and sediment passing through the mesh onto the table surface were spread out and carefully sorted to remove small items of interest, and the remaining residue was then discarded. As in 2008, we experimented with wet sieving but found this offered no advantage over sorting of dry deposits.

Vertical columns of bulk samples were retained at key points through the site, so that they could be taken away for detailed laboratory analysis of the fine fraction of shells and sediments. Larger bulk samples of shells were also retained from most excavation contexts.

Section cleaning and partial collapse of the eastern wall of the main trench resulted in a shift of the N–S section slightly to the east of its position in 2008. However the results showed a consistency and continuation from the 2008 section drawings, highlighting the difference between the two sides of the shell mound (Figures 11 and 12). The northern (inland) half of the mound is composed of a series of thick depositional units, primarily composed of large and robust gastropods and bivalves. Within these units are occasional discrete layers dominated by the smaller

*Strombus fasciatus* shell, often fragmented, and infrequent pockets of charcoal/ash (Figure 13). This contrasts with the southern (coastal) side of the mound, which is predominantly composed of alternating layers of clean *Strombus fasciatus* and ash/charcoal within which are frequent hearth deposits (Figures 14 and 15). Occasional small intrusions were also recorded in section, which could be interpreted as post holes.

The species of marine molluscs represented in the shell mound were found to vary little from the observations made in the 2008 study. The key exception is dense layers of *Pinctada negra*, the pearl oyster. Although present in smaller quantities in association with other shellfish species such as *Strombus* in the upper layers of the mound, *Pinctada* was found to be present in a number of dense layers in the lower levels of the deposit on the southern, coastal side of the shell mound. No other species of shellfish were present in these layers.

The 2009 excavations have resulted in a better understanding of the relationship between the two distinct sides of the mounds. It had previously been assumed that the two sides accumulated simultaneously, with the inland side representing dumping of larger shells, and the coastal side being used predominantly for habitation and processing. However these new excavations have shown that the deposits on the coastal side were deposited first. The deposits on the northern side only accumulated during the final phases of occupation, and therefore correspond to the latest period of mound formation.

### *Human burial pits*

During the re-opening and further excavation of the step trenches, two burials were discovered in the uppermost trench in the centre of the mound. These became apparent during section cleaning, which exposed the grave cuts in the western section. Both graves consist of shallow cuts through the upper layers of the mound. The first identified was that of a small child of perhaps about 5 years old (Hannah Koon, personal communication, 2010). The grave cut was lined with charcoal, and a worked piece of basalt had been placed at the bottom of the pit with the human remains on top of them (Figure 16). An unusual collection of shells was also found in the pit in association with the child burial (Figure 17), including a small number of distinctive gastropods that have not been identified elsewhere in the Janaba 4 deposits, and the bivalve of an ark shell *(Arca avellana*), which is also rare in this site. The human remains comprised fragments of skull and some milk teeth, and these were already in a damaged and fragmented state when first exposed in the burial pit.

The second burial had a larger grave cut, and contained the bones of an adult. Many more bones had survived in this burial, although they were severely degraded, with some being no more than dusty shadows within the sediments (Figures 18 and 19). The bone material was generally in very poor condition and the larger and better preserved bones were conserved *in situ* to consolidate the bones before they were lifted and removed from the site. Sufficient remains had survived to be able to infer that the body could have been interred in an upright crouched position. The fingers, wrists, arms, legs, ankles and toes were all articulated, suggesting that remains were buried before decomposition was advanced. Unfortunately, due to the shallow nature of the grave cut, and the likely erosion of the upper layers of the mound, the skull and most of the vertebrae, shoulders and pelvis were missing or had deteriorated beyond recognition.

The most common vertebrate remains recovered were fish bones. These are found in almost all layers of the shell midden, often being recovered in dense pockets. No further identification has been carried out since the work undertaken on the 2008 deposits by Mark Beech; however further work is planned.

A small number of bones of terrestrial mammals were also found in the southern half of the mound and in the deeper layers, perhaps due to better conditions for preservation in these lower levels. The bones were badly deteriorated and few in number. They have been tentatively identified as *Gazella gazella farasani*. Similar mammalian bone remains were also identified in the lower levels of disturbed shell midden deposits further east along Janaba Bay, where shell midden sites are being disturbed by new construction work close to the hotel.

### *Test Pit Programme*

The objective of the test pit programme is to increase understanding of the variability in composition, chronology and stratigraphy of shell midden sites without the need for time consuming and destructive excavation. The method employed was to dig a small trench, 50 x 50cm and up to 30cm deep close to the centre of the site (Figures 20 and 21). This is similar to the strategy adopted in 2008 (Alsharekh et al., this volume). It is hoped that this will give the best indication of what the mound is composed of by opening up a small window. Choosing a position close to the top should also minimise the risk of excavating disturbed material, if there has been any slumping which could result in re-deposition of material on the lower slopes of the mound. Although test pitting may not pick up large variations in shell composition within a given mound, it should provide some indication of variations in shell species between sites and between different areas. Samples were removed from the exposed sections of each test pit, and included bulk samples of shell to provide information on shell composition, and charcoal and shell samples for dating.

In selecting sites for test pitting, we concentrated on deposits of different size and location within particular clusters of shell middens. In 2008, five test pits were excavated in five sites in the Khur Maadi adjacent to the excavated site of KM1057, and three in sites adjacent to JE0004 (Alsharekh et al., this volume). The program was expanded during the 2009 field season, with twenty additional shell sites test pitted in the Khur Maadi, two in southern Sajid, nine in Qumah Bay and twenty six sites in Janaba West.

| Test Pit | Latitude Degrees | Minutes | Seconds | Longitude Degrees | Minutes | Seconds |
|---|---|---|---|---|---|---|
| JW1784 | 16 | 41 | 14.77372 | 41 | 58 | 31.42765 |
| JW1789 | 16 | 41 | 10.79856 | 41 | 58 | 35.20945 |
| JW1800 | 16 | 41 | 5.270933 | 41 | 58 | 37.46011 |
| JW1804 | 16 | 41 | 2.742956 | 41 | 58 | 40.49781 |
| JW1806 | 16 | 40 | 57.29752 | 41 | 58 | 42.71833 |
| JW1810 | 16 | 40 | 54.28177 | 41 | 58 | 43.23413 |
| JW1819 | 16 | 40 | 52.25388 | 41 | 58 | 42.94465 |
| JW1820 | 16 | 40 | 49.48541 | 41 | 58 | 42.82328 |
| JW1825 | 16 | 40 | 46.51477 | 41 | 58 | 42.54968 |
| JW1828 | 16 | 40 | 43.15509 | 41 | 58 | 42.23023 |
| JW1832 | 16 | 40 | 35.21756 | 41 | 58 | 41.95758 |
| JW1837 | 16 | 40 | 33.62811 | 41 | 58 | 44.27307 |
| JW1841 | 16 | 40 | 29.65814 | 41 | 58 | 45.80314 |
| JW1851 | 16 | 40 | 28.29159 | 41 | 58 | 46.3911 |
| JW1855 | 16 | 40 | 27.59072 | 41 | 58 | 45.78398 |
| JW1857 | 16 | 40 | 24.04273 | 41 | 58 | 43.11259 |
| JW1891 | 16 | 40 | 24.78686 | 41 | 58 | 46.38596 |
| JW2304 | 16 | 41 | 56.21697 | 41 | 57 | 35.67599 |
| JW2308 | 16 | 41 | 4.847907 | 41 | 58 | 18.084 |
| JW2309 | 16 | 40 | 53.04162 | 41 | 58 | 43.60799 |
| JW2311 | 16 | 40 | 39.25316 | 41 | 58 | 36.11999 |
| KM1048 | 16 | 44 | 2.633746 | 41 | 57 | 39.85879 |
| KM1056 | 16 | 44 | 1.461294 | 41 | 57 | 40.55257 |
| KM1304 | 16 | 43 | 56.90741 | 41 | 57 | 44.11232 |
| KM1307 | 16 | 43 | 52.19769 | 41 | 57 | 38.51485 |
| KM1313 | 16 | 43 | 46.71732 | 41 | 57 | 38.38842 |
| KM1317 | 16 | 43 | 42.57103 | 41 | 57 | 38.88168 |
| KM1324 | 16 | 43 | 44.86281 | 41 | 57 | 36.12883 |
| KM1328 | 16 | 43 | 53.11498 | 41 | 57 | 38.94105 |
| KM1330 | 16 | 43 | 52.92881 | 41 | 57 | 41.25366 |
| KM1335 | 16 | 43 | 51.24758 | 41 | 57 | 25.97333 |
| KM1336 | 16 | 43 | 45.90501 | 41 | 57 | 34.71484 |
| SS2150 | 16 | 48 | 6.920931 | 41 | 58 | 40.15977 |
| SS2500 | 16 | 47 | 37.72902 | 41 | 56 | 35.16432 |
| QB1416 | 16 | 38 | 7.598932 | 42 | 1 | 57.2163 |
| QB1421 | 16 | 38 | 6.577066 | 42 | 2 | 3.306851 |
| QB1422 | 16 | 38 | 4.848862 | 42 | 2 | 3.305843 |
| QB1444 | 16 | 38 | 1.998309 | 42 | 2 | 7.494455 |
| QB1448 | 16 | 37 | 36.16683 | 42 | 1 | 56.81999 |
| QB1449 | 16 | 37 | 37.08682 | 42 | 1 | 58.62752 |
| QB1451 | 16 | 37 | 42.17548 | 42 | 2 | 0.985194 |
| QB1459 | 16 | 37 | 48.19272 | 42 | 2 | 5.96944 |
| QB1467 | 16 | 37 | 33.90651 | 42 | 1 | 50.10508 |
| QB2068 | 16 | 37 | 51.77206 | 42 | 1 | 45.10199 |
| QB2082 | 16 | 36 | 54.96723 | 42 | 1 | 35.81759 |
| QB2083 | 16 | 37 | 12.8555 | 42 | 1 | 34.8312 |
| QB2084 | 16 | 37 | 21.43097 | 42 | 1 | 39.3996 |
| QB2092 | 16 | 38 | 5.541582 | 42 | 1 | 47.1698 |

**Table 2.** Location of test-pitted shell mounds. JW: Janaba West; KM: Khur Maadi; SS: Saqid South; QB: Qumah Bay

### *Evaluation and conclusion*

The survey data have demonstrated the extraordinary concentration of shell mounds on the Farasan Islands, taking the total number of such sites to 2811 – far beyond the 1000 estimated during the original survey in 2006. This is one of the highest densities of shell midden sites in the world, and is certainly unique for the region. Satellite image interpretation shows that there is still much work to be done to complete the survey of the sites, and the number of sites may increase, especially if work is undertaken on the smaller islands.

The distribution of sites shows a clear correlation between the largest concentrations of shell mounds and areas that would have been shallow bays, with extensive areas of intertidal and shallow subtidal habitat suitable for large numbers of marine molluscs.

The geoarchaeological survey focused on the Khur Maadi area has shown that the tectonic changes on the islands can be highly localised and act over relatively short timescales, creating considerable alterations in the geometry of the shoreline and its associated morphological features and distribution of molluscan habitats. Many of the shallow bays that previously created productive habitats for vast quantities of molluscs have now dried out and have shoreline conditions at the present day that are quite different from those that existed at the time when the shell mounds were being formed.

The new excavations of the Janaba 4 mound (JE0004) have added to the interpretation of the site, and suggest a change in exploitation strategies during the history of the mound. Certainly the depositional pattern changes through time – something which was not anticipated prior to excavation, and which has only become clear with the results of the 2009 season of excavations. The change in the dominant shell species in different layers of the mound suggests changes through time in local shoreline conditions and marine ecology, and these patterns will become clearer when a fuller dating programme of the deposits has been completed. This site certainly warrants further investigation to give more detail on the accumulation history of the mound and its cultural contents.

The presence of human burials at the site is a new finding, though not unexpected, as they are often found associated with shell mounds in other parts of the world, especially in areas where the landscape is dominated by impenetrable rock. The burials are clearly contemporaneous with the later stages of shell accumulation, but the upper part of the burial pits has been disturbed and truncated as a result of removal of material from the top of the mound at some point in its more recent history. The human bone material is also in very poor condition. A more detailed report on the human bone remains is in preparation.

### *Underwater work*

The diving work included exploration of seabed features and sediments in a variety of inshore locations. The aim was to explore patterns of underwater erosion and sedimentation in order to better understand the processes of landscape modification that take place when a terrestrial land surface undergoes inundation during a period of sustained sea-level rise, and to predict and test those locations where archaeological material associated with the pre-inundation landscape might be preserved.

This was the third season of diving in the waters of the Farasan Islands as part of the wider project. The first two seasons have resulted in a broad understanding of the submerged terrestrial and marine characteristics around the archipelago, and an assessment of the potential for human activity at 15 sites. This was coupled with a review of the conditions that would enable archaeological material to survive the last period of sea-level rise and be protected within marine deposits (Alsharekh *et al*., this volume). The archaeological objectives this year were to build on the work of previous seasons by targeting sites with underwater geomorphological features that might have been associated with favourable conditions for human activity when sea levels were much lower than at present. Key site types were those locations beneath marine-eroded overhangs, and palaeoshoreline locations that might have hosted shell mounds akin to those visible on the present-day shoreline.

Of the 15 different underwater areas investigated in previous years, one characteristic feature has been identified which offers the greatest potential for the discovery of archaeological material. This feature consists of low undercut cliffs forming a natural overhang, and created by marine erosion at the coast edge. These occur along much of the present day shoreline, often with shell mounds sitting on top of them. They are also found inland as a result of the recent seaward displacement of the shoreline by accumulation of sand or by tectonic movements. In these situations the undercut cliff offers shade and shelter for activities carried out beneath the overhang (see above?). Similar overhangs are also found underwater in association with palaeoshorelines formed when sea level was lower than today. These would have offered shelter to early humans when they were dry.

The underwater sites investigated in 2009 were selected on the basis of assessments carried out in 2008. Two sites were selected for detailed study, corresponding to the locations described above. Evaluation trenches were dug into deposits and stratigraphic layers were recorded and sampled. The first was in sheltered, shallow water within a cluster of islands south of Sulayn Island (Figure 22). The area would have been part of a large landmass extending east from the main island of Farasan when sea levels were about 5 m lower than present. A large deposit of shells was recorded underwater at this location during the 2008 fieldwork.

The second site is in an area of wave cut cliffs and solution notches towards the mouth of Qumah Bay on its western shore (Figure 25, location 2). A large circular basin dipping to a depth of greater than 100m below sea level was recorded to the south east of Qumah Bay. When sea levels were considerably lower and the climate was less arid, this could have contained fresh water and acted as a focal point for resources and human settlement. The wave cut notches formed at an even earlier period of higher sea level would have presented protection, shelter and a possible refuge. It is in such a place that we might expect human activities with associated, discarded materials to be concentrated.

### *The submerged geology and location of submerged archaeological sites*

The Farasan Islands have been subject to varying degrees of local tectonic activity as a result of rising salt dome migration and collapse. Examples of this process are evidenced by warping of the landscape involving localised uplift of old shorelines. Examples of this recent and small-scale tectonic movement are visible in Khur Maadi Bay and around the shorelines of Qumah Bay. Over a longer time period, more substantial changes have been caused. The clearest examples of this are the deep circular depressions with their bases now hundreds of metres below the surface of the sea where the salt has been dissolved away by underground water.

Sea level still-stands that took place during the last regression and transgression would have etched notches into now-submerged cliff faces and promontories. These are similar to those seen on the present-day shoreline where they are often associated with shell middens. These wave cut features features were recorded underwater during the 2006 and 2008 projects, and we believe that correlations can be made between their depths and low sea levels at times of prolonged sea-level stability (see reports on 2006 and 2008 underwater work in Bailey et al., Alsharekh et al., this volume).

The objective of underwater investigations is, then, to look for archaeological materials and shell deposits resulting from human activity both immediately above and immediately below wave cut notches and overhangs that are now submerged, and that may have survived the final stages of the last period of sea-level rise.

### *Strategy informing choice of diving locations*

The biggest threat to archaeological sites and materials during a marine transgression is physical erosion. This can be particularly acute when the sea first rises over the land in exposed locations. This is likely to displace or disperse archaeological material, and this tendency to erode away material may continue, as a result of underwater currents, after the site has become more deeply submerged. Conversely, where a site survives inundation in a sheltered location, marine sediments can cover and preserve archaeological artefacts. Such material may remain undisturbed and become covered by sediment to create anaerobic conditions that are excellent for the preservation of organic materials. However, these same conditions may make the original land surface difficult to reach because of the accumulation of overlying sediments that can be many metres thick.

Inevitably, there is a transition between the two types of processes, between locations of erosion and locations of sediment accumulation, and a boundary where the two processes meet. Where the protective cover of sediments is thin, an opportunity exists to reach the underlying land surface and potential archaeological material more easily.

The strategy was therefore to investigate geomorphological features such as submerged wave cut notches, particularly where they are associated with a boundary zone between areas of sediment accumulation and sediment erosion.

### *Dive planning*

The diving was conducted on air and with SCUBA. The depths were restricted to minimise the risk of decompression sickness. There was no diving that warranted in-water decompression. Work was concentrated in shallow waters within the 10m depth contour. If diving exceeded this limit, dive times were restricted to include a wide safety buffer which kept well within 'no stop limits'.

Diving practices were in line with the HSE (Health and Safety Executive UK) Scientific and Archaeological Approved Code of Practice. A full risk assessment was conducted before each dive, which identified and mitigated any diving risks while addressing local conditions such as underwater features, tides and the weather.

A minimum team of five personnel was always present during diving operations. This included a supervisor, qualified skipper, assistant and two divers. Four of these divers hold professional UK-recognised Health and Safety qualifications or their equivalent. All divers were experienced at diving in tropical waters.

At the dive sites, a buoy was fixed in the working area to act as a marker and a down line. Visual contact or physical communication was maintained with the divers at all times and the team was in constant communication with the Border Guard. Where divers moved away from the site, a surface marker buoy was deployed.

In case of an incident, the dive evacuation plan ensured the boat was clear and in a state of readiness to transport a casualty to land quickly. A modern and well equipped hospital is located in Farasan Town. A vehicle was always available on shore to transport any injured party to the hospital from the quayside. No diving took place that would result in a journey time of over 2 hours to the local hospital.

Had there been a need for medical treatment in a recompression chamber, emergency evacuation procedures were in place with Dive Master insurance, which ensures that divers can be transported to the nearest available facility.

**Dive Location 1: Sulayn al Janub archipelago (16° 44′ 05.5″ N, 42° 11′ 51.7″ E)**

The Sulayn al Janub archipelago is situated on a shallow plateau that would have been largely dry land when sea levels were 5–6 metres lower than today. Shell middens visible on the nearby islands demonstrate occupation and the availability of marine resources in recent millennia.

The area under investigation was a flooded basin surrounded by three islands (Figure 22). There are three entrances to the basin. The one to the southwest is wide and shallow, only a metre or two deep. The channel to the north is narrow and a little deeper at 2–3 metres. In the east the channel is recorded at 5m deep and fairly wide. This would have been the channel that saw the first ingress of water into the basin as sea levels began to rise. A break through in the north would have followed and finally the wide western channel would have been overwhelmed. These processes are interpreted from the modern bathymetry (see 2008 report in this volume).

## *Results*

Assessment near the shore adjacent to the northern channel in 2008 revealed shell deposits covered by a thin veneer of sand. The deepest part of the channel is the result of scouring by fast-flowing currents and these have also prevented the accumulation of thick deposits of sand. The thickness of the sand increased upslope where the water was shallower and the currents weaker. Filter-feeding corals were found on the sea floor towards the centre of the channel. The task in 2009 was to excavate an evaluation trench through the deposit, running from the shallower water down slope towards the channel. The objectives were to record the thickness of sand cover relative to distance from the channel, and to assess the shells to identify whether they might have been natural accumulations of dead shells of the result of human gathering activity.

A 10m long evaluation trench was dug which ran down-slope from west to east (Figure 23). The working depth was shallow, the west end recorded at c.2m below the surface. The relative depth between the ends of the trench was 0.7m, making the eastern end just under 3m. On completion of the trench, sections were recorded and five samples were recovered (Figure 24). Three contexts were noted. From top to bottom these are sand, fine grey organic silty clay, and a sandy shell mix. The total thickness of the sediments was recorded as 0.7m in the west and 0.35m in the east. However, the base of the deposit was not reached in the west so the total thickness is unknown.

The sand of the top layer measured 0.2m in thickness at the western end (context 1201). This reduced to 0.05m at the east where the channel currents were stronger. The middle context was fine grey silt which was easily removed by water movement and represented a sedimentary horizon that sealed the lower context (context 1202). Its presence indicated stability, demonstrating that wave and current action at this location did not have an impact on the lowest context, and that sediment mixing was largely limited to the upper sand layer. The main mixing agent was most probably live bivalves which would travel vertically through the sediments. Numerous shells including bivalves were recovered from amongst the shells of context 1204 although they were too small to have been edible and were not of a size that would have been found in a shell midden.

The lowest context of mixed sandy shell measured 0.25m in thickness at the eastern end of the trench, which was at the edge of the channel. The excavation was not deep enough to reach the bedrock in the west where the exposed context of sand and shells measured 0.44m in thickness.

Samples recovered from the trenches were dried and sorted. Shells were removed from the deposit and the midden-type species were separated. The sub-samples were weighed and the proportional relationship recorded as follows:

1.5m along: 8% shells 92% sand

2m along: 40% shells 60% sand

4.5m along: 8% shells 92% sand

6.5m along: 8% shells 92% sand

9m along: 45% shells 55% sand

### *Discussion*

The shells were densely packed in the lower context but the vast majority of shells were small and the wide spectrum of species was too broad to represent a midden deposit. It was concluded that the material in all the contexts was deposited by natural processes. However, detailed analysis at the University of York revealed traces of charcoal amongst the sand and shells. This suggests human activity and, should the opportunity arise, this warrants further investigation in the areas of interest.

Despite the site being natural rather than archaeological, the inspection has proved valuable in a number of ways. First, the results have helped inform our understanding of the depositional process. The fine grey silts of context 1202 indicate that stable material can survive in near-shore, shallow waters around the archipelago. Usually, such deposits would be reworked by wind induced waves. In addition, the fine grey silt recorded along the length of the trench indicates that protective sediments, which could create anaerobic conditions, were able to settle in a range of depths and in water currents of different strengths.

Secondly, the sampling strategy employed has provided baseline data from a natural site that can be compared to new sites. We have recorded the relationship between shells that would be found on a shell midden and those that would not. It is anticipated that the relative proportion of midden type shells to non-midden type shells will be greater if the source of the shells is a deflated or a remixed midden deposit.

Thirdly, the work at Sulayn has provided a successful test bed to develop methods that can be replicated at other sites to provide comparable data.

**Dive location 2: Qumah Bay (16° 36′ 27.0″ N, 42° 01′ 08.1″ E)**

Qumah Bay was chosen for investigation because it has a high potential to preserve archaeological material. This hypothesis is based on the shelter which the Bay affords to submarine deposits, the distinct overhangs and notches below the waterline that reflect the changing relationship between land and sea, and the presence of a rich archaeological resource of shell mounds along the present-day shorelines of Qumah Island. The location is also one that would have offered a favoured area for human occupation during periods of lower sea level (See 2008 report, this volume).

The site chosen for detailed investigations was in 10m of water half way along the inner side of the western peninsula. Here, a series of distinct wave cut notches line the side of the Bay, which is relatively free from sand cover. The location sits at the interface between deep sediment and scoured exposures (Figure 25, location 2).

A principal feature at this site is a notch with a large overhang, RS QB01. It has a 2m high opening with a sloping roof that tapers to the back of the cave (Figures 26, 27). The back of the cave is 3.5m from the entrance. When sea level was lower, this would have formed a rock shelter overlooking Qumah Bay to the east and south. Today, this feature is submerged and sits above a steep 7m-high slope that is terminated by a 1m-high cliff at its base in 17–18m depth of water. The lower cliff contains crevices, rock outcrops and notches that have accumulated material. In deeper water this low cliff gives way to a sandy seabed that runs down into the bay (See 2008 report, this volume).

The site appears to be a suitable location for human activity and occupation. If that is so, then any archaeological material deposited within the rock shelter while it was habitable might remain *in situ*. Or it might have been washed out during the subsequent rise of sea level, in which case the material would have dropped into the deeper water in front of the cave and between rocks where it might have been trapped. Here any artefacts would have been protected and covered by sand. If any archaeological material survived it would be robust stone tools or the remains of foodstuffs such as shell or perhaps bone.

It is worth noting that the depth of the submerged rock shelter from the top of the cliff is a little over 20m, so that it could have formed during a still stand that was 20–30 m lower than the MIS5 high sea level. A still-stand occurred c. 80–90,000 years ago, after which sea level dropped, and did not return to this level until the sea-level rise after 20,000 years ago. The overhang would therefore have offered shelter for some 60,000 years before sea level rose again to cover it during the last transgression.

### *Results*

The task in 2009 was to excavate evaluation trenches within, above and below the cave, and recover trapped sediment from the back. The first thing to consider when diving on the sites at Qumah Bay is the depth. The areas to be investigated vary from 7m to 18m below water. The deeper dives meant dive times had to be limited to reduce the risk of decompression sickness. Diving was conducted on air, restricting dive times at the 18m site to 30 minutes at a time. This included a safety margin to ensure there was no need to decompress in the water before returning to the surface.

The work at 7–9m included the clearing of sediment from above the roof of the cave, which forms a small platform. The purpose was to record the depth of sediment and to measure the slope that rises from the cave roof to the surface. The existence of a flat or gently sloping wave cut platform above the cave could have supported activities such as shell processing. However removal of sand revealed it to be a shallow unstratified deposit only a few centimetres deep. The ‘platform’ proved to be an incline rather than a flat surface, which rises at an angle of approximately 15° increasing to approximately 25° further up slope. Spot checks along the 25m transect from the top of the wave cut notch to within 5m of the reef (which is just below the surface in 1–3m of water) revealed a thin covering of sand over the rock throughout.

Within the cave at 10m depth, the thickness of deposit was measured by excavating two evaluation trenches from the back wall to the entrance. These revealed a thin layer of unconsolidated sand over bedrock and therefore without palaeo-deposits. Crevices in the back of the cave contained accumulations of small stones and gravel. These were sampled and sorted to assess their potential for trapping and retaining artefacts. They have been retained for laboratory study to identify any evidence of human interference or material out of context from its natural environment.

The slope at the front of the wave cut notch drops from 11m underwater, at an angle of about 40°, to 17m depth, where it is punctuated by a vertical drop at a metre-high rock outcrop. The depth of sand on the slope was checked at 2m intervals in a similar way to the investigations on the slope above the cave. It was found to be thin with bedrock beneath. The bedrock was exposed at the bottom of the slope above the small cliff and outcrop.

At the foot of this metre-high cliff at 17m depth, an arch rose above the seabed by 0.3m forming the mouth of a small wave-cut hollow or cave (RS QB02, Figure 28). An infill of sand indicated that part of this cave remained buried. The back of the cave, at 1.2m from the entrance, fed into another crevice which exited about the same distance to the north. The combination of crevice and hollow would have formed an ideal trap to catch any material that fell from above. The mouth of the arch was the area excavated. The objective was to uncover stratigraphy that might help to define the evolution of the sediments that built up following submergence by sea-level rise.

A 0.5m-wide trench was excavated to the back wall of this cave-like notch, creating an 85cm-high section, suitable for recording and sampling. The top of the section was capped with sand. Below this was a layer of sandy shells that became sandier at the bottom. In the entrance to the notch, a relic coral reef was recorded below a thin layer of sand. This reef formed a platform that stopped at the mouth of the notch, where it stepped vertically into the notch (Figure 26). It appears that the coral did not grow within this small cave-like feature, most probably due to the lack of direct sunlight. This resulted in a deeper area within the cave that could have trapped material.

Five samples were collected from the east facing section excavated at the mouth of the cave. The samples were sorted into midden-type shells and non midden-type shells. They were then subject to more detailed laboratory analysis to identify any archaeological material or any material out of context from its natural depositional environment. Examples of shells recorded at the site included *Strombus fasciatus*, which is found in the shallow sheltered waters of sandy bays. These were more prevalent in the upper part of the sequence. Following the initial sorting in the field, the samples were classified at the University of York. This revealed shells from a very broad range of species and particularly so when compared the midden sites found on land. There was also a great diversity of shell sizes. Both factors suggest a natural death deposit rather than an assemblage that had been influenced by humans.

Two samples of coral were removed from the fossil terrace for dating. Any dates could provide sea level index points for the time of their formation.

After the recovery of the first set of samples, the trench was deepened and pushed through to the back of the deposits within the hollow. The maximum depth of the trench was 0.85m, although it was not possible to reach the deposit in the bottom of the cave during the time available. Excavation had to be aborted early due to the adverse risk associated with a resident shark. Prior to the arrival of the shark, bulk samples were collected from the sections on both sides of the trench and from the base of the excavation.

### *Discussion*

Assessment of the cliff face demonstrates that the slope was covered in a thin layer of sand and was devoid of any level platforms other than those associated with the underside of the wave cut notches.

Within the 10m deep wave cut cave, the sediment was thin unconsolidated sand. This would have accumulated after it had been cleared of sediment by sea action during the process of submergence. Numerous fissures, one of which runs deep into the back of the cave, have the potential to trap and preserve material. Samples were collected but more undisturbed deposits remain.

Material that may have covered the cave floor would most probably have been removed by the sea c. 8,000 years ago when it transgressed upwards past the wave cut feature. Any artefacts would have been washed out to fall down the steep slope in front of the shelter immediately below the rock shelter; RS QB01. The possibility exists that some of the material would have found its way to the crevices where it could remain amongst the infill deposits at 17–18m depth. If the shells from edible mollusc species remained, there is the chance that they might have left an anomalous or biased signature within the accumulation of natural shells. However, this was not the case. The samples recovered from the site looked natural and as such would have drifted into the cave after the sea level had risen above it. The variation in concentrations of shell types within the layers in RS QB02 did show that differing species arrived in sequential phases. This could have been due to locally changing environments brought about by the different depths of water over the site at different times as sea level rose. The manor of deposition indicates that patterns can be detected within the assemblage and relationships between shell types can be calculated through time. The analysis did not reveal evidence of human interaction in this case but it demonstrated that the method was viable in underwater sites.

## *Additional diver investigations*

### *Sulayn East*

In addition to the diving at Sulyan and Qumah, underwater searches were conducted in 5m of water on the edge of a palaeo-valley feature immediately to the east of Sulayn Island. A flat seabed was recorded running up to a slope angled at about 35°. The area was covered with sand although rock and coral boulders were scattered intermittently across the seabed. The sand appeared thinnest along the top edge above the drop-off, where the underlying rock was more exposed.

### *Abker Island*

An inspection dive was carried out on Abker Island (16° 38′ 03.1″ N, 41° 55′ 02.8″ E) (Figure 29). Live coral dominated the seabed in a few metres of water near the island. There was evidence of broken and dead coral in a number of locations near the northern side of the island. The damage was widespread and looked greater than would be caused by anchors. It was suspected that fishermen had used dynamite in the area. The broken coral suggests this possibility.

A transect was followed north of the island. The coral became less and the seabed was dominated with sand. Further north still, around 200m from the island and in about 5m of water, the seabed dropped at an angle of about 35°. Coral reef grew along the rim of the drop off and extended down slope before thinning out at about 15–20m depth.

### *Discussion*

Both dive sites recorded a seabed which changed from wide platforms at a depth of 5m to steep inclines angled at about 35°. Both sites had a cover of sand although a much thinner layer was recorded at Abker Island. Abker had a reef which rose 0.5m, and exposures of the coral terrace down to 15–20m, while at East Sulayn the coral stopped growing in shallower water. The results suggest that greater sand cover and reduced visibility to the east of the Farasan Islands is restricting growth compared to the west, which has more extensive coral growth. This could make archaeological material easier to identify if suitably sheltered conditions can be found around the western side of the archipelago.

## *General conclusions*

The field investigations of 2009 have provided new information about the shell mounds on land and their geological context, and new information about the submerged landscape around the Farasan Islands. The work on land has generated a very substantial archive of data about the nature and distribution of the shell mounds and a substantial collection of samples relating to the dating and contents of the mounds that is awaiting more detailed laboratory analysis. The results have more than doubled the number of shell-midden sites on the Islands, and confirm that this region has one of the highest known concentrations of such sites on a world scale. A matter for concern is that an increasing number of these sites are being damaged or destroyed, or threatened with destruction, as a result of new development, road building and construction work, particularly on Farasan Island and southern Saqid.

The greatest concentrations of shell middens and the largest mounds are associated with extensive, shallow bays that provided suitable habitat for huge numbers of marine molluscs. However, these bays are now dry because of accumulation of sand and tectonic movements. Geoarchaeological sampling has confirmed the highly dynamic nature of the coastal environment and the existence of tectonic warping of palaeoshorelines that is both localised and that had effects over quite short time spans, with significant effects on the ecology of the intertidal zone. This pattern is confirmed by the new excavations at Janaba 4, which show significant changes in the species composition of the dominant molluscs during the history of the mound, most probably reflecting changes in the nature of the local intertidal and offshore ecology and substrates.

The new excavations at Janaba 4 have also provided new evidence for human burials, and the presence of faunal remains of gazelle. They have also increased the sample size of fish bone material, and produced a large number of charcoal samples suitable for radiocarbon dating, which should provide a more detailed understanding of the history and mode of formation of the mound. Test pitting of 48 other shell mounds on Farasan Island, Saqid and Qumah has also produced samples for shell analysis and dating, and this should throw additional light on the general chronology and inter-site variability of the shell middens.

Underwater, we have obtained a clearer understanding of the ways in which the submerged landscape was transformed by flooding with sea level rise, and examined in detail a number of promising locations where we think there should be a good chance that underwater archaeological remains have been preserved. We have demonstrated that sediments can remain intact after submergence, and have conducted trial excavations in a number of locations including submerged overhangs in Qumah Bay on the south side of Qumah Island. Unequivocal evidence of archaeological data relating to the pre-inundation landscape remains elusive. However, accumulations of shell have been found in the underwater excavations, and samples of this material are currently being analysed in the laboratory in order to develop robust criteria for distinguishing between shells accumulated on the sea floor by natural processes and shells that represent the food remains of human subsistence activity.

Further work is currently underway to analyse the substantial quantities of material already recovered from the existing survey and excavation, and new work is planned both on land and underwater. As the Farasan Islands become more frequently visited, and as the pace of development of building and new infrastructure intensifies, so the pressures on the archaeological resource will increase. We have already noted evidence for the damage or destruction of archaeological sites on land, and we have also noted some evidence for the destruction of the natural coral surface under water by fishing activity. These pressures reinforce the importance of continuing archaeological research on land and underwater in order to record and preserve as much as possible of this unique and internationally significant example of the cultural heritage of Saudi Arabia.

### *Acknowledgements*

We are indebted to HRH Prince Sultan bin Salman bin Abdul Aziz, President of the Saudi Commission for Tourism and Antiquities, KSA, and Professor Ali Al-Ghabban, Vice-President, for granting permission to undertake the fieldwork and for supporting our work more generally. For funding, we thank the British Academy (grant LRG-45481) the Leverhulme Trust (grant F/00 224/AB) and the National Geographic Society. We are also grateful to the Farasan Border Guard for providing equipment and assistance in the diving operation, and in particular to Commander Hamad Al Bor for his good help and advice, and to Eng. Misfer Mohammad Alwetaid of the Farasan Municipality and his staff.

Geoff Bailey and Abdullah Alsharekh were responsible for the overall direction of the work. Garry Momber led the diving team with Nabiel Al-Shaikh, Lawrence Moran, Jan Gillespie and Julie Satchell. Abdullah Kamil undertook the conservation work on the human bone from Janaba 4, and Matthew Williams led the survey and excavation work on the shell mounds with the collaboration of the other authors. We also thank the other members of the Commission for Tourism and Antiquities who participated in the excavations and fieldwork: AbdulMosin Al-Monif, Yahyia Hazazi, Faisal Mugalith, and AbdulAziz Saad; and Mohammad Moftah from the town of Farasan. We also thank the Hampshire and Wight Trust for Maritime Archaeology for provision of underwater archaeological and audiovisual equipment.


**Figure 1:** Location of shell midden sites on the Farasan Islands, Saudi Arabia. Square indicates Khur Maadi excavated sites, and solid circle indicates Janaba East excavated sites. Circles with dotted lines are shell sites located on satellite images. Some of these have been visited, but most have not yet been surveyed in detail.

**Figure 2:** Shell mound on the Gandeel Peninsula north of Farasan Town. The shell mound was originally located on a coral platform, forming an island surrounded by sea water. The marine erosion forming the characteristic undercut feature is visible at the base of the mound. At some later date, the sea has retreated, leaving the mound surrounded by sandy deposits. Photo by Nabiel AlShaikh, March 2009.

**Figure 3:** Stone-built circular structure on the Gandeel Peninsula looking south-east. The compass in the lower left of the picture provides a scale and orientation. Photo by Nabiel Al Shaikh, March 2009.



**Figure 4:** a & b Two worked flakes struck from a *Tridacna* shell. These were part of a group of flakes found within a 1-metre radius on the surface, about 100m inland from a group of shell mounds in a bay on the south of Qumah Island to the west of Qumah Bay. Photos by Nabiel Al Shaikh, March 2009.

**Figure 5:** Augering in progress by Matthew Williams, with samples laid out in chronological order. Photograph by Nabiel Al Shaikh, March 2009.

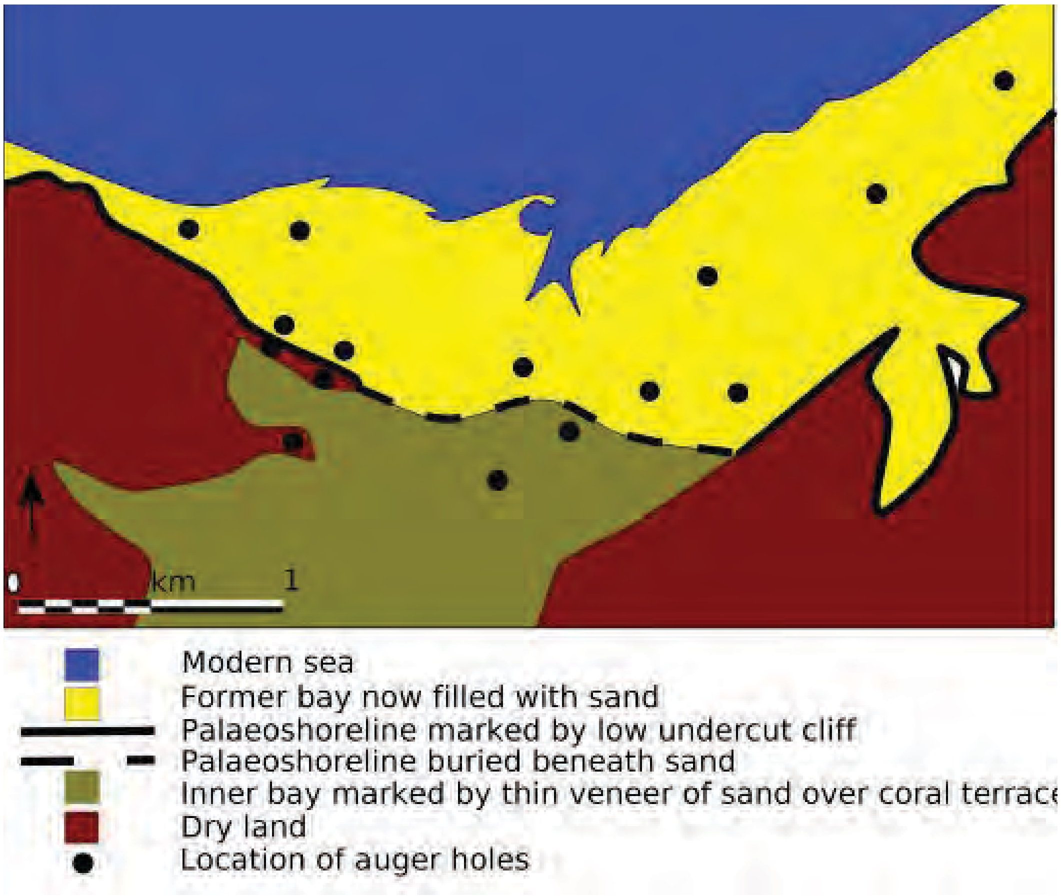


**Figure 6:** Location map showing the distribution of auger holes and configuration of palaeoshorelines in the Khur Maadi Bay. Drawn by M.G.M. Williams.

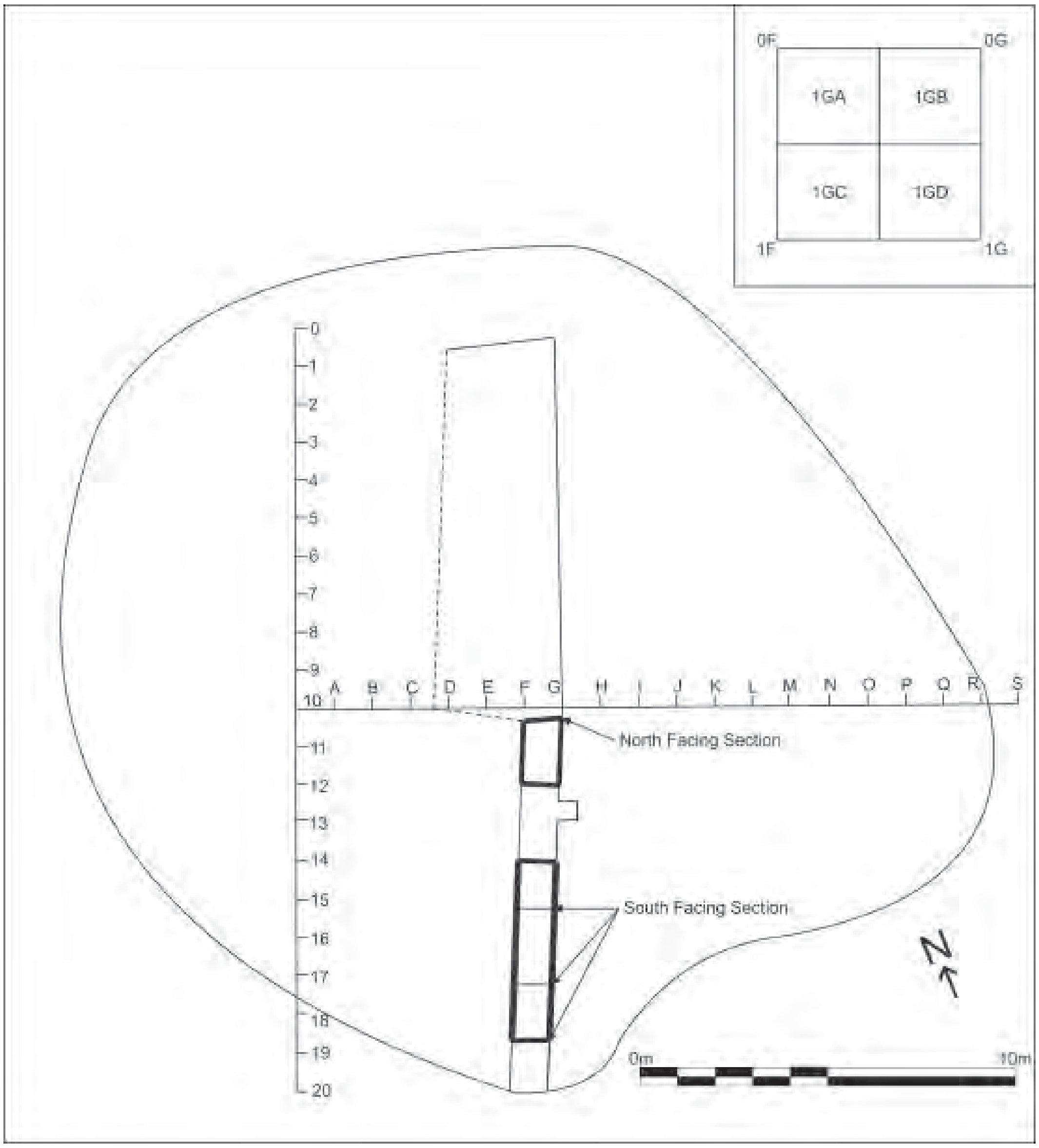


**Figure 7:** Plan of Janaba 4 (JE004), showing excavation trenches, and the principal areas of new excavation in 2009, indicated by the heavier outline. Drawn by M.G.M. Williams.

**Figure 8:** Excavated material being sieved on site, using both sieve trays, with Yahyia Hazazi and Harry Robson. Photo by Nabiel Al Shaikh, March 2009.

**Figure 9:** Excavation in progress at Janaba 4, with Geoff Bailey, AbdulMohsin Al-Monif and Matt Williams, showing bags of deposits lined up ready for sieving. Photo by Claire Reeler, March 2009.

**Figure 10:** Sieving in the municipal compound b Harry Robson, Matt Williams, and Claire Reeler. Photo by Nabiel Al Shaikh, March 2009.

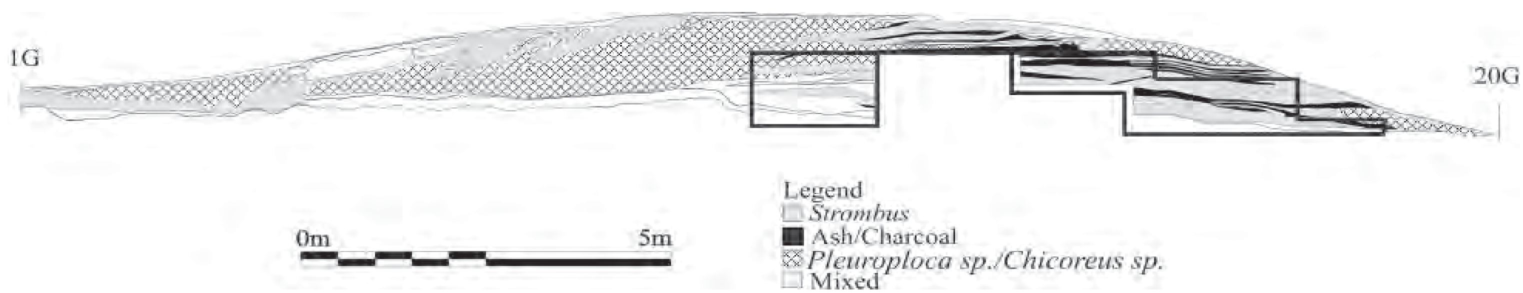


**Fig. 11.** JE0004, west-facing section, 2009. The black lines enclose areas of deposit that were excavated in 2009. Drawn by M.G.M. Williams.

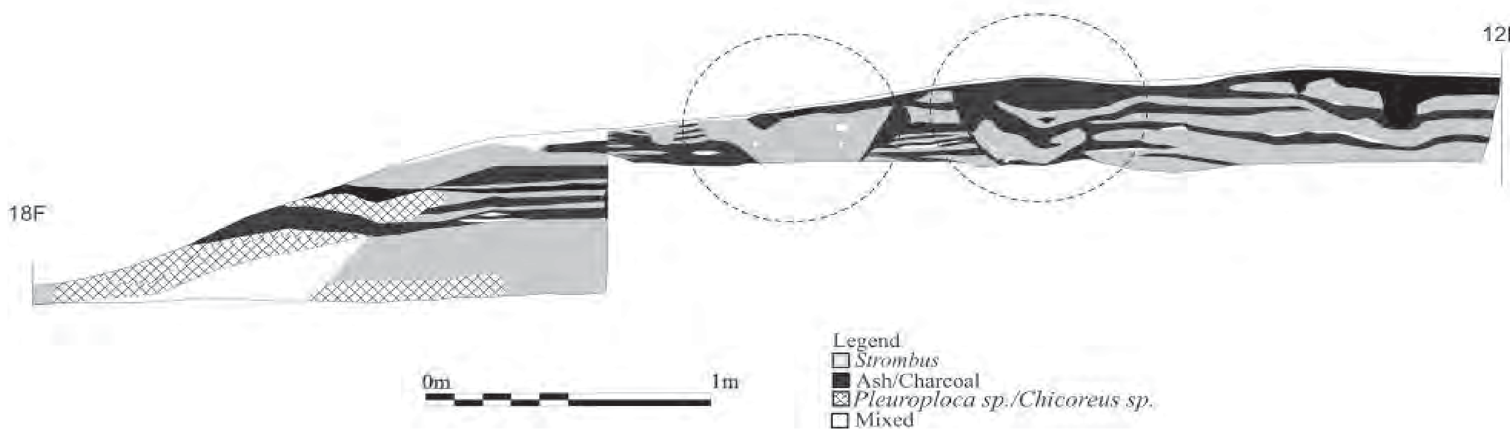


**Fig. 12.** JE0004, east-facing section. 2009. Conventions as in Figure 7. The two pits shown in the centre of the section are the burial pits associated with human remains. Drawn by M.G.M. Williams.


**Figure 13.:** West facing section in northern half of mound, showing alternation of layers with large gastropod shells and layers dominated by the small *Strombu*s *fasciatus* species. Photo by Harry Robson, March 2009.

**Figure 14.:** Alternating layers of clean *Strombus* and ash/charcoal layers. West facing section at the boundary of 14G and 16F. Photo by Harry Robson.


**Figure 15a and Figure 15b.:** In situ hearth in 12FB. Figure 15a. General view on left showing hearth in relation to south-facing section. Figure 15b. Vertical close up on right. Photos by Nabiel Al Shaikh.

**Figure 16.:** Grave cut of child burial in the east facing section of squares 14FC, 14FA, 13FC and 13FA (see also Figure 12). The pit is about 50 cm wide at the top and 25 cm deep. The pit has been cut from the present-day surface, but the original surface of the mound at this point was probably higher, and the uppermost deposits of the original mound have been removed by some earlier clearance operation. The pit clearly truncates earlier stratified layers of alternating fine shell and ash. The worked stone flake placed at the base of the pit beneath the skull fragments is visible to the left, indicated by the arrow. Photo by Harry Robson.


**Figure 17.:** Shells of gastropods and the shell of a large bivalve associated with the child burial. Photo by Nabiel Al Shaikh.


**Figure 18.:** Adult human femur and other long bones from the second burial showing their degraded state. Photo by Harry Robson.


**Figure 19.:** Heavily degraded hand and wrist bones from the adult burial. Photo by Harry Robson.

**Figure 20.:** A test pit excavated into the top of a shell mound in Khur Maadi. Photo by Harry Robson, March 2009.

**Figure 21.:** Section of test pit in one of the Khur Maadi shell mounds (KM1307), showing charcoal sample in section before removal for dating. Photo by Harry Robson, March 2009.

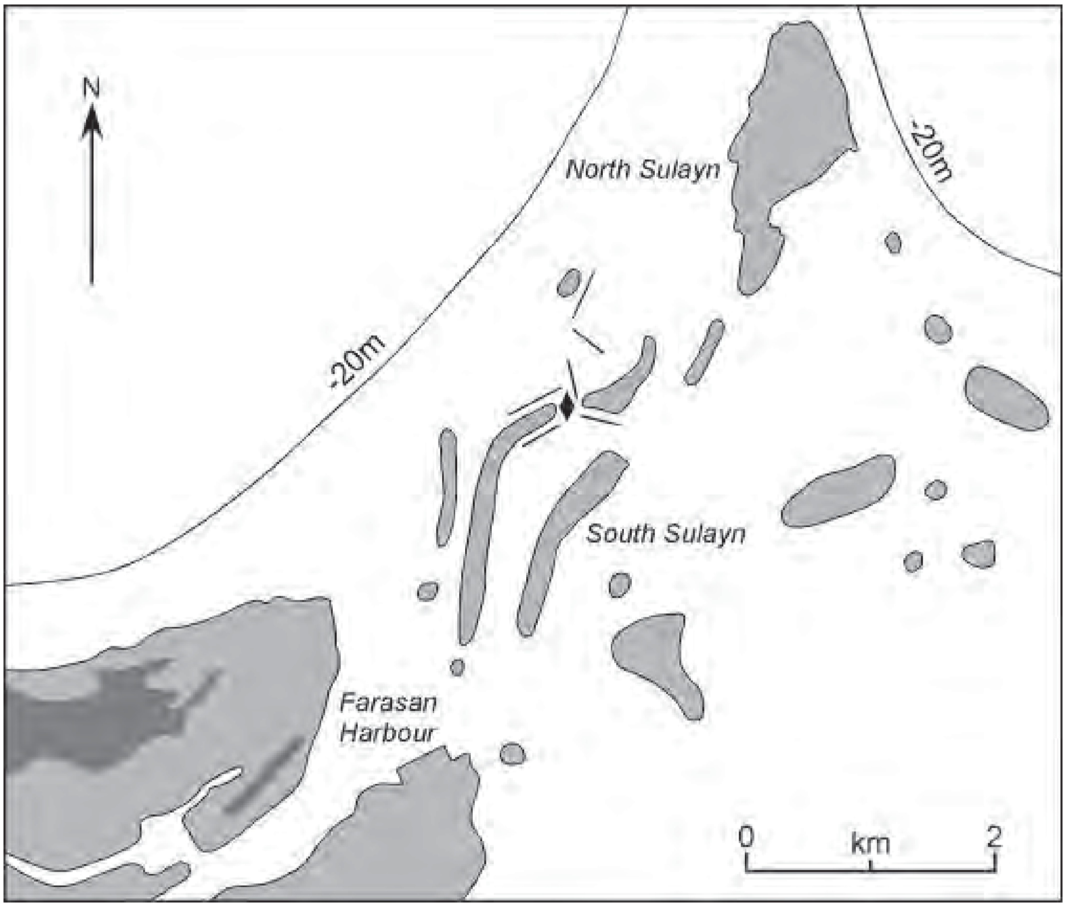


**Figure 22.:** Chart showing the 20m contour around the Sulayn al Janub archipelago and location of diver inspections and excavation. Drawn by G.N. Bailey.

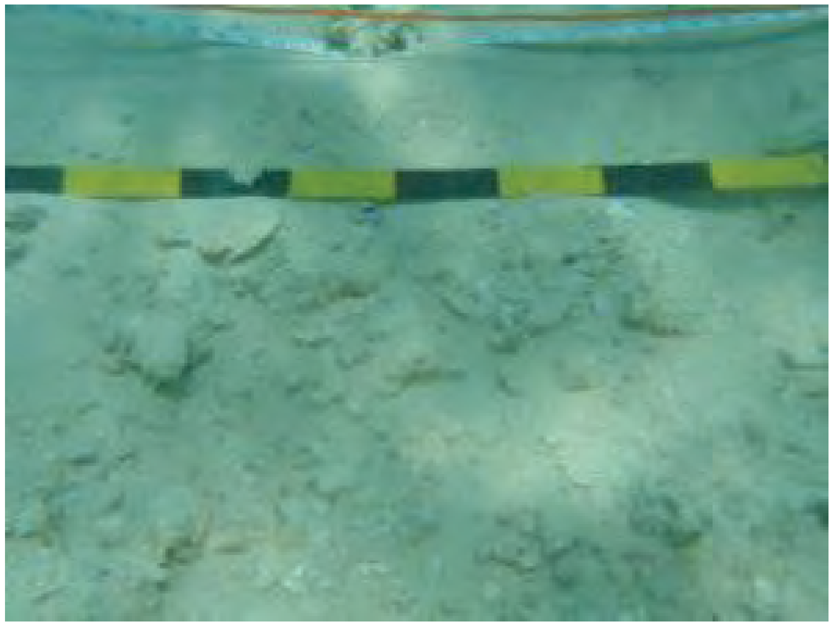

**Figure 23.:** Section of trench at the western end showing high concentration of shells in a sandy/shell mix. The grey lens has been obscured by falling sand. Photo by Garry Momber, March 2009.

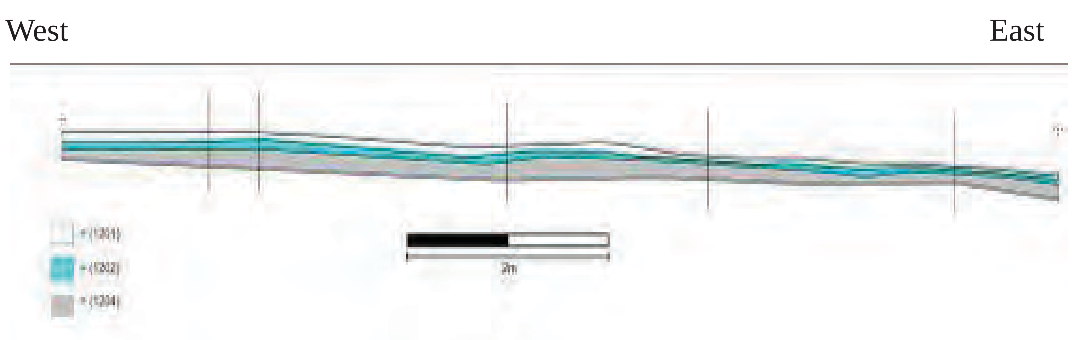


**Figure 24.:** Image shows the stratigraphic layers across the slope from west to east. The location of the samples is marked with vertical lines. From west to east, the distances along the trench were 1.5m, 2m, 5m, 6.5m and 9m. The depths below water level range from 2m below local Ordnance datum in the west to 3m below in the east.

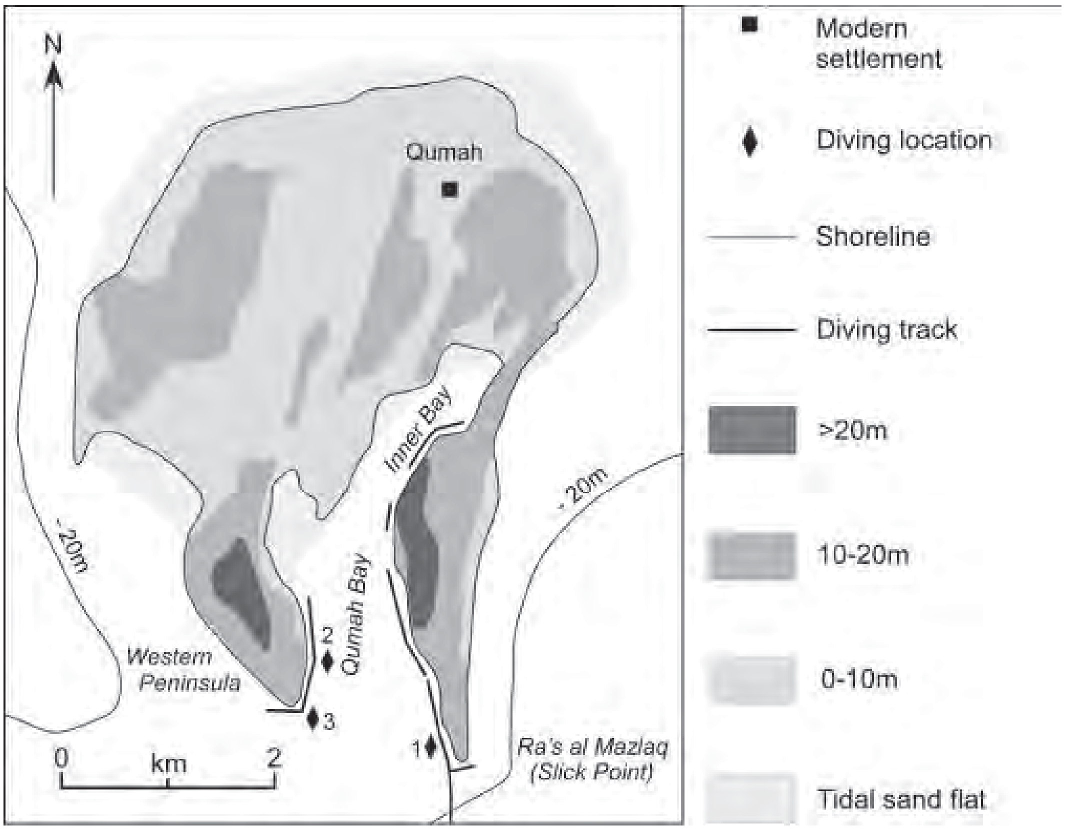


**Figure 25.:** Map of Qumah Island, showing diving locations and places mentioned in the text. Diving locations are: 1. Slick Point; 2. Western Peninsula; 3. Shark Point. The site of RS QB01 is at location 2. Drawn by G. N. Bailey.

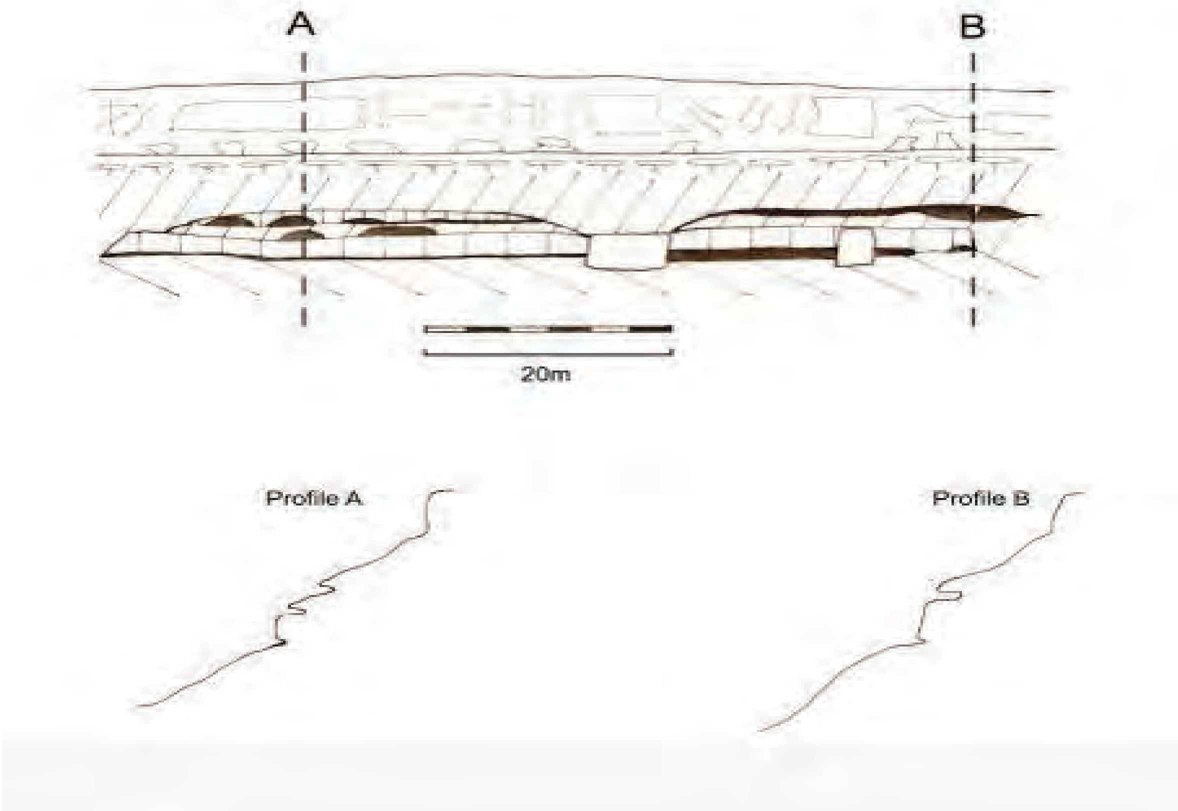


**Figure 26.:** Measured section drawing of the wave cut terraces and overhangs exposed at Qumah Bay, location 2. Redrawn by Rachel Bynoe after Garry Momber.

**Figure 27.:** South facing entrance to wave cut notch on the western side of Qumah Bay. It would have offered a view over a low lying area to the south west and would have been large enough to provide shelter for humans when sea level was lower. Photo by Garry Momber.

**Figure. 28.:** The small cave filled with layers of shells was revealed following excavations below the wave cut arch in 17m of water. The relic coral reef can be seen outcropping in the bottom right hand corner. Photo by Garry Momber.

**Figure 29.:** The north side of Abker Island The reef is below water in the middle of the picture while the drop off is to the right of the picture. Photo by Garry Momber.