Coastal archaeology in the Farasan Islands: 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 work 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			Longitude		
	Degrees	Minutes	Seconds	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 24). 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 28, 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 Bayand around the shorelines of Qumah Bay, as described above (This volume?). 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 above ref 2006 and 2008 reports).

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 (see above ref 2006 and 2008 reports)..

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 above, this volume 2008 report).

Results
Assessment near the shore adjacent to the northern channel in 2008 revealed shell deposits covered by a thin veneer of sand (Figure 23). 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 24). 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 25). 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 above this volume 2008 report).

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 26, 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 (Figure 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 above this volume 2008 report).

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). 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 29). 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 30). 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

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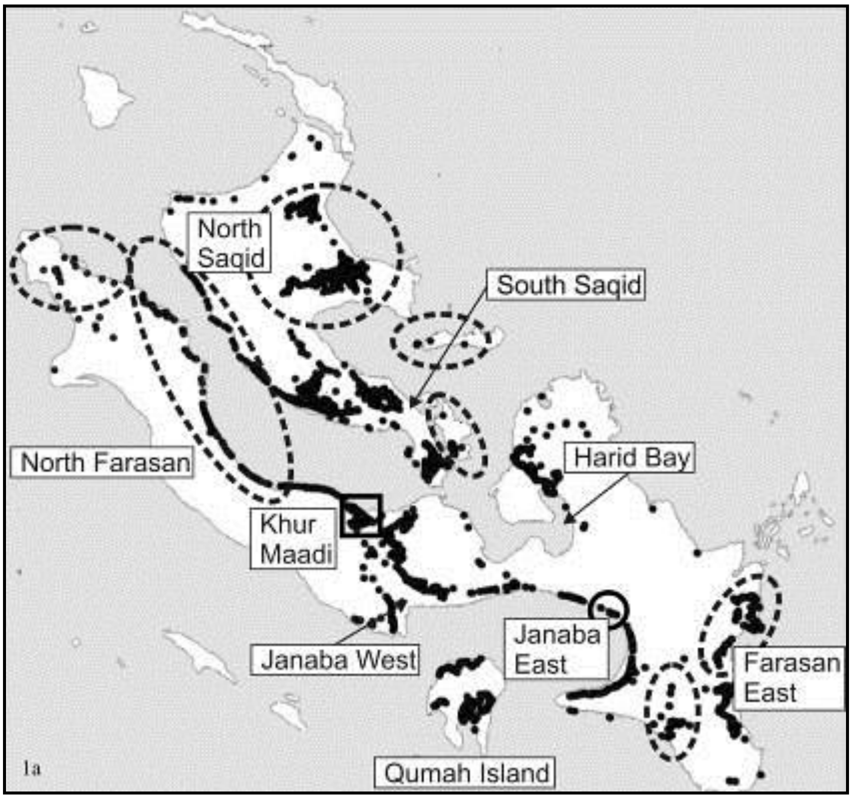

Figure 1: Location of shell midden sites on the Farasan Islands, Saudi Arabia. Square indicates Khur Maadi excavated sites, and solid circle indicates Janaba East excavated sites. Circles with dotted lines are shell sites located on satellite images. Some of these have been visited, but most have not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

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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.

Figure 4. 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 bay on the south of Qumah Island to the west of Qumah Bay. Photos by Nabiel Al Shaikh.

Figure 5. Augering in progress with samples laid out in chronological order.
Photograph by Nabiel Al Shaikh.

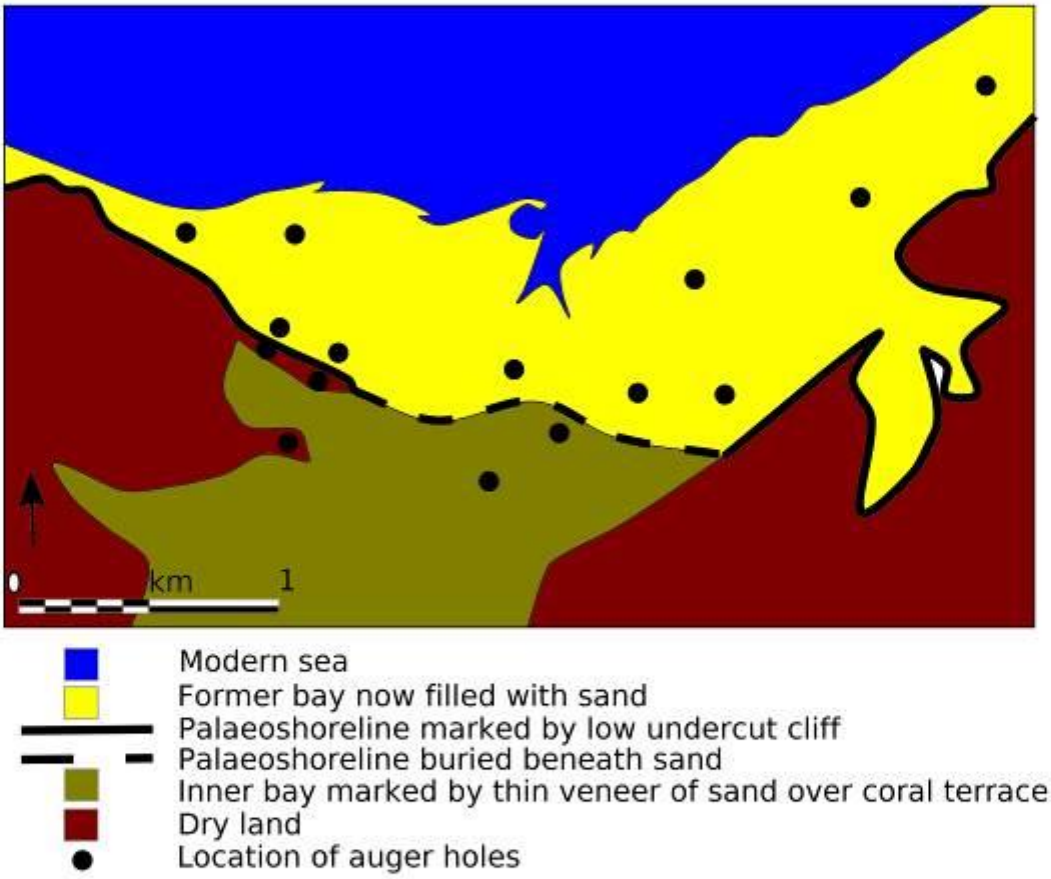

Figure 6. Location map showing the distribution of auger holes and configuration of palaeoshorelines in the Khur Maadi Bay. Drawn by M.G.M. Williams.

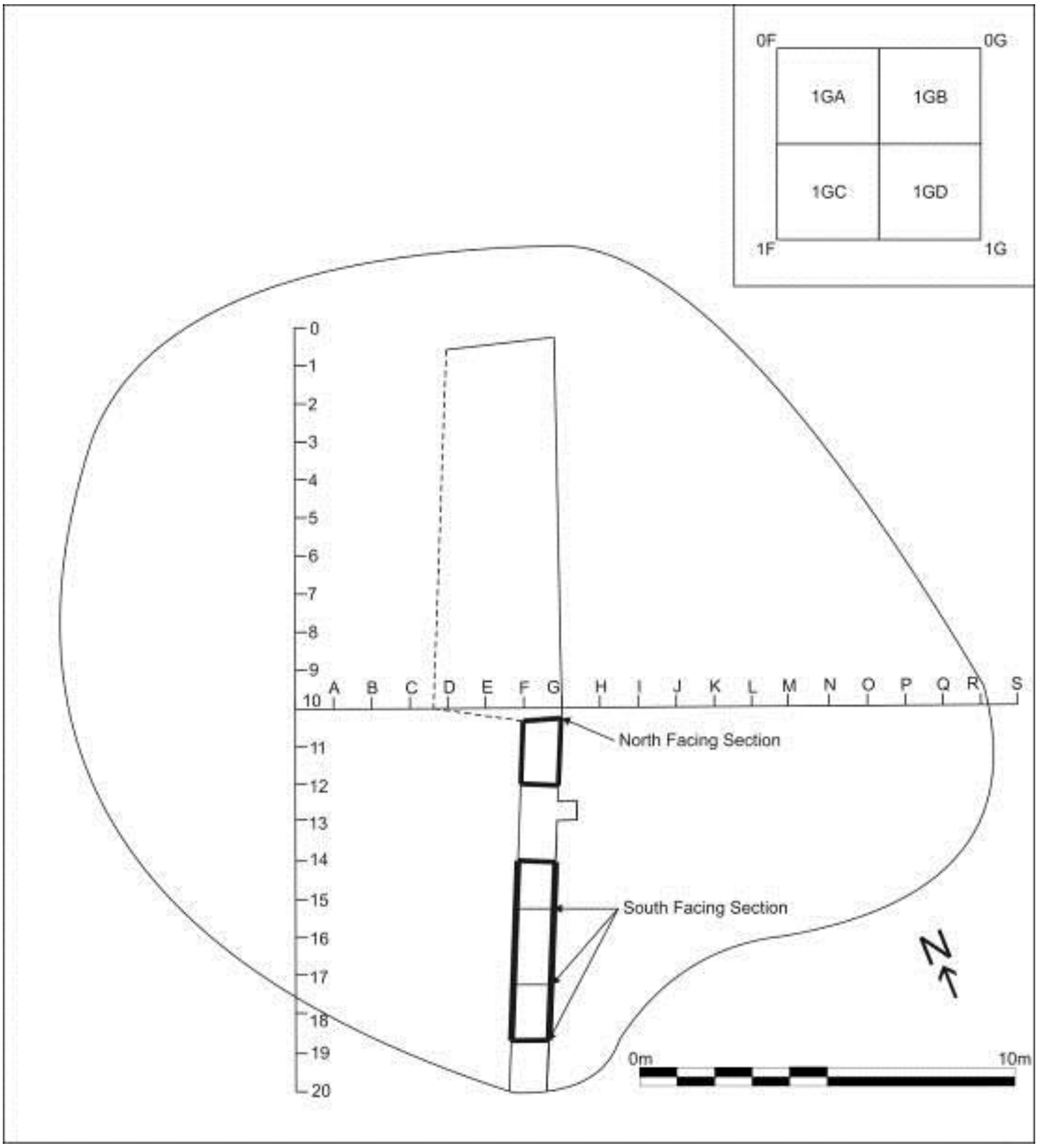

Figure 7. Plan of Janaba 4 (JE004), showing excavation trenches, and the principal areas of new excavation in 2009, indicated by the heavier outline. Drawn by M.G.M. Williams.

Figure 8. Excavated material being sieved on site, using both sieve trays. Photo by Nabiel Al Shaikh

Figure 9. Excavation in progress at Janaba 4, showing bags of deposits lined up ready for sieving. Photo by Claire Reeler.

Figure 10. Sieving in the municipal compound. Photo by Nabiel Al Shaikh.

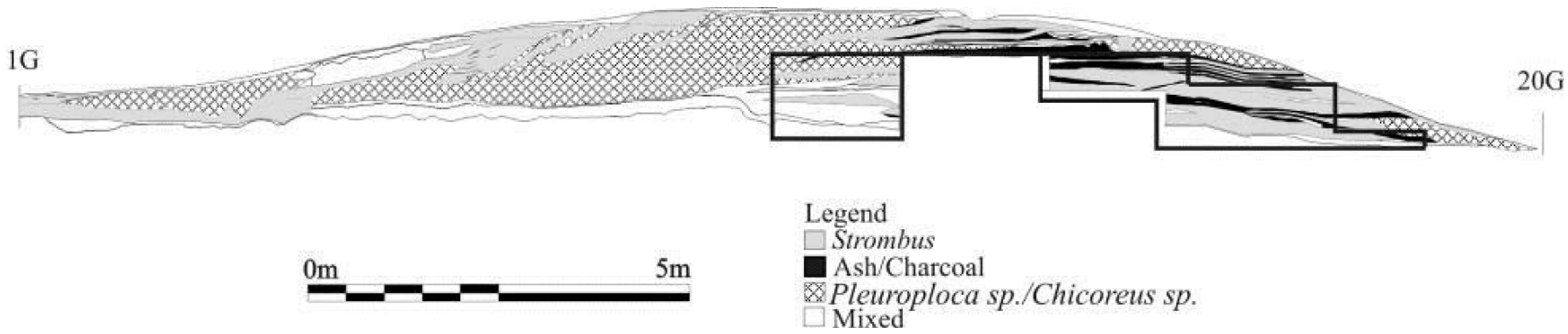

Figure 11. JE0004, west-facing section, 2009. The black lines enclose areas of deposit that were excavated in 2009. Drawn by M.G.M. Williams.

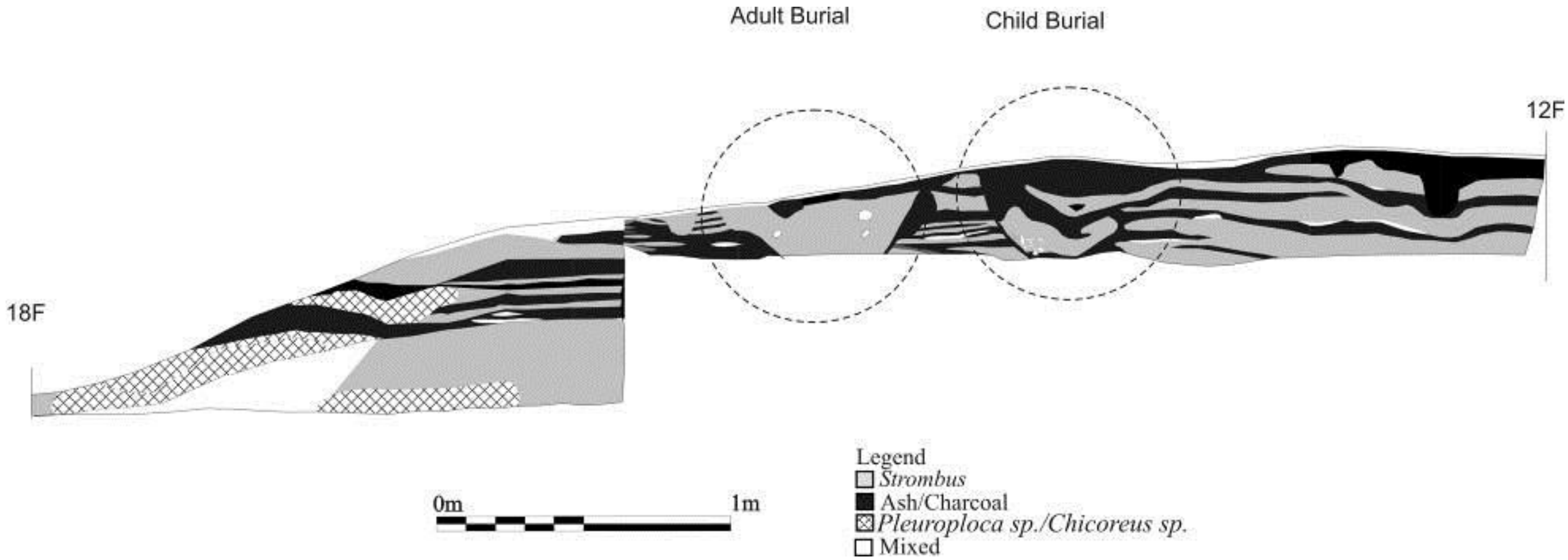

Figure 12. JE0004, east-facing section. 2009. Conventions as in Figure 7. The two pits shown in the centre of the section are the burial pits associated with human remains. Drawn by M.G.M. Williams.

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

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

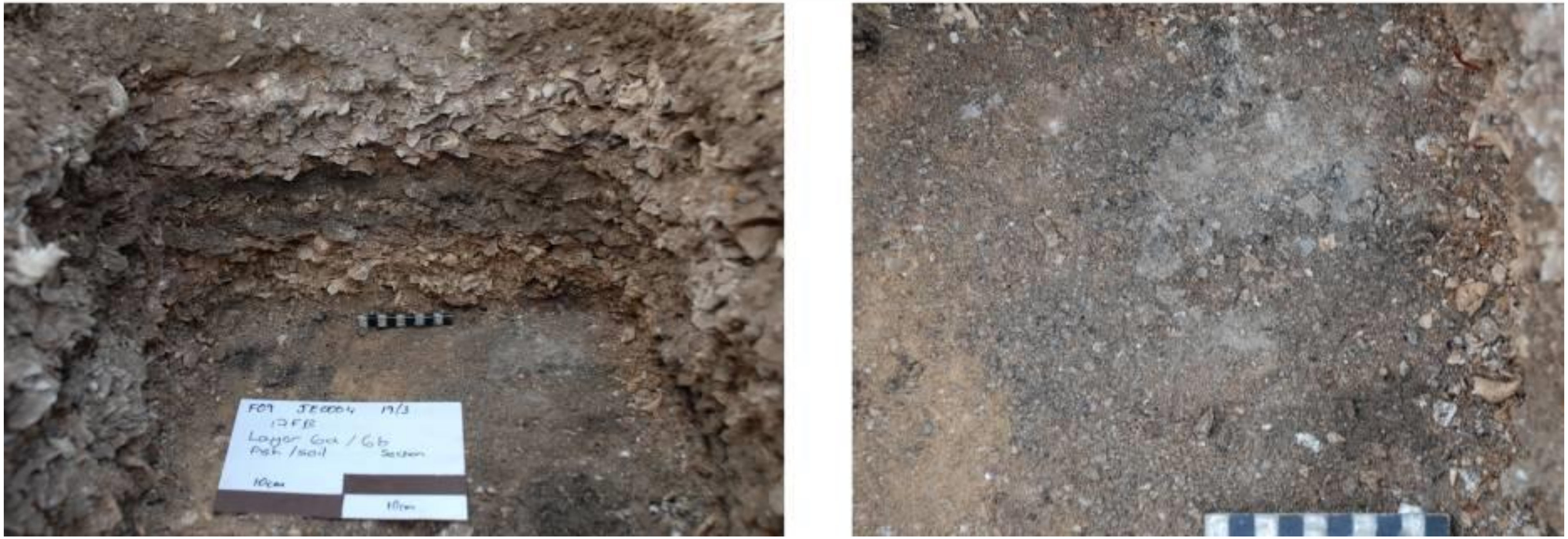

Figure 15. In situ hearth in 12FB. General view on left showing hearth in relation to south-facing section. Vertical close up on right. Photos by Nabiel Al Shaikh.

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.

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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 Janaba West (JW1841). Photo by Harry Robson.

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.

Figure 22. Wave and solution cut features now elevated above sea level in Qumah Bay. Photo by Nabiel al Shaikh.

Figure 23. Shell midden on South Sulayn Island. Photo by Garry Momber.

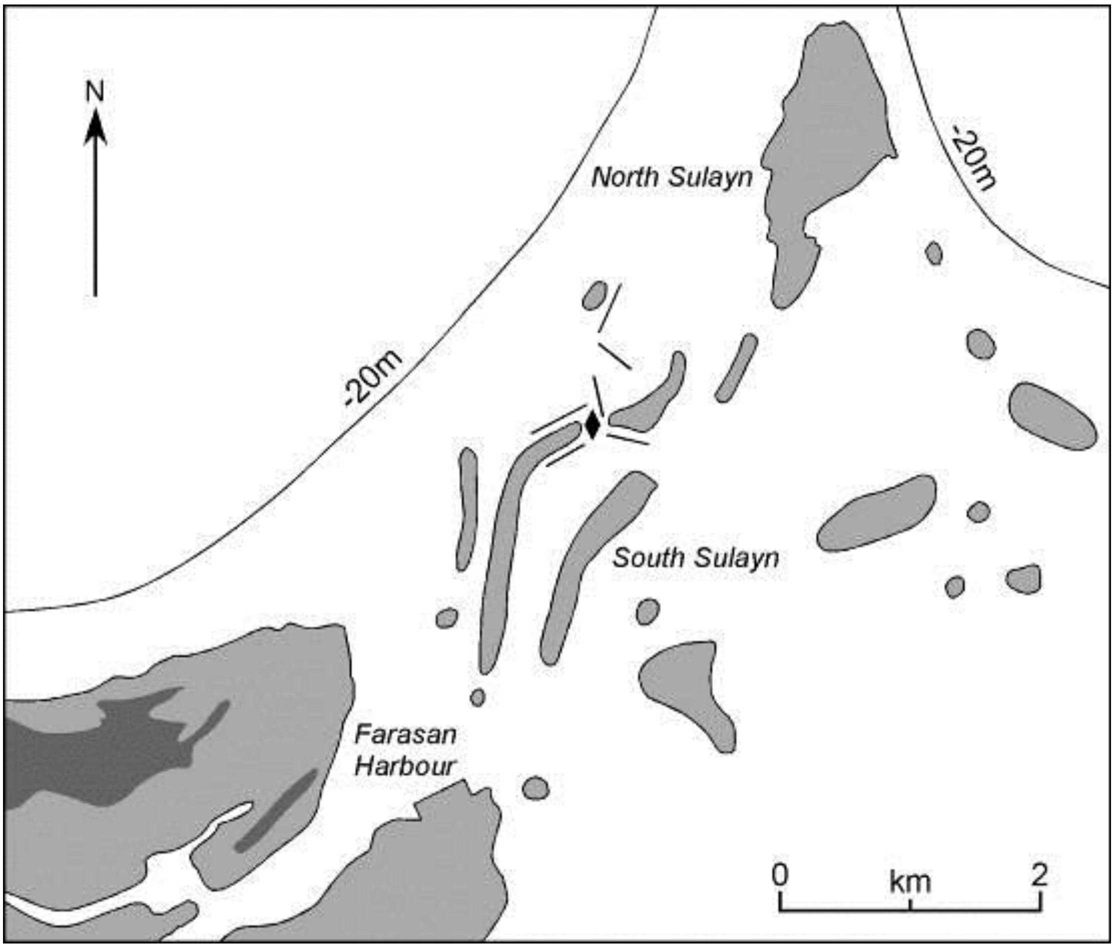

Figure 24. Chart showing the 20m contour around the Sulayn al Janub archipelago and location of diver inspections and excavation. Drawn by G.N. Bailey.

Figure 25. Headland on the western side of the north channel investigated in Sulayn al Janub archipelago. Diving operations were conducted from left to right below the water in the foreground. Photo by Nabiel Al Shaikh.

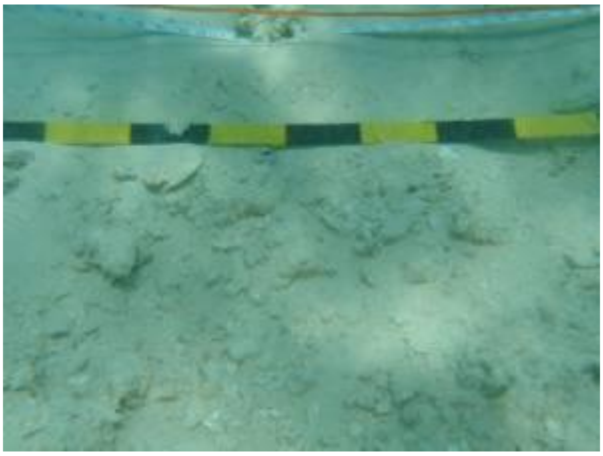

Figure 26. Section of trench at the western end showing high concentration of shells in a sandy/shell mix. The grey lens has been obscured by falling sand. Photo by Garry Momber.

West East

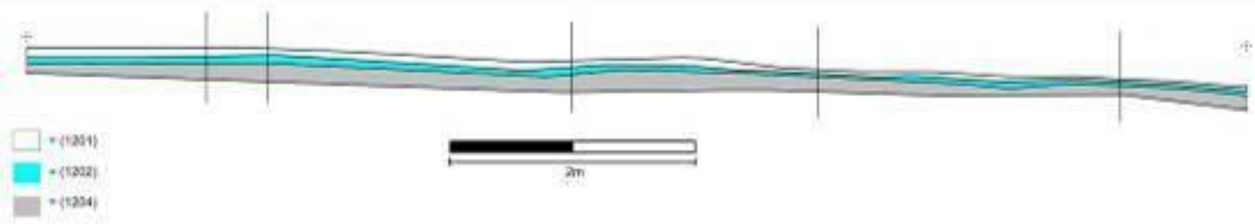

Figure 27. Image shows the stratigraphic layers across the slope from west to east. The location of the samples is marked with vertical lines. From west to east, the distances along the trench were 1.5m, 2m, 5m, 6.5m and 9m. The depths below water level range from 2m below local Ordnance datum in the west to 3m below in the east.

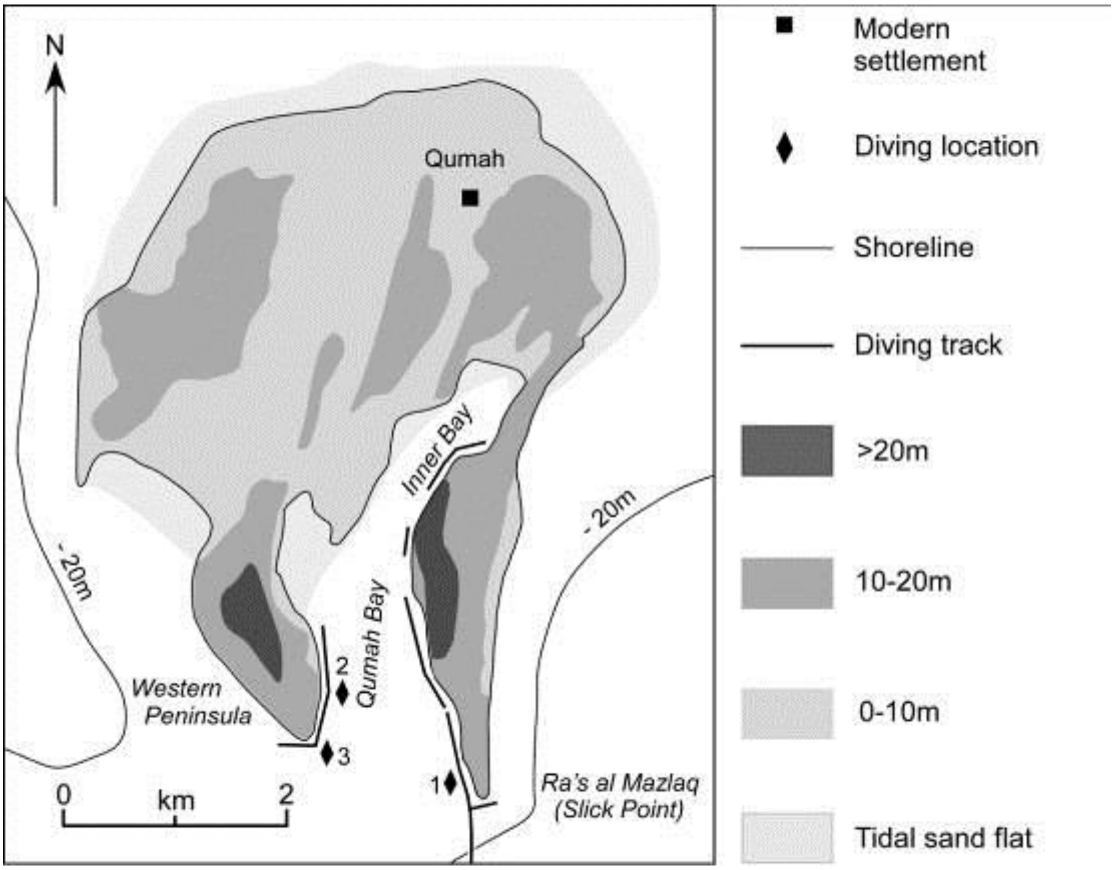

Figure 28. Map of Qumah Island, showing diving locations and places mentioned in the text. Diving locations are: 1. Slick Point; 2. Western Peninsula; 3. Shark Point. The site of RS QB01 is at location 2. Drawn by G. N. Bailey.

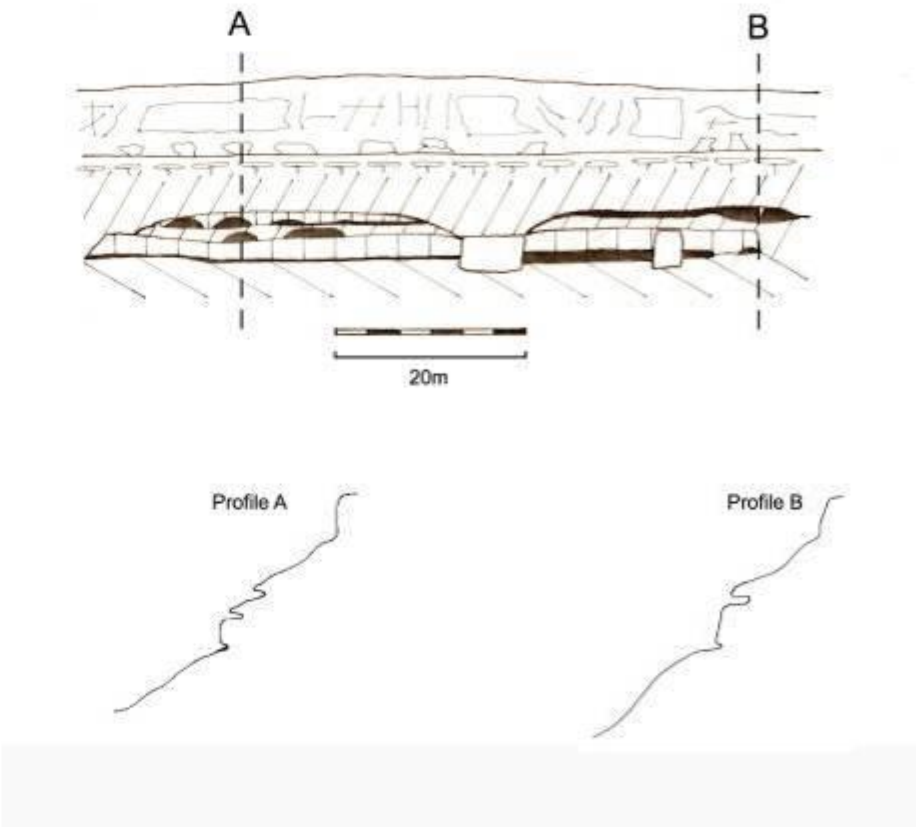

Figure 29. Measured section drawing of the wave cut terraces and overhangs exposed at Qumah Bay, location 2. Redrawn by Rachel Bynoe after Garry Momber.

Figure 30. 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 31. Cliff inside west peninsula and above submerged wave/solution cut features. Photo by Nabiel Al Shaikh.

Figure 32. 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 33. 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