Report on the Saudi-UK Palaeolithic Research Project Field Season 2018 in the Tabuk and Al Jowf Provinces, Northwestern Saudi Arabia.

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1. Overview

The Saudi-UK Palaeolithic Research Project Field Season 2018 is a preliminary assessment of the potential for Palaeolithic archaeology in the northwestern region of Saudi Arabia covering the coastal areas of the Gulf of Aqaba and the northern end of the Saudi Arabian Red Sea Coast. The work undertaken in 2018 is an initial study required to set a framework of background knowledge and archaeological potential necessary for future grant applications that will support a future long-term project by the team in this area. Since the region is close to the Arabian side of the Nile-Levant dispersal route, the Palaeolithic record of this region is potentially key for understanding hominin dispersals out of Africa. It is also important to an understanding of later adaptations to coastal margins during the Palaeolithic and later. The area also preserves outstanding examples of the archaeological record from later periods in the prehistory of Saudi-Arabia.

The survey area, primarily in Tabuk province, northwestern Saudi Arabia covers an area of over 180 x 180 km, including a variety of landscapes and stretching from the coast in the Gulf of Aqaba and Red Sea in the west and south to beyond the watershed of the Arabian escarpment in the east (Figure 1). The fieldwork in 2018 was undertaken by a team of 7 that included 4 Saudi and 3 UK nationals (Dr Abdullah Alsharekh, Dr Dhaifallah Al Othaibi, Mr Saud Al Huwaiti, Mr Abdulillah Timani, Professor Anthony Sinclair, Dr Robyn Inglis, and Mr Christopher Scott).

This report outlines the main archaeology, geological and geomorphological data from the region and describes a preliminary framework for the archaeological investigation of the region, based on the definition of broad-scale landscape zones, and their potential for preserving Palaeolithic archaeology. (Devès, et al., 2013, Inglis, et al., 2014). It also includes preliminary information based on the findings from 11 days of field survey. Future development of the region for business and tourism will likely have an impact on the landscape and the archaeology it currently contains.

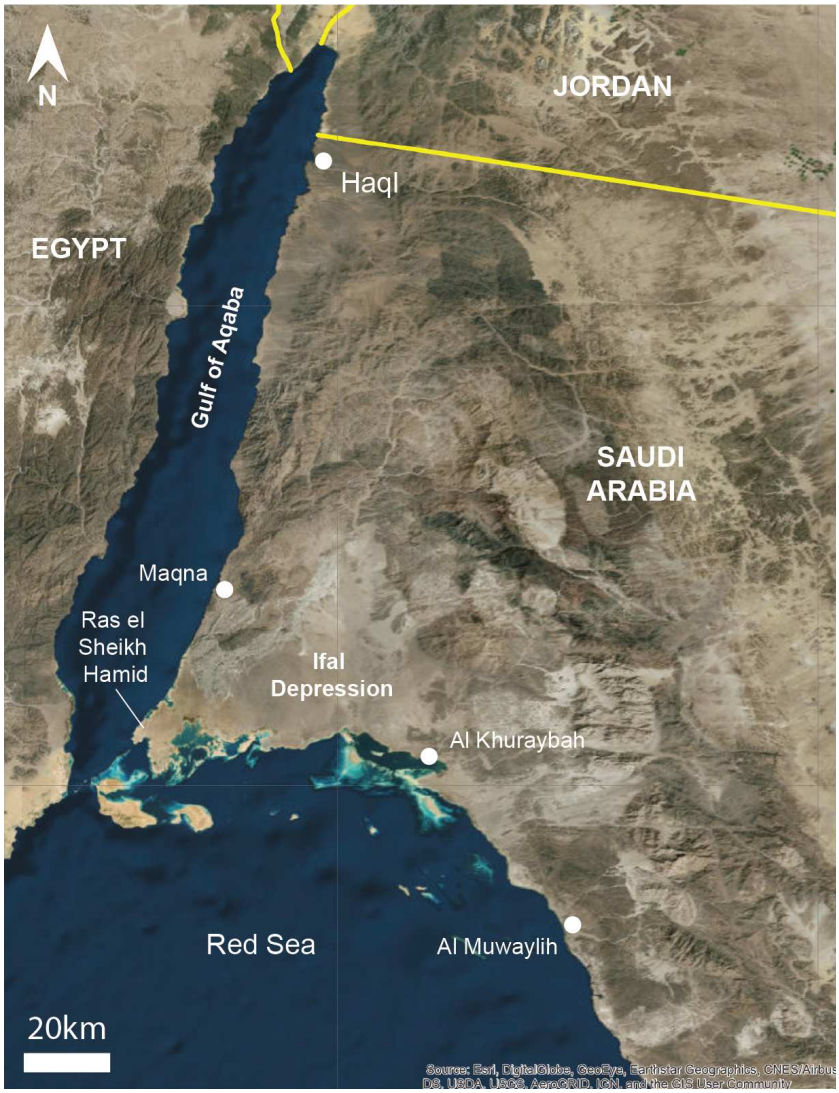

Figure 1: The study region in northwestern Saudi Arabia. Basemap © ESRI.

2. Topographical Setting

The survey area, spans from the coastline to beyond the watershed of the northernmost extent of the Hijaz Mountains/Arabian Escarpment which, running SE-NW in this region rise to over 2500 m asl. The north of the region in particular is dominated by this mountainous landscape that deeply incised valleys cross-cut by wadis (Figure 1). The coastal plain is far narrower than that further south in the Red Sea, whilst along the Gulf of Aqaba it disappears completely as the mountainous landscape extends to the sea for ~65km (Bayer, et al., 1984).

In the central part of the study region, the Ifal Depression (a northern extension of the Red Sea graben system) extends south from the town of Al Bad' to the Red Sea (Briem and Blümel, 1984). Wadi Ifal is the main wadi draining the basin and has the largest catchment area of the wadis that drain into the Red Sea within the study region. Another major wadi system runs from the southeastern tip of the

region into the Red Sea, meting the coast ~50 Km north of Al Muwaylih. Few of the major wadis drain into the Gulf of Aqaba, probably a factor of the steep topography and uplift within this region.

In 2018, the region explored for archaeological survey of Palaeolithic materials includes the Red Sea coastal plain within the planned study region to the west and southwest of the Hijaz Mountains, the Ifal Depression and the coastal plain along the Gulf of Aqaba from Haql down to the Ras el Sheikh Hamid.

3. Geological Setting

The Midyan region is part of the crystalline shield of the Arabian plate, and in this region consists primarily of Precambrian (Cryogenian and Ediacaran) rocks (Figure 2; Bayer, et al., 1984, Johnson, 2006).

The following lithological units are summarised from Johnson (2006) - more detail can be found in Appendix 1:

The survey region is dominated by granitic basement rocks. Both the Qazaz (qa) and the Al Bad (abg) granite super suites cover large areas of the escarpment, along with the mafic plutons of the Muwaylih suite (mw) which are present mainly in the southeast of the region. Another significant unit, covering a large area in the southeast of the region is the Ghawjah formation (gj), which comprises metavolcanic and meta-sedimentary rocks including massive porphyric andesitic flows. There are also small areas of ‘Ediacaran rhyolite’ (er).

Other lithiologies in the centre of the region are the sedimentary and volcanic rocks of the Amlas formation (am), as well as the volcanic, volcaniclastic and sedimentary rocks of the Hegaf formation (ga). In the far north the Hinshan formation comprises intermediate to felsic volcanic and sedimentary rocks, and in the northwest the Zaytah formation (zy) of metamorphosed felsic lava and tuff and schists. Around the areas of the Ghawjah formation (gj), the Silasia formation (sl) comprises a further sedimentary-volcaniclastic succession.

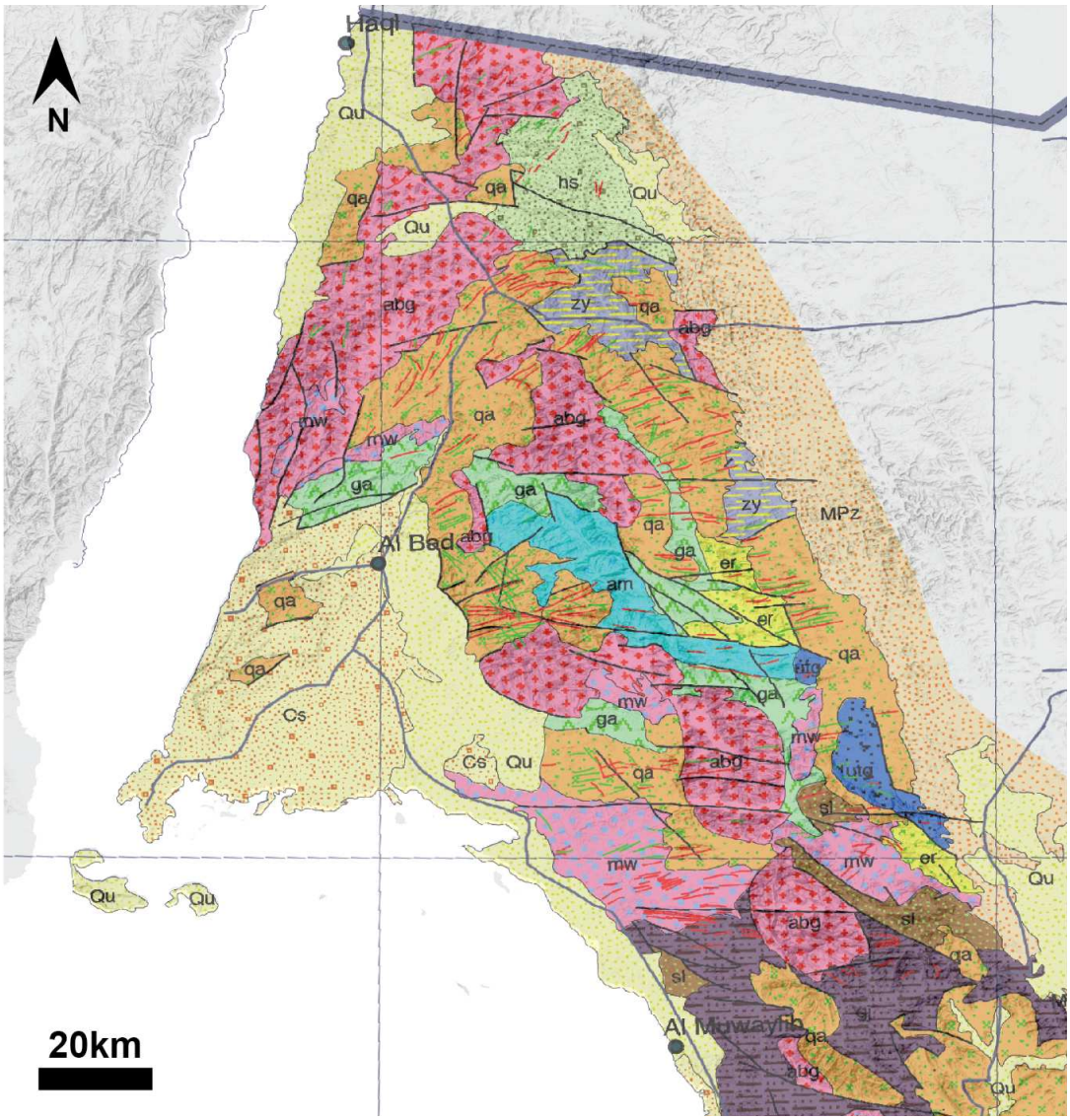

Figure 2: Geological map of the study region (Johnson 2006).

There are large areas of Quaternary sediments (Qu) along the coastal plain, and a long area of undivided Mesozoic and Palaeozoic sedimentary rocks to the east of the region (Mpz). At the southeast edge of the region, the basalt flows of the northern part of the Harrat Uwaynd are visible, marked as Cenozoic basalts (Cb). The area of undifferentiated Cenozoic rocks (Cs) in the southwest of the region corresponds to the outcropping of Ifal Formation (Briem and Blümel, 1984).

Whilst the predominance of granite lithologies in the region would have provided little material suitable for stone tool making, the various plutons and formations with volcanic origins (eg. the Amlas, Hegaf, Hinshan, Zaytah, Ghawjah and Silasia formations) may have provided sources of raw material for manufacture, such as the andesitic flows of the Ghawjah formation in the southeast of the region. In addition, the catchments of the major wadis that drain the escarpment cross-cut many of these lithologies, potentially transporting material in the form of cobbles for tens of kilometres from their sources.

4. Palaeolithic archaeological remains recorded prior to 2018

The area of the 2018 Survey was both first and last surveyed for Palaeolithic archaeological materials as part of the Comprehensive Archaeological Survey Programme of the Kingdom (CASP) conducted in the late 1970s and early 1980s. In particular this region was surveyed as part of the Northwestern region of the CASP (Ingraham, et al., 1981). Four Palaeolithic sites were recorded on the coastal plain on Wadi terraces in Wadi Surr and Wadi Tiryam northeast of Al Muwaylih (Figure 3). The survey also reported circular enclosures from these locations, similar to those found by other survey teams in the interior. Lithics were largely undiagnostic, aside from a single Middle Palaeolithic transverse scraper found at site 204-61. Large basalt flakes and blades were also found which were 'probably' Palaeolithic. The authors report that no Palaeolithic sites were found in the Hijaz mountains, and attribute this lack of finds to either their methodology of survey or geomorphological factors including the nature of the terrain or its Quaternary sediment cover (Ingraham, et al., 1981). Of particular importance to an assessment of this prior research is that the CASP survey team specifically did not investigate the 'beach terraces' along the Red Sea coastline (Ingraham, et al., 1981).

5. Fossil Coral Terraces

Numerous outcrops of Quaternary coral terrace deposits preserved above present-day sea level have been documented along the Gulf of Aqaba and the northern Red Sea (Figure 3; Al-Sayari, et al., 1984, Dullo, 1990). A number of these deposits have been recently dated to MIS5 (Bosworth, et al., 2017, Manaa, et al., 2016), a period in which humans were known to inhabit the interior of the Arabian Peninsula (Groucutt, et al., 2015). Reefs have, however, also been dated to MIS7 and older (Taviani, et al., In press). These deposits are a high priority for this survey given that they provide direct and dateable evidence a coastal environment which may have been exploited by past populations.

On the basis of the topography and bathymetry of the coastline, the reefs so far identified are primarily narrow fringing reefs (Taviani, et al., In press). Bosworth et al. (2017) undertook a recent comprehensive survey of the terraces (Appendix 2) , and found that at the very north of the Gulf of Aqaba, MIS5e terraces lie at elevations of ~10 m, increasing to ~25–26 m above sea level when adjacent with the Aragonese and Dakar Deeps, before dropping again to ~3.5 m at the southern end of the Gulf of Aqaba. Further south, on the Red Sea coastline, near Duba, Manaa (2016) has dated a fossil terrace to MIS5 which extended for 5km in length.

The dates now available for these fossil terraces clearly show that certain areas would have been coastal during MIS5. Recent archaeological research elsewhere now shows that these terraces may

contain archaeology directly related to these past shorelines. During archaeological survey in the southwest of Saudi Arabia in Asir province, Palaeolithic artefacts of have been found in situ embedded within such deposits (Sinclair et al. in press). The difficulty lies in identifying shoreline deposits, which, however, remain little reported for the study area, rather than coral reefs.

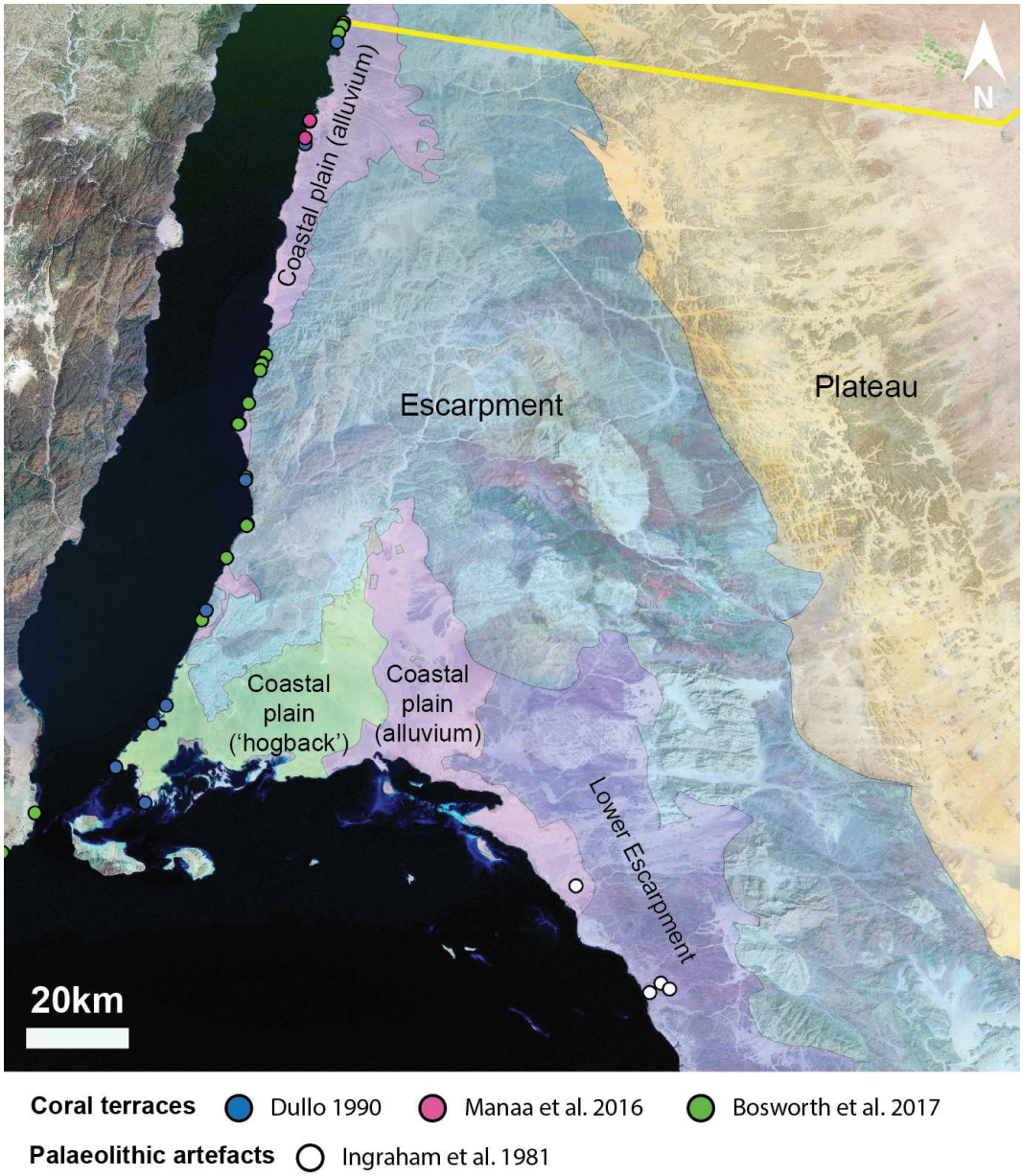

Figure 3: Landscape zones as defined in the study region, as well as the location of known coral terraces and Palaeolithic findspots. Basemap satellite imagery . Satellite imagery © USGS Landsat ETM+ 2000 Gecover Mosaics.

6. Regional Landscape Zones

The survey region has been separated into first order 'landscape zones' primarily based on the topography of the region (which in itself is closely related to the lithology and patterns of sedimentation), that can be used as a broad framework for understanding the broad-scale dynamics

of the landscape (Figure 3). The zones have been defined on the basis of the elevation and topographic data from the region, as well as examination of Geocover 2000 imagery, with reference to the literature. The definition of such landscape zones is essential for an understanding of the main processes controlling landscape development, and their implications for the development of a future archaeological research strategy that would seek to target geomorphological settings that are conducive to the preservation, exposure and visibility of Palaeolithic artefacts.

The geomorphology of the region is dominated by the erosion of basement rocks from the escarpment areas to the coastal plains (or where these do not exist, directly into the sea), and the deposition of this eroded material as large fans on the coastal plains. Tectonic movement related to rifting on a broad and regional scale scale has driven the incision of the shield into these valleys at the broad scale. This influence was interleaved, in the coastal plain, with drops in sea level driving periods of increased incision.

The landscape zones are:

Plateau – The study area extends onto a zone termed here as the 'Plateau', defined by the watershed between wadis that flow south and west into the Red Sea, and eastward into the interior. Given its probable exclusion from the survey little time was spent assessing the area, but its low relief, coupled with Quaternary sediment cover and patches of exposed bedrock, presents a mosaic of areas of high and low potential for archaeological research, and would be a target for future work if the survey was extended into this area.

Escarpment – a large area of heavily-incised valleys formed by the erosion of the Arabian escarpment. With little sediment cover, lithologies are exposed at the surface, and sediments are constrained to wadi channels, where they are subject to rapid, sporadic movement downstream. In the main this zone would be of low potential for finding archaeology, given the rapidity of the erosion of the hillsides, and the repeated flushing through of deeply-incised wadi channels removing any material that was deposited at the base of these slopes. In the east of the region, this landscape zone extends to the shoreline, proving a major topographic barrier to movement along the coastal plain.

Lower Escarpment – In the southeast of the study region, this area is defined by a low, flattish topography that projects above the Quaternary sediments of the coastal plain. Dominated by the Ghawjah and Silasia formations, the exposed lithology of this 'lower escarpment' is dominated by the volcanic and sedimentary rocks. The incision of wadis within these lithologies suggests the preservation of an ancient patterning of river systems, and the flattish topography may promote the

preservation of Palaeolithic artefacts on the surface. In addition, the underlying geology could contain raw material in andesite and other volcanic rocks.

Coastal Plain – this landscape zone can be divided into two main areas, defined by the dominant geomorphological processes.

Coastal Plain (Alluvium) – An area between the foot of the escarpment and the coastline, this gently sloping zone is dominated by alluvial fans from the wadis emerging from the escarpment. Many of these fans are undergoing erosion, and most reflect the lithologies of the lithological units that their wadis move through – this is most clearly seen in Geocover Images. Whilst the depositional environment of the fans may bury artefacts which were deposited on their surfaces, the development of 'desert pavements' on the surface of the alluvial deposits, especially on wadi terraces (Briem and Blümel, 1984) may provide promising targets for survey. Wadi cuts through these fans may also provide sections through these fans, and access to artefact-bearing units if the sediments are of an appropriate age. There are also numerous locations of fossil shoreline and coral terrace deposits along both the Gulf of Aqaba and the Red Sea coastline (see below). Detailed sediment mapping in the region will need to be carried out to further understand the evolution of the region and to determine targets for survey.

Coastal Plain (Tertiary 'Hogbacks') – in the south and southwest of the Ifal depression, stretching to the tip of Ras el Sheikh Hamid, alternating layers of reddish Late Tertiary clastic and fine sediments have been tilted, folded and faulted, with differential erosion of the layers leading to the development of a 'hogback' ridge topography (Briem and Blümel, 1984). Pleistocene coral terrace deposits are also preserved along the headland of Ras el Sheik Hamad (Al-Sayari, et al., 1984).

Built – areas of development and/or agricultural management. These areas are considered to be an underestimate given the pace of development in other areas of the coastal regions, and that seventeen years have elapsed since the creation of the Geocover 2000 Mosaic. It is expected that development would have destroyed archaeology within these areas, although they may also have exposed quarry cuts that can provide stratigraphic data on the region, and potentially stratified archaeology.

7. Survey strategy

The survey region remains a challenging region within which to develop a long-term research strategy for artefacts from the Palaeolithic period on the basis of desktop research alone. As noted above, very little is currently known about the region's Palaeolithic archaeology, whilst the basalt fields that have proved so useful in locating Palaeolithic artefacts in the Southern Red Sea are absent in the study region. Finally, it is likely that the large escarpment areas will preserve little in archaeological

remains. As a result, the focus of investigation for this first initial survey aims to address the following priorities:

- Investigation of the low-profile, low-sedimentation 'lower coastal region' including mapping of main streams etc. through this landscape zone.
- mapping and examination of sediment units in the Ifal Depression and an area of 'hogback' topography to identify representative landforms for future survey.
- examination of deposits identified as marine (coral) terrace to identify those with potential shoreline deposits and which may contain archaeological artefacts.
- listing of specific locations of interest outside of these categories, e.g. Maqna and Aynunah 'oases settlements' (Bayer, et al., 1984) that may be related to springs with long histories of activity.

In order to address these priorities, the initial survey has been planned in two parts. In the first part survey work has concentrated on an examination of potential deposits along the coastal margin along the Gulf of Aqaba, and within the Ifal Depression. During the second part of the survey, work has focussed on deposits along the Red Sea Coast including the coastal margin and its interior hinterland.

8. Survey Methodology

At each locality visited, a detailed description of the local topography, sedimentary units and their potential stratigraphic relationships, the vegetation cover, and the conditions of visibility of artefacts, and the details of all artefacts observed was noted in the field and later transcribed to a specific sheet. These 'locality sheets' provide the primary archive for each place visited, along with photographs of artefacts (if observed) and the local topography, sediments, and finally a location determined using a Garmin 62e GPS device.

For each locality, lithic artefacts or groups of artefacts if found within the same place, were individually located by GPS. A brief description of these artefacts and basic measurements were also recorded on the locality sheets. Finally, photographs of the artefacts (both ventral and dorsal surfaces) were taken. It was decided that no archaeological artefacts would be collected, allowing the possibility for revisiting and assessing sites in the future. A limited number of exceptions have been made to this approach based on the nature and quality of materials encountered. These are listed below. Any archaeological materials located were recorded and photographed in the field.

It should be noted that, given the age of the artefacts sought, the nature of the geomorphological deposits in which they have been found, and the many years of exposure to sun, changing

temperatures, blown sand and other natural processes of erosion, almost all of the pieces observed and recorded have been heavily weathered and often rolled. Rolling leads to a battering / 'softening' of the edges and sometimes a breaking of the pieces. Weathering leads to patination or discolouration, as well as forms of thermal fracture (such as pot lid fractures), the features of which may also soften with later weathering or rolling processes. As a result, many of the diagnostic features necessary to the recognition of Palaeolithic artefacts have been eroded or in some cases disappeared on the pieces observed at these localities. Moreover, the constant process of rolling that happens on deposits containing clasts, cobbles and pebbles will lead to the production of natural flakes and cores ('geofacts') that need to be distinguished from archaeological artefacts. The recognition and recording of artefacts in the field, therefore, has erred on the side of caution. In these circumstances it is presence of a combination of flake scars or the clear imposition of deliberate shape that has been relied upon as the primary factor which differentiates natural geofacts from archaeological artefacts. As a result, the numbers of artefacts recorded at any locality represents a minimum possible number, whilst the percentage of retouched artefacts and cores that has been recorded will be higher than is the case in reality due to the regular reliance on a pattern of positive and negative flake markings rather than the features of a single flake surface.

Where artefacts diagnostic of a particular Palaeolithic period have been recorded they have been identified as either Early Stone Age, Middle Stone Age, Upper Palaeolithic or Neolithic. Where artefacts are non-diagnostic to period, they are listed as non-diagnostic. The period names used here for Early Stone Age and Middle Stone Age recognises the closer similarity of these industries in technological and typological terms to archaeological sites found in Africa rather than Europe – where sites of such age are usually termed Lower and Middle Palaeolithic. The use of the African terminology also reflects a continuity in the types of rock used for lithic tools between Africa and Saudi Arabia (basalt, andesite, indurated shale, hornfels, rhyolite, schist, chert). Early Stone Age artefacts include hand axes, cleavers, and large cutting tools. Middle Stone Age artefacts are recognised by the use of prepared core technologies, and Upper Palaeolithic artefacts by the use of blade technology. Neolithic artefacts include recognisable (arrow) point forms made on small blades and bladelets. Certain artefact forms are known to overlap periods: discoid cores are present in the Early and Middle Stone Age, burins and piercers are made in both the Middle Stone Age and Upper Palaeolithic; small blades and bladelets are produced in both the Upper Palaeolithic and Neolithic.

Chronologically, as a preliminary assumption, we may presume that Early Stone Age materials will predate 300,000 years ago, whilst Middle Stone Age will predate 50,000 years ago. Upper

Palaeolithic materials may date from 50,000 years ago, whilst Neolithic artefacts will date from approximately 10,300 to 6,000 years ago.

9. Initial Results

Eleven days of archaeological field survey was undertaken between 13/2/2018 and 24/2/2018, with three days examining deposits along the Gulf of Aqaba, three days in the Ifal Depression, and five days along the Red Sea Coastal Plain between Sharma and Al Muwaylih. In total, the survey has examined 34 localities within these regions, including fossil coral terraces, alluvial fans and alluvial terraces (Figure 4).

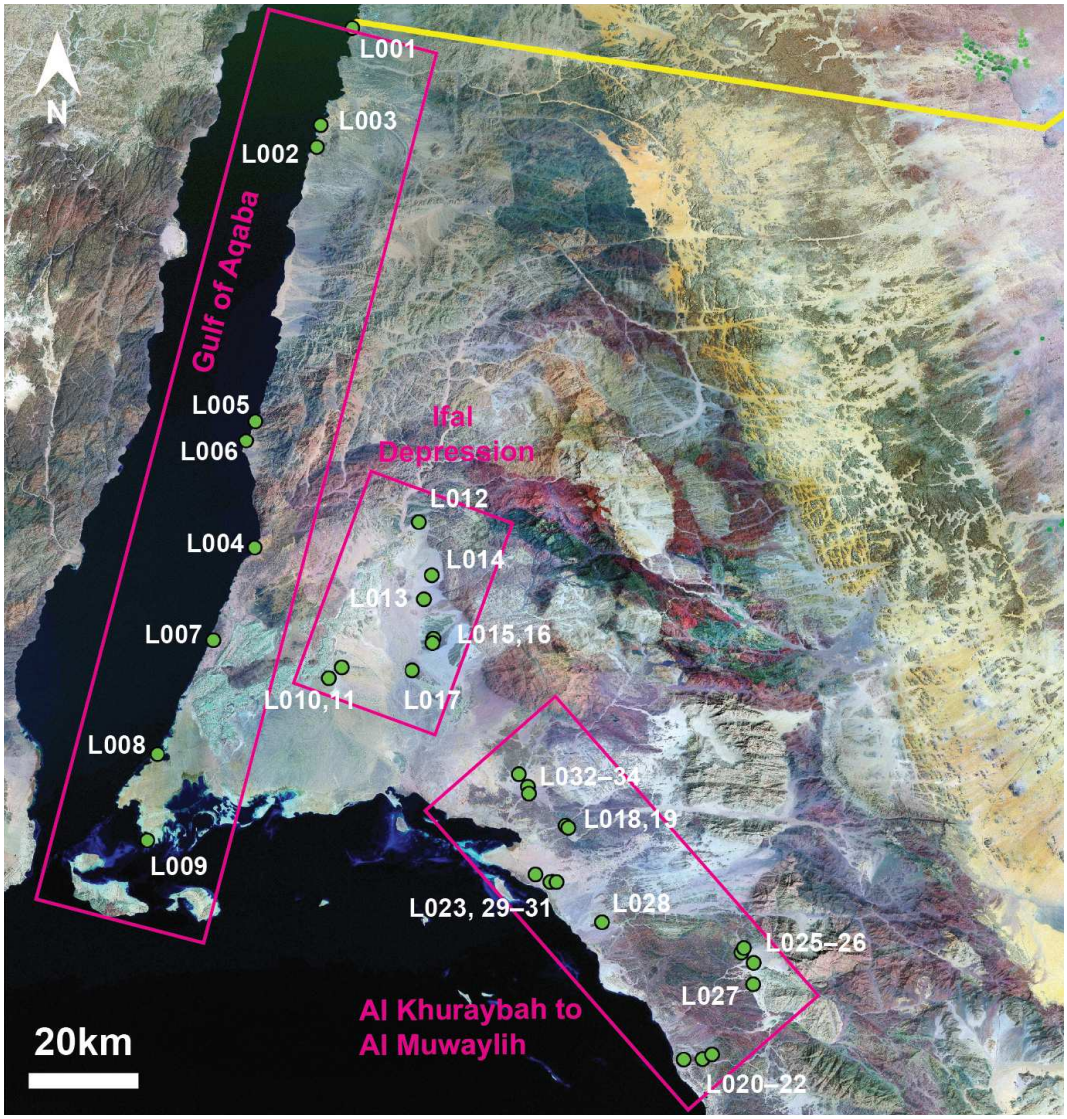

Figure 4. *Localities visited within the study region in northwestern Saudi Arabia. Satellite imagery © USGS Landsat ETM+ 2000 Gecover Mosaics..*

In the following sections, the localities visited and examined for each region are identified as well as their geographical co-ordinates and the archaeological materials observed. An indication of the age of these materials is given by identifying pieces known to be typically diagnostic of the major periods of the Palaeolithic and Neolithic.

Gulf of Aqaba

Locality No.	**Co-ordinates**	**Landscape Setting**	**Archaeological Contents** Early Stone Age (ESA); Middle Stone Age (MSA); Upper Palaeolithic (UP); Neolithic (Neo); Non-diagnostic to period (nd)
L001	***N** 29° 20′ 79.6″ **E** 34° 57′ 19.0″*	Scree slopes of coral terrace	*2 artefacts recorded (1 x MSA)*
L002	***N** 29° 09′ 16.1″ **E** 34° 53′ 45.1″*	Coral terrace abutting jebel	*3 artefacts recorded (1 x UP)*
L003	***N** 29° 11′ 24.4″ **E** 34° 54′ 08.1″*	Coral terrace	*1 artefact recorded*
L004	***N** 28° 30′ 25.8″ **E** 34° 47′ 45.3″*	Alluvial unit over coral terrace	*2 artefacts recorded (1 x UP/Neo)*
L005	***N** 28° 42′ 41.6″ **E** 34° 47′ 48.7″*	Alluvial unit over coral terrace	*No archaeological materials observed*
L006	***N** 28° 40′ 46.5″ **E** 34° 46′ 55.3″*	Alluvial unit over coral terrace	*47 artefacts recorded (7 x ESA; 3 x MSA; 3 x UP)*
L007	***N** 28° 21′ 27.9″ **E** 34° 43′ 44.6″*	Alluvial unit over coral terrace	*7 artefacts recorded (1 x ESA)*
L008	***N** 28° 10′ 23.8″ **E** 34° 38′ 17.3″*	Coral terrace	*No archaeological materials observed*
L009	***N** 28° 02′ 03.3″ **E** 34° 37′ 17.7″*	Coral terrace	*No archaeological materials observed*

Table 1. Localities visited within the study area along the coastal plain of the Gulf of Aqaba, their landscape units and a basic description of their archaeological contents.

Nine separate localities (L001 to L009) were visited by the survey team (Table 1). They extend along the Gulf of Aqaba from just north of Haql to the southern tip at Ras el Sheikh Hamid. Palaeolithic age artefacts have been found at five localities (L001, L003, L004, L006, L007). There is also no evidence of shell midden deposits along the Gulf of Aqaba at the locations visited.

Localities L001, L003, L004 and L007 are all situated on fossil coral terraces where artefacts include an Early Stone Age hand axe in rolled condition (L007), a few pieces of Middle Stone Age prepared core flake technology (L001, L006), with the majority of pieces being relatively fresh artefacts made on chert using a blade technology and probably dating to the Upper Palaeolithic. These artefacts are in a relatively non-weathered and unrolled state suggesting that they were probably made and discarded on these terraces themselves.

The most important locality investigated on the Gulf of Aqaba during this survey season has been L006. This locality is located on a terrace formed at its seaward extent by fossil coral dated to the last interglacial MIS 5e (Bosworth et al. 2017). This terrace, like many others in the area, is capped by a

Figure 4. Artefacts and Geological Context of Locality L006.
(A. a series of four hand axes found and collected from the surface of the alluvial terrace unit. Note the fine edges of the pieces and the clarity of the negative flake scars on the surfaces. B. An example of a hand axe found in situ within a gully eroding from the top flat alluvial surface into a series of 'green-grey', water-lain sediments. C. A view looking up towards L006 showing the green-grey, water lain sediments, and the gully within which the artefact shown in photo B was found. The arrow points to the approximate location where the hand axe (B) was found. The remaining pieces identified and collected from L006 are to be found on the top of this terrace.)

unit of cobbles and sand, probably deposited by an alluvial fan; this unit also overlies, to the west of the coral deposits, green, fin-grained laminar sediments. Resting on top of the lower surface of the alluvial unit, the survey team found a rich archaeological deposit which includes a series of seven examples of Early Stone Age hand axes, as well as some examples of Middle Stone Age prepared-core flakes and cores (Figure 4). Many of these artefacts, although highly weathered appear to be hardly rolled, with edges largely fresh and the evidence of final phases of retouch and use still visible, suggesting that they have not been moved far in this landscape. The artefacts from this locality are made on a variety of raw materials ranging from quartzite to basalt and indurated shale. Examination of higher terraces of alluvium to the east and above this artefact level, revealed no artefacts suggesting that the artefacts at L006 are related to the deposition and exposure of this part of the alluvial deposit, which is undergoing deflation and erosion. Two handaxes were found in gullies incised into the green laminar deposits, although these too could have originated from the overlying alluvial unit. Detailed survey and recording of the artefacts within a 5m x 10m grid located more than 40 artefacts.

Ifal Depression

Locality No.	**Co-ordinates**	**Landscape Setting**	**Archaeological Contents**
L010	***N** 28° 17′ 49.0″ **E** 34° 54′ 55.7″*	Alluvial fan remnant	*9 artefacts recorded (1 x ESA/MSA; 4 x UP)*
L011	***N** 28° 18′ 51.5″ **E** 34° 56′ 11.0″*	'Hogback' ridges formed by Tertiary deposits.	*20 artefacts recorded (1 x MSA; 2 x Up Pal)* *3 Cobbles with pictographic markings*
L012	***N** 28° 32′ 53.7″ **E** 35° 03′ 41.6″*	Alluvial fan remnant	*No artefacts observed*
L013	***N** 28° 25′ 25.4″ **E** 35° 04′ 12.3″*	Alluvial fan remnant	*4 artefacts recorded (1 x ESA; 1 x MSA)* *1 cobble with pecked image*
L014	***N** 28° 27′ 44.3″ **E** 35° 04′ 57.9″*	Isolated outcrop of sedimentary rock	*1 artefact recorded*
L015	***N** 28° 21′ 37.1″ **E** 35° 05′ 07.7″*	Alluvial fan remnant	*No artefacts observed*
L016	***N** 28° 21′ 09.4″ **E** 35° 05′ 00.2″*	Alluvial fan remnant	*4 artefacts recorded (1 x ESA/MSA; 1 x MSA; 1 x Neo)*
L017	***N** 28° 18′ 33.2″ **E** 35° 03′ 02.2″*	Alluvial terrace	*8 artefacts recorded (3 x MSA)*

Table 2. Localities visited within the study area within the Ifal Depression, their landscape units and a basic description of their archaeological contents.

Eight localities were examined in the Ifal Depression (L010 to L017); all are on alluvial terraces either to the West or to the East side of the Depression (Table 2). Four of these localities contain Palaeolithic age archaeological materials (L010, L011, l013, L016, L017), whilst one locality, L011, contained three cobbles bearing Thalmudic form images or possibly inscriptions (these were collected for storage by the local SCTH team members). The Palaeolithic artefacts include artefacts that can be assigned typologically to both the Early and Middle Stone Age, as well as a number of artefacts

that appear to be Upper Palaeolithic in age, and a few that might tentatively be assigned to the Neolithic. Artefacts of Early and Middle Stone Age are usually made on flakes or clasts of basalt, quartzite or metamorphosed schists and shales. They are heavily weathered, and usually well-rolled. Later artefacts appear to be made on chert and sometimes metamorphosed schists and shales. All artefacts appear to be weathered and lightly or moderately rolled. No localised concentrations of artefacts have been found so far at these localities, and the condition of all of the artefacts observed suggests that they have moved from an original location of manufacture or use to the current location.

Red Sea Coastal Region

Seventeen localities were visited and surveyed along the Red Sea coastal plain from Al Khuraybah in the north to Al Muwaylih in the South (Table 3). Whilst the majority of localities are on alluvial deposits that form terraces in the modern landscape, the landscape setting of these deposits varies. Some of these are remnants of alluvial fans that are now located directly on the coast; others are located on alluvial terraces within enclosed basins separated from the coast (Wadi Ayonunah, Wadi Sharma); and others are located on alluvial fans that have been deeply incised by wadis to form terraces (for example at Al Muwaylih). There is a complex depositional history for these alluvial terraces in this part of the survey region, and in many cases it has been possible to survey multiple heights of terraces at one locality (for example at Al Muwaylih and Al Ayonounah).

Locality No.	**Co-ordinates (Northing/Easting)** *(degrees, minutes, seconds)*	**Landscape Unit**	**Archaeological Contents**
L018	***N** 28° 03' 28.9" **E** 35° 17' 56.4"*	Jebel of isolated alluvium and bedrock in basin	*1 cobble with pictographic markings*
L019	***N** 28° 03' 16.4" **E** 35° 18' 09.6"*	Alluvial terrace	*9 artefacts recorded (2 x MSA; 1 x UP-Neo)*
L020	***N** 27° 40' 54.2" **E** 35° 29' 25.3"*	Alluvial fan (lower and upper 'terrace')	*9 artefacts recorded (1 x UP; 3 x UP-Neo)*
L021	***N** 27° 40' 56.1" **E** 35° 31' 14.2"*	Alluvial fan (lower and upper 'terrace')	*2 artefacts recorded (1 x UP)*
L022	***N** 27° 41' 24.4" **E** 35° 32' 09.1"*	Alluvial fan (lower and upper 'terrace')	*9 artefacts recorded (1 x ESA; 3 x MSA)*
L023	***N** 27° 58' 03.7" **E** 35° 16' 38.5"*	Alluvial terrace (at coast)	*23 artefacts recorded (3 x ESA; 2 x ESA/MSA; 7 x MSA; 1 x UP)*
L024	***N** 27° 51' 13.7" **E** 35° 35' 00.2"*	Alluvial/colluvial slope close to edge of basin	*No artefacts observed*
L025	***N** 27° 51' 40.2" **E** 35° 35' 13.6"*	Alluvial terrace (in basin)	*12 artefacts recorded (3 x MSA)*
L026	***N** 27° 50' 13.2" **E** 35° 36' 11.7"*	Bedrock jebel (in basin)	*No artefacts observed*
L027	***N** 27° 48' 10.6" **E** 35° 36' 08.0"*	Modern wadi bed (in basin)	*No artefacts observed*
L028	***N** 27° 54' 09.7" **E** 35° 21' 26.3"*	Alluvial terrace (at coast)	*20 artefacts recorded (1 x ESA; 1 x ESA/MSA; 3 x MSA)*

L029	***N** 27° 58' 02.3" **E** 35° 16' 26.5"*	Alluvial terrace (at coast)	*21 artefacts recorded (1 x ESA; 4 x MSA; 1 x UP)*
L030	***N** 27° 58' 45.9" **E** 35° 15' 00.5"*	Ancient fossil coral/bedrock terrace (at coast)	*1 artefact recorded (1 x MSA)*
L031	***N** 27° 58' 45.9" **E**° 35° 15' 00.5"*	Alluvial terrace (at coast)	*6 artefacts recorded (2 x MSA; 1 x UP)*
L032	***N** 28° 07' 14.3" **E** 35° 14' 15.7"*	Alluvial terrace (in basin)	*14 artefacts recorded (1 x ESA; 1 x ESA/MSA; 2 x MSA; 1 x UP)*
L033	***N** 28° 06' 35.7" **E** 35° 14' 21.5"*	Alluvial terrace (in basin)	*10 artefacts recorded (4 x ESA)*
L034	***N** 28° 08' 27.8" **E** 35° 13' 23.1"*	Alluvial terrace (in basin)	*9 artefacts recorded (2 x MSA; 2 x UP)*

Table 3. Localities visited within the study area along the Red Sea coastal plain, their landscape units and a basic description of their archaeological contents.

The surface of most of these alluvial deposits consist of desert pavements of clasts, with clasts having undergone varying degrees of weathering. In some cases, the clasts are weathered but still retain a large degree of differentiation between components of different lithology by colour. In other places, all the surface material has both weathered and received a 'desert polish' that renders the materials a uniform glossy dark brown colour. This particular pattern of weathering affects both the visibility of potential artefacts during survey, as well as the estimation of the lithology of any artefact and the deposit from which it was identified.

Of particular interest in the Red Sea region has been the discovery of a series of Early Stone Age artefacts at L034 in the Wadi Ayounah basin. These artefacts include a small number of hand axes, a cleaver and a large cutting tool. They appear to be in good condition: weathered but with fresh edges and little sign of damage from rolling (Figure 5). The condition of these artefacts despite their location on the surface of a cobble-filed alluvial terrace suggests that they have not moved far, and may have originally been deposited within the terrace and subsequently revealed by more recent erosion.

Collected Artefacts

For 2018, it has been our policy not to collect all of the artefacts observed at the survey localities visited. This policy has made it possible to visit and assess a greater number of potential localities during the field season, whilst leaving any archaeological materials observed available for more detailed recording, collection and examination of the material in its specific geomorphological context where appropriate in the future. However, a small number of examples of Palaeolithic age lithic artefacts, along with some examples of the cobbles with petroglyphs have been collected as

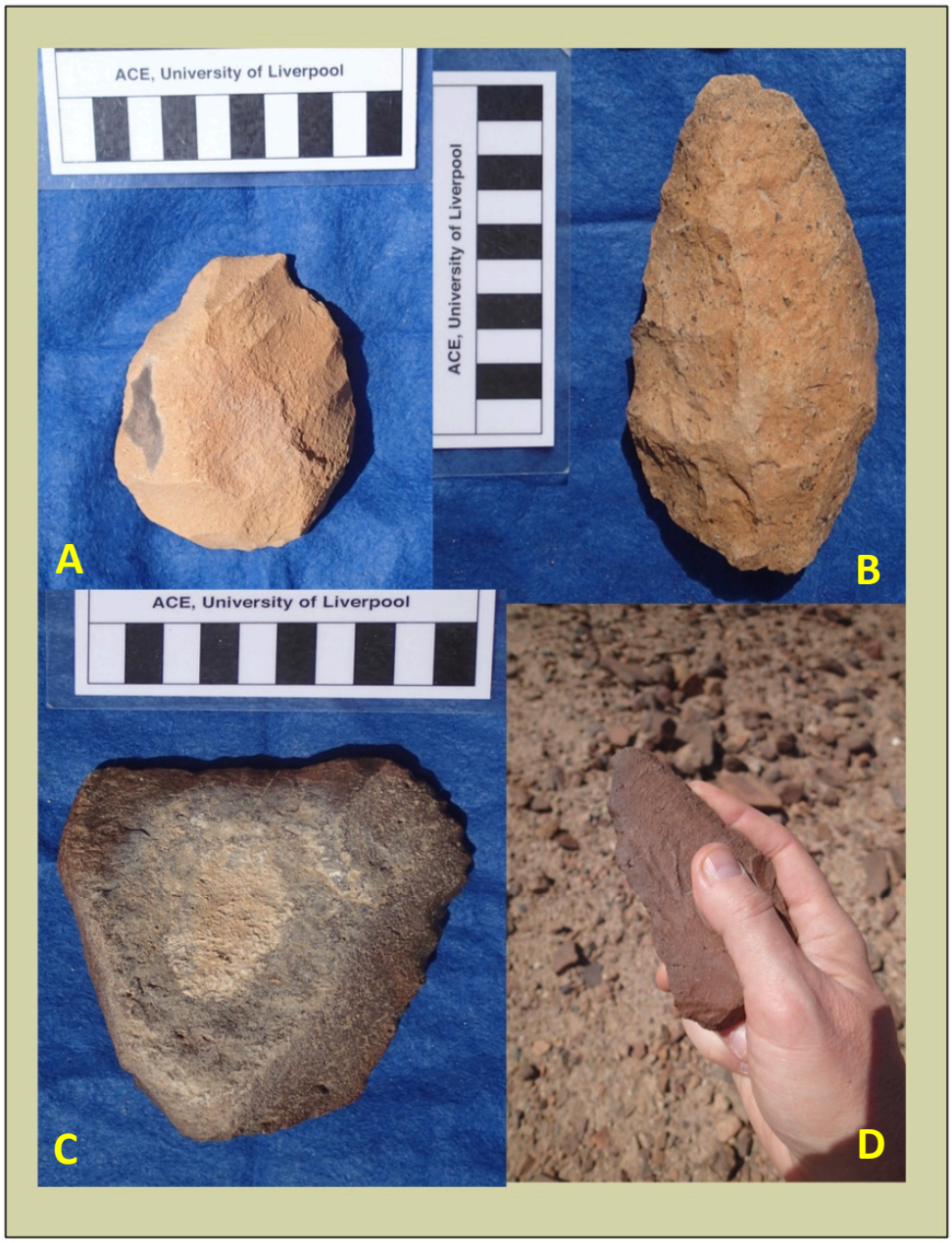

Figure 5. Artefacts recorded at Locality L033 in the Red Sea Region.
(A & B - hand-axes; C cleaver; D large cutting tool. The degree of weathering of these pieces is apparent from the difference in surface colour present in the hand axe shown in photo A. The dark colour is the original dark quartzite, whilst the light brown is a colour resulting from weathering. Despite the weathering it is also clear that the edges of the artefacts are well-preserved without signs of fracture damage caused by extensive rolling of the artefact.)

high quality representative samples of Palaeolithic age materials. They have been placed in store with the SCTH and museum in Tabuk. The rationale for the collection of these specific samples has been that, as exemplar pieces, without previous record in the study region, they can assist SCTH staff to recognise Palaeolithic materials in their area and at the same time provide examples of the earliest

archaeological materials in the province for the interest and education of the local people possibly through display in the new museum at Tabuk. A complete list of the collected artefacts is presented in Appendix 3.

9. Initial Interpretations

1. The study area of this survey is highly complex and will be difficult to interpret spatially and chronologically without extensive study that combines geomorphological and archaeological approaches. This is an outcome of the combination of an ancient geology in the region (the Arabian Shield), and its varied bedrock lithology, and finally the complicated, long-term geomorphological history of the various deposits that have to be sampled. Any future research investigating the Palaeolithic archaeology of this area will require a detailed understanding of the evolution of these deposits and their relative relationships and dates.
2. Although few Palaeolithic age artefacts were discovered by the CASP survey team working in the late 1970s within the survey area (Ingraham et al. 1981), the artefacts identified during this survey indicate that Palaeolithic age materials can be found throughout the area including the Gulf of Aqaba and across the Ifal Depression, and throughout the Red Sea coastal plain.
3. Diagnostic lithic artefacts come from both the Early and Middle Stone Age, the Upper Palaeolithic and probably the Neolithic.
4. Many of the Palaeolithic artefacts visible on the surfaces of the alluvial terraces of Middle or Early Stone Age date have been severely weathered and often rolled, indicating that the materials have been moved from their initial place of deposition. However, there are places where artefacts of both ESA and MSA typology are to be found in a weathered but significantly less rolled state (for example at localities L006, L034). The fresh (lightly weathered and non-rolled) state of the materials suggests that they have recently been exposed by deflation of the fan deposit. It is very possible that more, perhaps many more, artefacts remain *in situ* within the fan deposits at these locations. Further survey on these fans will undoubtedly reveal more artefacts, whilst intrusive test excavation may give an idea of the nature of the assemblages still buried.
5. Artefacts of Upper Palaeolithic or possibly Neolithic age are significantly less weathered and less rolled. This is of course to be expected given their younger age, but the reduced rolling visible on these artefacts may also indicate that they have been moved less (if at all) from their original place of discard. In other words, they are to found close to their locations of manufacture or use. If the find locations are indeed places of manufacture or use, then it

seems possible to suggest that the alluvial fans and coral terraces represent places in which humans of these time periods could go to seek lithic materials for tool manufacture or that the geographical location of these fans was useful for particular activities. The smaller number of Upper Palaeolithic artefacts, despite their more recent age, might also indicate that populations were either smaller in number and/or more dispersed.

6. The concentration of well-preserved Palaeolithic artefacts at Locality L006 indicates that there is the possibility of finding examples of *in situ* concentrations of artefacts, but that these are rare. Where found, they will need close study.

22nd March, 2018

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Appendix 1: Geological Units in the study region from Johnson (2006)

Al Bad granite super suite (abg) – posttectonic granites characterised by syenogranite and alkali-feldspar granite compositions and high topographic relief. Light gray to pink, massive, and medium to coarse-grained and includes biotite, monzogranite, hornblende-biotite syenogranite and riebeckite-, arfvedsonite- and aegerine-bearing alkali-feldspar and alkali granite. Large areas of the the study area on a SE-NW axis. High topographic relief is reflected in the SW of the region where sharp contrast between the escarpment and the lower escarpment corresponds to lithological boundaries

Amlas formation (am) – sedimentary and subordinate volcanic rocks. Conglomerate and sedimentary breccia, immature sandstone, greywacke, siltstone, shale, and minor amounts of quartzite. Subordinate lithiologies to the top of the succession including andesite, felsic tuff, and porphyritic felsite. Found in the centre of the study region.

Cenozioic basalt (Cb) – [Harrat Uwaynd], found in the extreme SE of the study region.

Cenozoic rocks (Cs) – [Tertiary Ifal Formation] Found in SW of the study region.

Ediacaran rhyolite (er) – small exposures of porphyritic rhyolite, rhyolitic crystal and ash-flow tuff, and sparse volcanogenic conglomerate. Mainly to the east of the study region, in the escarpment close to the plateau.

Ghawjah formation (gj) – low-grade metavolcanic and meta-sedimentary rocks. Massive porphyric andesitic flows with interbeds of dacite, thin felsic tuffs and quartz latite, and wackes. Rocks are metamorphosed to the greenscist facies, locally to amphibolite facies and, adjacent to some fauilts, are strongly foliated biotite-chlorite schist.

Hegaf formation (ga) – volcanic, volcaniclastic and sedimentary succession predominantly volcanic in the South and mixed volcaniclastic and epiclastic in the north. Common rocks – mafic and felsic tuffs, andesite, basalt, minor rhyolite, agglomerate, siltstone, limestone, and chert. Rocks metapmorphosed to greenschist, amphibolite, mafis schist, quartz-fedlsparic mics shist and calc-silicate rock. Found in outcrops in central area of the study region.

Hinshan formation (hs) – Intermediate to felsic volcanic and sedimentary rocks, metamorphosed to greenschist facies, and includes andesitic lava and tuffs, rhyolitic flow rock and welded tuff, subordinate basalt and well-bedded and locally graded wachke, siltstone, and shale.

Mesozoic and Palaeozoic sedimentary rocks, undivided (mpz) – along Plateau edge in east of the study region.

Muwaylih suite (mw) – mafic plutons with main rock types of tonalite, trondhjemite, diorite, quartz diorite, gabbro, and norite. Part of volcanic arcs that make up Midyan terrane. Found throughout the study region, in the escarpment and lower escarpment regions.

Silasia formation (sl) – sedimentary-volcaniclastic succession in the northern Midyan terrane. Found towards the SE of the study region.

Unaasigned Neoptoterozoic rocka (utg) Grandiorite and tonalite. Found in eastern area of the study region in the escarpment, close to the border with the plateau.

Qazaz granite super suite (qa) – granite. Predominantly monzogranite but also areas of grandodiorite, diorite, syenogranite and gabbro. One of the most dominant lithologies in the study region, in both the escarpment and the lower escarpment.

Zaytah formation (zy) – metamorphosed felsic lava and tuff, tuffite, greywacke, and mafic and felsic schist. Rocks metamorphosed to greenschist facies. Found in the NW of the study region, in the escarpment and close to the plateau boundary.

Appendix 2: Descriptions of coral terrace stations from Taviani *et al.* In Press.

Station 1 is a coastal spur made up by a composite carbonate body (Fig. 6a); the basal coral carbonate is of unknown Pleistocene age, and is plastered by younger but undated carbonates above; the carbonate bedrock hosts recrystallized coral heads (Fig. 5d) and is bored by *Lithophaga* mussels and settled by *Spondylus* bivalves; large coral heads occur on the upper part of the section; no MIS5e deposits have been clearly recognized here.

Station 2 is close to the south in the same small embayment and displays a rather similar geological situation (Fig. 5a); it is noteworthy that it exposes coastal marine sands enriched in pectinids and irregular echinoids (*Clypeaster* and *Laganum*) whose tests are aligned along the bedding.

Station 3 is a small rocky spur immediately before the entrance fence of a coastguard site (Fig. 5b); besides older Pleistocene carbonates as at the previous two stations, last interglacial (MIS5e) reefal carbonates are exposed as documented by classic index-fossils, that is, the molluscs *Diodora impedimentum* and *Euplica turturina* (Taviani 1998a, c).

Station 16: 2.3 km south of Al Wasel (Fig. 3a). This station is one of the best exposures of MIS5e coral terraces in the entire Gulf of Aqaba area coral reef systems, culminating at ~19-20 m above m.s.l. The preservation state of the host fossil content here is exquisite; noticeably fossiliferous, this site contains a *Pinna* bed with articulated shells amidst echinoids, other bivalves and gastropods. Corals are represented by a number of scleractinians (e.g., *Fungia*, *Acropora*, *Porites*, faviids etc.), organ-pipe alcyonarians (*Tubipora*), and hydroids (*Millepora platyphylla*). The mollusc fauna of this terrace is one of the most diverse of the study area (Angeletti et al., this volume), representing various habitats including shore (the gastropods *Nerita orbignyana* and *N. sanguinolenta*), backreef (strombids, *Mammilla*, *Rhinoclavis*), reef-flat and edge (*Tectus dentatus, Trapezium oblongum*), and fore-reef (*Pinctada margaritifera*, *Spondylus* spp).

Station 17: 2.65 km south of Al Wasel. The site exposes a poorly preserved reefal terrace, with degraded corals, *Tridacna* fragments, partly dissolved and replaced molluscs, including *Conus* spp, pectinids, and *Lithophaga* mostly as moulds; vestiges of ancient Pleistocene marine coral reef deposits are found at ~44 m above m.s.l.

Station 18: 2.4 km south of Ra's Suwayhil as Saghir. The site is represented by a granitic bedrock with carbonate veins and Neptunian dikes; some carbonate served as hardground substrate to encrusting serpulids.

Station 19: 2.45 km south of Ra's Suwayhil as Saghir. A spur-like outcrop of undated Pleistocene coral carbonates, macrofossiliferous, and at places cemented by botryoidal aragonite or bored by *Lithophaga*. Mixed carbonate-arkosic breccias (from the dismantling of the Arabian basement) also show cementation by aragonitic botryoids (Fig. 15c); the most recent reefal carbonates (MIS5e) contain molluscs and corals.

Station 4: 4.1 km south of Ra's Suwayhil as Saghir. MIS5e reefal terraces partly covered by alluvium along the coastal road at an elevation of ~20 m above m.s.l., are rich in well preserved frame-building scleractinian corals and molluscs; botryoidal aragonite cement occurs in the host rock (Fig. 15d).

Station 5: 5.8 km south of Ra's Suwayhil as Saghir. A fresh road cut exposes pre-MIS5e carbonate bedrock between 19-23 m above m.s.l.; next to the outcrop, loose but fresh *Porites* erratic blocks are found bored by *Lithophaga* mussels. This site was not examined in detail.

Station 12: 7.1 km south of Ra's Suwayhil as Saghir. Hanging Pleistocene coral limestones and semilithified carbonates plaster as relics the crystalline bedrock at 25 m above m.s.l. (Figs. 6b and 7d); this relic feature is extremely interesting since it documents a rare example of a late Pleistocene exposed slope, under pelagic input (pteropods, globigerinids) with-reef talus deposition. Abundant environmentally-valuable fossil material is found at this site, such as *Spondylus*, large barnacles and oysters on limestone bedrock, micromolluscs, melobesian fragments, decapod claws, rare corals, benthic foraminifers (including *Amphistegina*), ostracods, and echinoids in the loose or firm sediment.

Station 6: 8.3 km south of Ra's Suwayhil as Saghir. This outcrop is noticeable since it exposes large boulders overgrown by reefal carbonates attributable to MIS5e (Fig. 6c). This last interglacial fauna includes a variety of well-preserved scleractinian corals and molluscs, such as articulated (*Trapezium oblongum*) and disarticulated bivalves (*Spondylus* spp*, Trachycardium* sp), and gastropods (e.g., Trochidae spp and Cypraeidae spp); large mamelon-like aragonite botryoids have been found here cementing Pleistocene reefal carbonates.

Station 7: 13.8 km south of Ra's Suwayhil as Saghir. A well-preserved flat-topped MIS5e coral terrace is exposed reaching up to ~22 m above m.s.l. (Fig. 7a-c). Fresh carbonates and scleractinian corals are exposed on the flanks along the wadi cut, revealing very large and articulated shells of the giant clam *Tridacna maxima*. The fossil system comprises a paleoshoreline, testified by *Cellana radiata* shells. The preservation of reef-building scleractinian corals is excellent, providing suitable material for geochronological dating and geochemical analyses.

Station 8: 14 km south of Ra's Suwayhil as Saghir. There is a large exposure of MIS5e reefal terraces at the same altitude as the previous station, with intervening bioturbated arkosic coarse-sandy deposits; the rich mollusc assemblage includes index-fossils such as *Diodora impedimentum*, and *Euplica turturina*. This site is characterized by reef edge and upper slope abundant scleractinian corals including *Acropora*, *Porites*, *Caulastrea*, *Fungia* and faviids among others (Fig. 8d). The back-reef coarse coral sands host numerous articulated *Pinna* bivalves, and many other molluscs (especially common is *Architectonica trochlearis*). Finally, a MIS5e former shoreline is here documented by the limpet *Cellana radiata*.

Station 9 is immediately south of St. 8 and displays MIS5e tabular coral terrace remnants, some of which collapsed, and whose facies are equivalent to the previous station.

Station 10 is a series of well-preserved coral terraces dissected by wadis at ~20 m above m.s.l. that is a conspicuous geomorphological aspect of the coastal plain at this location situated between stations 8 and 9 (Fig. 8a-c). Terraces consist of reefal facies enriched in scleractinian corals as *Lobophyllia*, *Platygyra* (Fig. 8b), and molluscs such as trochids, *Chicoreus ramosus, Spondylus* spp and *Tridacna* (Fig. 8c). This site is relevant for reconstructing the paleogeography and assessing post-depositional vertical movements since it keeps vestiges of the former last interglacial shoreline, also evidenced by outwashed worn shells of intertidal gastropods (*Cellana radiata*, *Nerita* sp), other shallow marine molluscs (*Tridacna, Lambis*), and corals.

Station 13: 17.6 km south of Ra's Suwayhil as Saghir. The coral terraces reaching up to 25 m above m.s.l. (Fig. 9a), display *Platygyra* colonies on top (Fig. 9b), and contain terebrid gastropods and sands with in situ *Tridacna* shells. The topmost coral rich carbonates cap a melobesian-rich whitish siliciclastic-carbonate sand, with scattered coral heads in situ (Fig. 9e). In this area we have identified a concentration of broken and bleached *Lambis* shells on the ground, possibly representing a sub-recent shell midden related to human activity (Fig. 9f).

Station 14: 17.9 km south of Ra's Suwayhil as Saghir. A complex coral reefal situation occurs at this site exposing un-dated Pleistocene coral bedrock affected by diagenetic processes as documented by more or less completely dissolved corals and molluscs (Fig. 5c), and younger deposits with such features such as *Tridacna* beds, whitish melobesian sand, and frame-building corals.

Station 20: 3 km north of Wadi Tayyib Ism. This outcrop exposes the interfingering of MIS5e reefal carbonates with conglomeratic layers sitting on Arabian basement granitoids (Fig. 9c). Abundant scleractinian heads are observed in the middle part of the section and are more common on the top carbonates, including *Porites, Acropora, Fungia* and faviids. The accompanying benthic fauna

includes the index-fossil *Diodora impedimentum*, and other gastropods (e.g., *Turbo radiatus, Ceraesignum maximum*), cemented (*Chama* spp, *Spondylus* spp), epifaunal and infaunal bivalves (*Tridacna maxima, Trachycardium* sp).

Station 21: 3.4 km north of Wadi Tayyib Ism, and before Al Maqnah. Here a presumed MIS5e coral growth at ~25 m above m.s.l. caps the Pliocene/Miocene bedrock; this outcrop has not been analyzed in detail.

Station 22: 5.9 km south of Wadi Tayyib Ism. This site consists of a cluster of three disconnected main outcrops culminating at altitudes between ~14-22 m above m.s.l., a few tens of metres apart separated by gullies on a wide coastal lowland. The reefal terraces (Fig. 10a-f) exposes coral-rich facies, back-reef lagoonal red sands with marine molluscs (*Codakia tigerina*, *Lambis truncata sebae*), at places intensely bioturbated (*Thalassinoides*: Fig. 10e), and arkosic gravels. The raised reef deposit at ~12 m above m.s.l. hosts a dense coral growth mostly represented by well-preserved and large *Porites* heads (Fig. 10d), *Montastrea cylindrica, Fungia*, faviids, *Millepora* and other corals, which are draped by a veneer of coral debris which contains also highly degraded branching hydroids (*Millepora*) and molluscs.

Station 23: 6.1 km south of Wadi Tayyib Ism. The site is a MIS5e coral terrace whose dismantling sheds well preserved fossils in the talus.

Station 21: 6.2 km south of Wadi Tayyib Ism (St. 24). The area is characterized by prominent coral terraces (Fig. 11a) and displays large coral heads on top but has not been analyzed in detail (Fig. 11b).

The Al Maqnah (or Maqna) area is described and commented on in detail for its Pleistocene marine terraces by Dullo (1990).

Station 25: 5.6 km north of Al Maqnah. Here the faulted Miocene substrate is plastered by Pleistocene reefal deposits at 26 m above m.s.l. (Fig. 11c, d). The scant paleontological legacy includes clusters of the intertidal barnacle *Tetraclita*.

Station 26: 4.5 km north of Al Maqnah. This site exposes a flat-topped coral terrace flight at the same elevation as the previous station over Miocene sandstones (Fig. 12a), and is characterized by a rich coral content with *Lobophyllia*, *Acropora*, *Leptoseris*, *Platygyra*, *Stylophora*, *Porites*, *Fungia*, *Favites*, documenting a fore-reef setting (Fig. 12c, d); spectacular giant coral heads (*Galaxea fascicularis*: Fig. 12b) are found here.

Station 27: 6.75 km south of Al Maqnah. A series of terraces around ~17 m above m.s.l. separated by gullies, typifies the coastal setting with MIS5e coral terraces growing onto dipping Miocene strata (Fig. 6d). *Porites*-dominated reefs and intervening sandy sediments host abundant and diverse associated fauna which includes large bivalves (e.g., *Tridacna* spp, *Codakia tigerina*) and gastropods.

Station 15: Ash Shaykh Humayd. At the extreme south of the Gulf of Aqaba facing the Straits of Tiran and unconformably overlying Miocene sandstones (Fig. 13), there is a noticeable exposure of MIS5e coral reef terraces reaching a maximum elevation of ~8.7 m above m.s.l., which also host typical index fossils (*Diodora impedimentum*, *Euplica turturina*). The terraces expose reef-edge and back-reef lagoonal deposits, the latter culminating at ~4-6 m above m.s.l. This site is extremely rich in well preserved and diverse macrofossils (Fig. 13), including various stony corals (*Porites, Acropora, Montastraea, Favia, Favites*, *Fungia*, etc.), a number of molluscs (the bivalves *Tridacna* spp, Tellinidae spp, *Circe* spp, the gastropods *Conomurex fasciatus*, Cypraeidae spp, *Conus arenatus, Bulla ampulla*, and many others; Fig. 13f), echinoids (clypeasterids and *Heterocentrotus*), *Tetraclita* barnacles, melobesians, and much more. Botryoidal aragonite has been also found here.

Appendix 3: Lithic Artefacts Collected by the Saudi-British Team - Tabuk Province, February 2018

Area	Locality Number	Waypoint Number (WP)	L0006 Point Number (PT)	Latitude	Longitude	Description
Haql	L0001	3	-	29.345745	34.952367	Flake (quartzite)
	L0001	2	-	29.344608	34.951471	Prepared core preparation flake
Ras Suwayhil al Kabr	L0006	59	-	28.679599	34.782428	Handaxe
	L0006	25	-	28.678546	34.782702	Handaxe
	L0006	-	3	28.677523	34.782497	Endscraper
	L0006	-	24	28.677518	34.782435	Handaxe
	L0006	-	25	28.677526	34.782422	Prepared Core
	L0006	-	30	28.67754	34.782402	Handaxe
	L0006	-	35	28.677551	34.782388	Retouch Flake (possibly from handaxe trimming)
	L0006	-	36	28.677554	34.782387	Pointed Handaxe
	L0006	-	42	28.6776	34.782341	Handaxe (outside of grid)
	L0006	-	43	28.677534	34.782543	Hammer stone (outside of grid)
	L0006	-	44	28.677429	34.782595	Handaxe (on shale) (outside of grid)
	L0006	-	45	28.677306	34.782662	Handaxe (outside grid)
	L0006	-	46	28.677339	34.782661	Tip of Handaxe (outside grid)
Wadi Sharma basin	L0019	87	-	28.055017	35.302822	Prepared Core (unexploited)
	L0019	89	-	28.055025	35.303105	Prepared Core (unexploited)
Al Muwaylih	L0021	106	-	27.681192	35.516867	Blade
Sharma	L0023	161	-	27.966849	35.277204	Prepared Core (unexploited)
	L0023	162	-	27.966744	35.277311	Twin-Platform Flake core
	L0023	164	-	27.966759	35.277151	5 x brown quartzite flakes
	L0030	167	-	27.973692	35.284889	Core (made on hornfels)
	L0031	170	-	27.980521	35.249898	Bifacially-worked clast
	L0031	171	-	27.980152	35.249963	Blade
Wadi Ayonunah basin	L0032	182		28.122011	35.238460	Handaxe
	L0033	190		28.107215	35.236689	Quartzite Blade
	L0034	197		28.141160	35.222525	Handaxe (cordiform)
	L0034	199		28.141194	35.222300	Cleaver (quartzite)
	L0034	200		28.141333	35.222506	Handaxe (quartzite)
	L0034	201		28.142301	35.220311	Blade (chert)