Palaeolithic Survey in Southwest Saudi Arabia Methodology and Preliminary Results

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Abstract: *This paper reports the results of a survey for prehistoric archaeology in the Southwest region of Saudi Arabia carried out in 2012 as part of a wider international project involving British, French an d Saudi collaborators. The aim of the wider project is to develop systematic methods for reconstructing landscapes associated with active tectonics, volcanism and sea level change at different spatio-temporal scales, and their impact on early human settlement and dispersal out of Africa, combining remote sensing techniques with archaeological and geo-tectonic field surveys on land and underwater. In this paper we set out the methodology we have developed to search for and record archaeological sites and to place them in their wider geological and palaeoenvironmental setting. We also present and evaluate some of the first results of what is intended to be an ongoing project.*

Introduction

The archaeology of the Arabian Peninsula is pivotal to the understanding of the timing and mode of the earliest dispersals of modern human and earlier populations from Africa into Eurasia. Traditional emphasis on the Nile-Levant dispersal route has been challenged by growing evidence supporting a southern route across the southern end of the Red Sea (e.g. Petraglia and Alsharekh 2003; Beyin 2006). Some authors have even proposed that the use of this southern route was accompanied by early skills in seafaring, fishing and shellgathering, and that these were novel adaptations developed by anatomically modern humans in Africa some time after 150,000 years ago, which facilitated a rapid dispersal across the Arabian Peninsula and around the rim of the Indian Ocean (Stringer 2000; Walter et al. 2000; Macaulay et al. 2005).

Yet, despite recent key developments in our knowledge of human occupation in Arabia (e.g. Armitage et al. 2011; Petraglia et al. 2011; Rose et al. 2011; Delagnes et al. 2012), the Palaeolithic archaeology of the Arabian Peninsula remains extremely patchy, and there is little or no evidence yet available to test these recent ideas about early patterns of human dispersal. This situation is especially marked in the coastal region of Southwestern Saudi Arabia, where little work has been carried out since the Comprehensive Archaeological Survey Program (CASP) in the 1980s (Zarins et al. 1980, 1981). This region is particularly important in dispersal debates given its proximity to the Strait of Bab al Mandab and the Hanish Sill region. During periods of low sea level, this southern channel of the Red Sea was relatively narrow and shallow, and could have been crossed quite easily by human populations moving between Africa and the Arabian Peninsula (Lambeck et al. 2011). It also opened northwards to a very extensive coastal landscape, which is now submerged, and which could have offered attractive environments for

ISSN: 1319-8947 (pp. 7-30)

human occupation during long periods of the Pleistocene.

All of these issues have been under investigation by the Southern Red Sea Project since 2004, a joint Saudi-UK initiative aimed at investigating the Palaeolithic archaeology of the mainland, the 'Neolithic' coastal shell middens of the Farasan Islands, and the offshore submerged landscape of the region (Bailey et al., 2007a, 2007b; Bailey 2009; Williams 2010; Lambeck et al. 2011; Bailey et al. 2013; Alsharekh and Bailey, in press). This has now expanded into a new phase of investigation as the DISPERSE project, an ERC-funded collaboration between the University of York, UK and the Institut de Physique du Globe de Paris, France (Bailey et al. 2012). This project aims to develop systematic methods for reconstructing landscapes associated with active tectonics, volcanism and sea level change at different spatio-temporal scales, and their impact on early human settlement and dispersal in Africa, the Arabian Peninsula and the Near East, combining remote sensing techniques with archaeological and geo-tectonic field surveys on land and underwater.

Identification of possible routes and conditions of human dispersals from Africa throughout the last 2my has focussed on reconstructing broad-scale climatic and vegetation zones. Dispersals into, and across, Arabia were probably controlled by global climatic and sea level fluctuations, with low sea stands allowing dispersals across water bodies (Bailey et al. 2007a,b; Lambeck et al. 2011; Rose 2004), and periods of humidity allowing expansion of occupation ranges into present-day deserts (Petraglia et al. 2011). Yet within broad-scale reconstructions, understanding the physical morphology of the landscape and its evolution through time is also critical to palaeoenvironmental reconstruction at the scale experienced by early human populations.

Landscapes evolve dynamically due to an interplay of processes occurring over different time-scales. Tectonic deformation, volcanism, and sea level changes, by acting on the topography, the lithology, and the patterns of erosion and deposition in a given area, can moderate or amplify the influence of climate at the regional and local scale, impose or alleviate physical barriers to movement, and modify the distribution and accessibility of plant and animal resources in ways critical to human ecological and evolutionary success (King and Bailey 2006; Bailey and King 2011).

The major tectonic event represented by the opening of the Red Sea over the last 30my has been associated with several episodes of tectonic deformation and magmatism. Along with climatic changes, these processes have shaped the present landscape over the last 2my, a time-scale relevant to human occupation. The region is, therefore, a key one to study the influence of such processes on landscapes and the potential of the latter in creating attractive conditions for early human settlement and dispersal.

Here, we consider just one aspect of the wider project, namely the search for Palaeolithic sites in the Southwest region of Saudi Arabia. Our aims in this paper are twofold: firstly to set out the framework of concepts and methods we are using to search for sites and to place them within their regional landscape setting; secondly, to report on our preliminary results, based on surveys conducted in May-June and November 2012.

Questions of methodology

The question of methodology in Palaeolithic site survey is an important one, but is rarely discussed, and there is little in the published literature by way of explicit guidance about the appropriate procedures. In so far as there is a methodological framework, it is best described as a form of 'geological opportunism' (Bailey et al. 1997), in which geological features are assessed for the likelihood that they will provide exposures of the right age, or features such as caves and rockshelters conducive to the preservation and discovery of archaeological remains. The goal of such searches is invariably the discovery of the stratified site, which offers the prospect of a cultural and environmental sequence, geochronological control, and a focus for excavation and the deployment of a wide range of analytical studies. This site-based approach results in one or more type-sequences, and these are then taken as representative of a much wider area or region.

Chronological control is, of course, vitally important, especially when dealing with the long time ranges of the Palaeolithic, and with stone-tool types and technologies that are not distinctive of particular periods of time, or only very approximately or unreliably so. How many eager investigators have picked up a surface find of what looks like an Oldowan chopping tool, thinking they have found evidence of a Lower Palaeolithic presence dating back hundreds of thousands of years, only to be disappointed when later investigation shows that it could have been a rough-out or an expedient tool made in much more recent millennia?

Nevertheless, without neglecting the need for chronological control, it has long been recognised that this site-based approach is inadequate. Mobile Palaeolithic peoples do not confine their activities to one or a few locations. Rather we should conceptualise their activities as a distribution of variable activities extending over a regional landscape, representing many different types of activities of varying duration and intensity, often carried out by different social groupings or sub-groupings of the wider population, and at different times of the year. The ultimate goal of Palaeolithic site survey, then, should be a four-dimensional map of finds with both temporal and spatial/geographical controls.

Implementing such an agenda poses enormous challenges, because the physical landscape, which provides the framework for spatial and geographical control, is itself a changing entity. Many of the landscape features visible today have most likely changed over time because of processes of erosion and sedimentation, tectonic and volcanic activity, sea-level change, and changes of climate, vegetation and hydrology, to say nothing of human activity in recent decades. The further back in time we go, the more dramatic these changes are likely to have been. Moreover, these changes can affect survey research design in two ways. Firstly, they affect our assessment of which parts of the landscape are likely to have been most attractive to Palaeolithic populations in terms of local water supply, food resources, raw materials, shelter, and routes of access. Secondly, they affect our assessment of which locations in the landscape are most likely to have preserved material and exposed it to discovery. We refer to this second set of considerations as 'landscape taphonomy', a study of the processes by which material remains have been variously moved, modified, preserved, damaged, destroyed and exposed to discovery by transformations of the land surface.

Two consequences follow from the above considerations. The first is that the starting point for any comprehensive discovery and interpretation of Palaeolithic archaeology at a regional scale must be a detailed investigation and understanding of the physical landscape and its various geological and geomorphological transformations over time. The second is the importance of recording all background information and observations made during the course of survey. This should include the rationale for the survey strategy, routes taken to reach particular target areas, the precise location of finds including surface finds, photographs of finds and find areas, time spent in searches, locations visited which failed to yield finds as well as those that were productive, the policy of picking up material as opposed to recording in situ, and so on. Too often, the published record of archaeological survey (and excavation) is a record of unqualified success, a record of what was found, rather than a fuller record that includes what was overlooked or might have been missed – the failures of discovery as well as the successes. Without that fuller record, it is difficult for an independent observer to evaluate the significance of what was found, or to learn from previous experience. Much relevant information may be lost, and subsequent generations of observers, none the wiser, are doomed to repeat the mistakes of their predecessors. Modern digital technology, with satellite imagery, GPS devices, and the use of GIS programmes, makes this task much easier than was the case even as recently as 20 years ago.

Survey aims, objectives and methods

The multi-disciplinary nature of the DISPERSE project means that methods from both earth science and archaeology are employed during fieldwork and research. Landscape and tectonic studies require the use of geological maps, satellite imagery and topographical data together with field observations in order to identify and characterise the processes acting at various scales, from that of a single outcrop to that of the volcanic edifice or the mountain belt.

Archaeological survey, in contrast, operates between the meso-landscape scale and that of the individual site. Areas for investigation are targeted for their archaeological potential based on factors such as favourable sedimentary conditions for the preservation of in situ archaeology, the presence of known archaeological sites in a given area (e.g. the locations of sites recorded by the Comprehensive Archaeological Survey Program), and proximity to landscape features likely to have been attractive to human populations, such as sources of water, suitable raw materials for making stone artefacts, and pathways of movement for people and animals.

Moving between these different scales of study and different disciplines requires flexibility in the fieldwork itinerary. As the understanding of the landscape features, their history of development, and their associated archaeological potential evolves through observations made in the field, so must the strategy and areas targeted for more detailed study.

In this first phase of exploration we set ourselves two aims: firstly, to assess the potential of the study region for examining the interrelationship between early human settlement and dynamic landscape evolution with specific reference to tectonic and volcanic processes; and secondly, to make a first assessment of Palaeolithic find spots.

Within these broad aims, our specific objectives were to:

1. Characterise the broad scale-landscape zones within the study area, from the coastal plain to the western part of the Arabian escarpment, as a function of the geology and geomorphology, and to relate this to possible underlying tectonic and volcanic processes.
2. Record the archaeology observed during the course of this reconnaissance and assess the potential of different landscape zones for archaeological preservation and future investigation.
3. Locate stratified sedimentary sequences with or without archaeology within them for palaeoenvironmental reconstruction.

4. Identify areas of archaeological potential for more localised and intensive survey and record archaeological material discovered during the course of the general reconnaissance

The routes taken and areas visited during the fieldwork are shown in Figure 1. Travel was by four-wheel drive vehicle using accessible roads and occasionally off-road tracks. In the May-June reconnaissance, the survey team comprised Al Ghamdi, Devès, Inglis and Meredith-Williams. In the November survey, the team included Al Ghamdi, Alsharekh, Bailey, Inglis and Meredith-Williams. The topography and the slopes were prepared from terrain

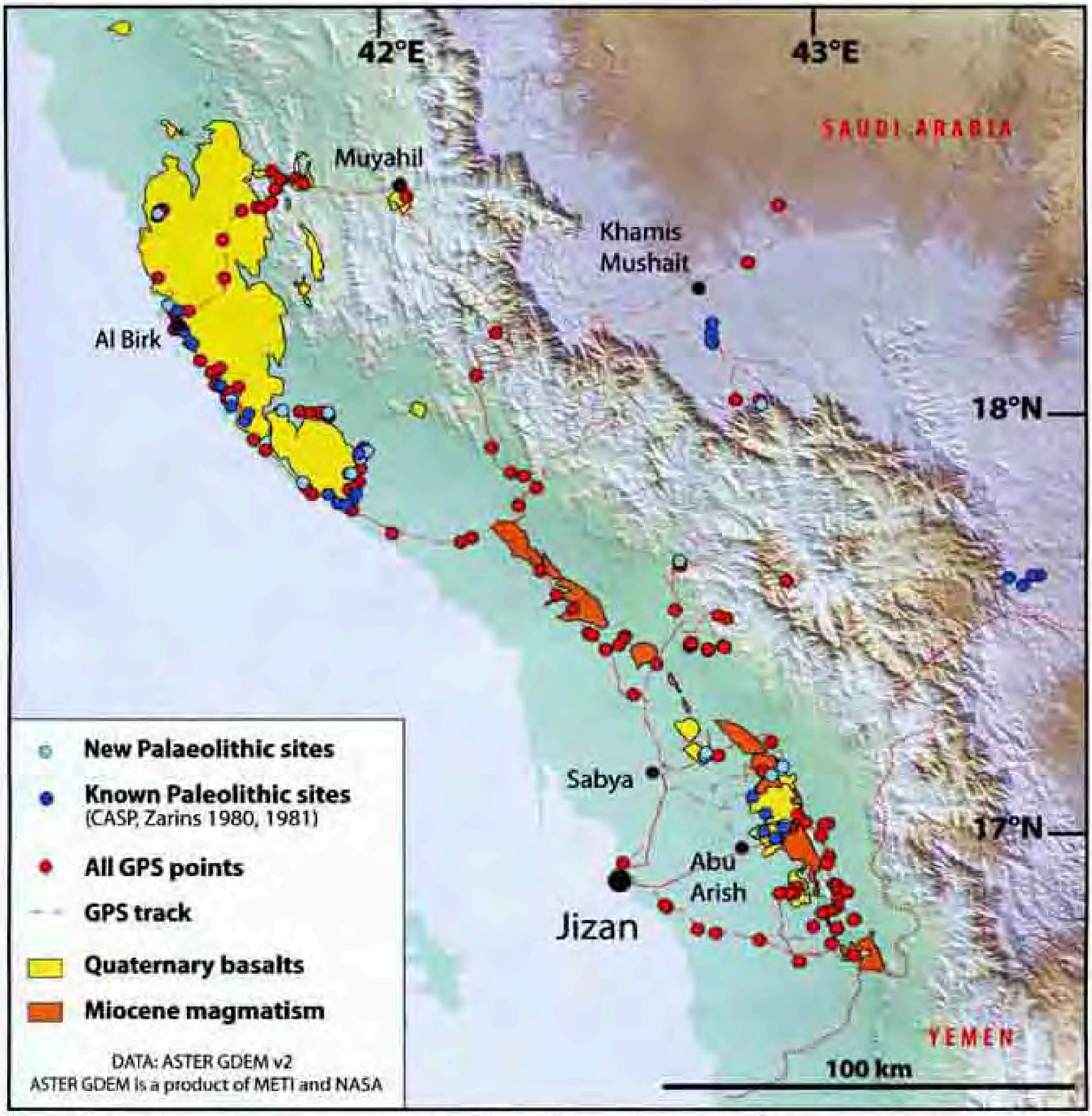

Fig. 1. Map showing the itinerary followed by the DISPERSE team during the 2012 reconnaissance, Waypoints (GPS points), sites with .potential Palaeolithic artefacts, and other places mentioned in the text. Map prepared by Maud Devès and Robyn Inglis.

elevation data and inspected before the survey. Available geological maps were georeferenced. All maps were loaded on a laptop computer, which was taken in the vehicle with the survey team throughout the survey. A GPS device was also taken, so that at all times the survey team could identify their position in relation to the satellite maps, and use these to inform travel plans and search strategies, and to obtain precise locational coordinates of finds and other features. A photographic record was kept and all photographs and other finds were related to their position using a series of Waypoints with GPS coordinates.

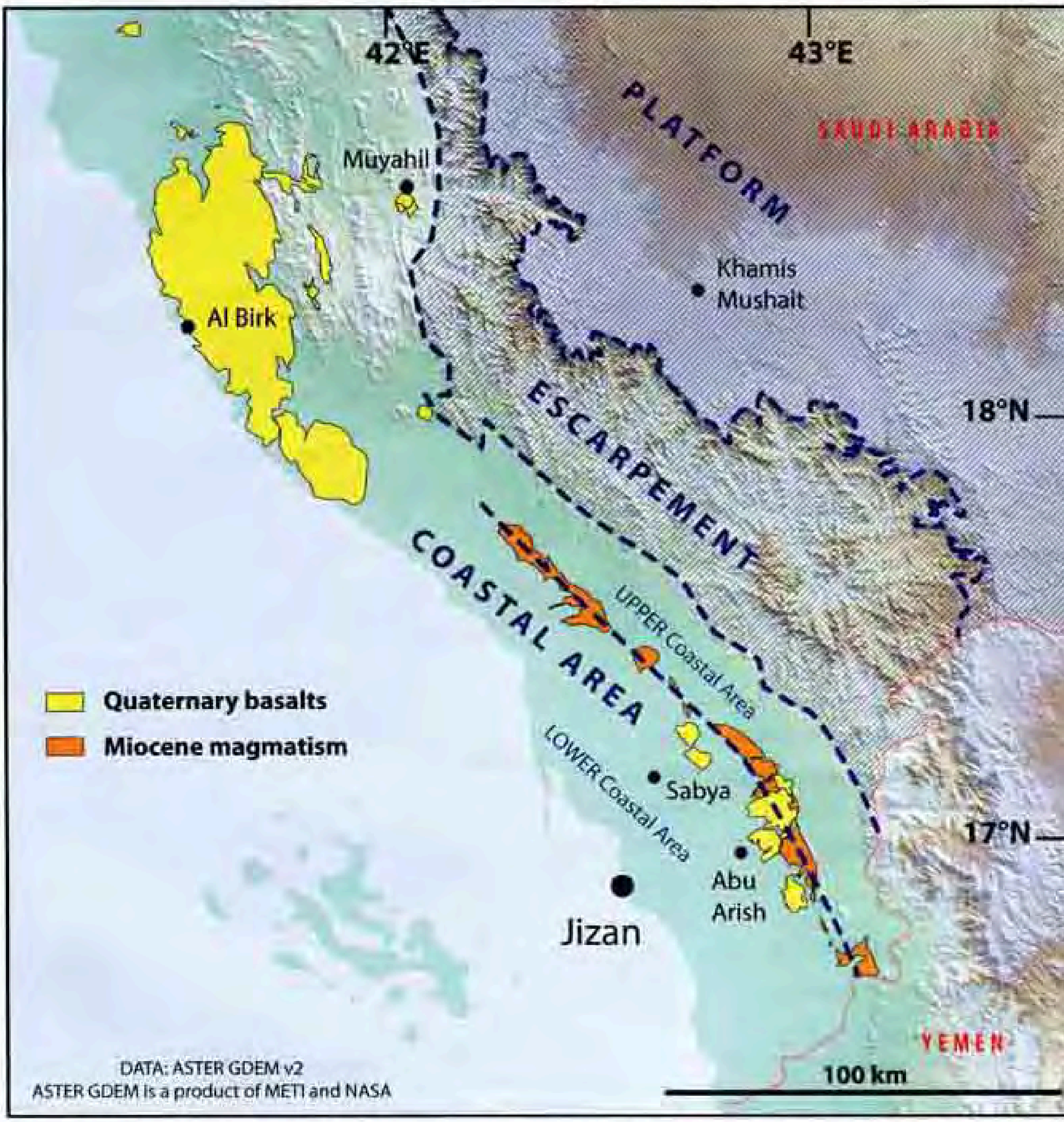

Fig. 2. Map showing broad-scale landscape zones characterised by DISPERSE during the 2012 fieldwork. Map prepared by Maud Devès.

Fig. 3. Landscapes of the Lower Coastal Area. The upper image shows a landscape of sand dunes with little vegetation. The lower image shows a cultivated river bed at Waypoint 244. Photos by Maud Devès, May 2012.

For the purposes of definition, we treat an archaeological site as any location which has yielded at least one artefact, and all artefacts observed in the field were recorded, even if they were individual finds. Experience shows that sites with one or a few artefacts may yield far more material when subjected to more intensive searches. Also even isolated finds contribute to an understanding of how past activities were distributed across the wider landscape. The time taken in searching specific localities for artefacts was limited by the extensive nature of the survey and the time available. Some locations first identified in the May-June survey were re-visited for more careful inspection in November, and further work is planned in future surveys. Some artefacts were left in the position where they were first observed. However, most material was collected, bagged and labelled, and all artefacts retained for later inspection have been placed in the Sabiya Museum, and will ultimately be stored in the National Museum, Riyadh. Details of search times and quantities of material recovered at each locality will be included in the full archive.

Here we outline the landscape zones identified in survey, and their distinctive features, and summarise some of the most important archaeological and palaeoenvironmental results. More detailed descriptions of selected Waypoints are given in Appendix 1. These Waypoints have been selected because of the presence of artefacts or because of especially illustrative geological and palaeoenvironmental features of potential archaeological significance. We do not attempt a full description of the archive here. Rather, our intention is to demonstrate the methodology with selected Waypoint descriptions and photographs and to provide a summary evaluation of significance and future potential.

Results

Landscape Zone Characterisation

On the basis of geomorphological, geological and tectonic observations, we distinguish between three large-scale landscape units: the coastal area that extends between the Red Sea coast and the escarpment, the escarpment itself, and the Arabian platform (Figure 2).

The overall morphology of the coastal 'plain' of western Saudi Arabia is that of a gentle slope rising from sea level to the foot of the escarpment. Nevertheless, the landscape of the coastal area varies considerably as a function of the underlying tectonic and volcanic processes and their impact on topography, lithology, erosion and deposition. We therefore make an additional distinction between a 'lower coastal area', in the Jizan region, extending 30–40 km inland, an 'upper coastal area', which occurs further inland, and the Al Birk coastal area. Each of these has different characteristics and archaeological potential.

The Lower Coastal Area

In the area extending east and northeast of the town of Jizan there are no major topographical features in the first 20–30km inland from the coastline, apart from the salt dome of Jizan that rises to about 40m, and several depressions that might be associated with karst processes observed along the coast. This 'Lower Coastal

Fig. 4. Landscapes of the Upper Coastal area and Magmatic Belt. Upper image shows sedimentary flats and volcanics at Waypoint 224; lower image shows a lava flow incised by a river at Waypoint 228. Photos by Maud Devès, May 2012

Fig. 5. General view of the topography around the artificial lake created by the Wadi Bayish dam. Photo by Maud Devès, May 2012.

Area' is covered by Quaternary fluvial, aeolian and marine deposits. Several wadis have incised through these deposits creating wide and shallow river beds that are today heavily cultivated. Outside of these wadi beds, the Lower Coastal Area is dominated by vast areas of sand dunes and sparse shrub vegetation (Figure 3).

The Upper Coastal Area and the 'Magmatic Belt'

About 30–40km from the coastline, the wider coastal plain is crosscut by a marked topographical and geological barrier that results from episodes of magmatism and tectonic deformation, defined here as the 'Magmatic Belt'. The first stage of magmatic intrusion occurred during the Miocene. It was followed by the eruption of basalts during the Quaternary, which built isolated volcanic edifices north east of Sabya and nearby Keyr Ayash, and more widespread volcanic fields near Abu Arish. The Magmatic Belt is aligned roughly parallel to the Red Sea Rift. This specific spatial distribution, as well as the timing of these events, suggests that these magmatic episodes have occurred in relation to the opening of the Red Sea. Xenoliths with olivines were observed in some of the Quaternary lavas, supporting an interaction of the magmas with the mantle. The magmatic and deformation history in this area has been poorly studied so far; further work is required to understand under which regional tectonic and structural context the deformation has taken place, by which melting mechanisms the magmas have been produced, why magmatism has occurred in two stages, and ultimately how this deformation and these magmatic events have changed the landscape seen by humans in the last million years and more.

This Magmatic Belt plays a key role in shaping a distinctive landscape in the Upper Coastal Area. The morphology of the belt varies along strike, creating a variety of landscapes at different scales. The southernmost part of the belt is dominated by deformed diabase, andesites, schists and granites. Deformation and subsequent erosion and deposition processes have created numerous elongated sedimentary basins in the middle of a complex topography. Quaternary lava flows cover the underlying topography, and enclosed sedimentary basins are found at the edges of the lava flows, or where rivers have incised (Figure 4).

Generally speaking, the Magmatic Belt is an area of topographic complexity located between two large sedimentary plains. Complex topography may be used by early humans for protection but also strategically while hunting, and an area of such topography may therefore be attractive. The Magmatic Belt is also a boundary for stream catchment, and the topography is exploited today by the modern Jizan dam (Figure 5). Similar damming and capture of water flowing from the escarpment to the coast may also have occurred through natural processes in the past, creating areas attractive to animal and human populations. This attractiveness is enhanced by an abundant source of raw materials for tool manufacture in the lava flows. This complex topography also may trap and protect areas of sediment, preserving archaeological and palaeoenvironmental archives in situ.

The Upper and Lower Coastal Areas, as well as the numerous enclosed sedimentary basins within the Magmatic Belt itself, exhibit differences in lithology and soils. Whereas the Lower Coastal Area is fully covered by Quaternary sediments, older rocks are showing on the surface of the Upper Coastal Area. It is worth noting that different soils can have different nutrient potential for vegetation, and thus animal grazing. From field observations made during this reconnaissance, it could be suggested that the soils derived from granitic rocks were more successfully cultivated than the soils derived from the schists. The latter are also often associated with medium-scale roughness whereas the areas with granitic soils are usually smoother. Exploring the influence of such differences on vegetation and attractiveness to animal populations, and therefore their importance to early human populations, forms an important part of landscape characterisation in the DISPERSE project.

Al Birk and the Coastal Lava Flows

In the region of Al Birk, the landscape is dominated by a superposition of Quaternary lava fields and volcanic cones on deformed pre-Permian schists. The proximity of these flows to the present-day coast results in distinct landscape characteristics, producing a wide variety of landscapes, from sandy beaches to coral terraces, volcanic cones, lava fields, mangroves, cultivated river beds, and enclosed sedimentary basins, as well as low-energy alluvial sediments (e.g. WP304, see Appendix 1). Within the wider landscape there are various scales of topographic complexity and various lithologies and soils.

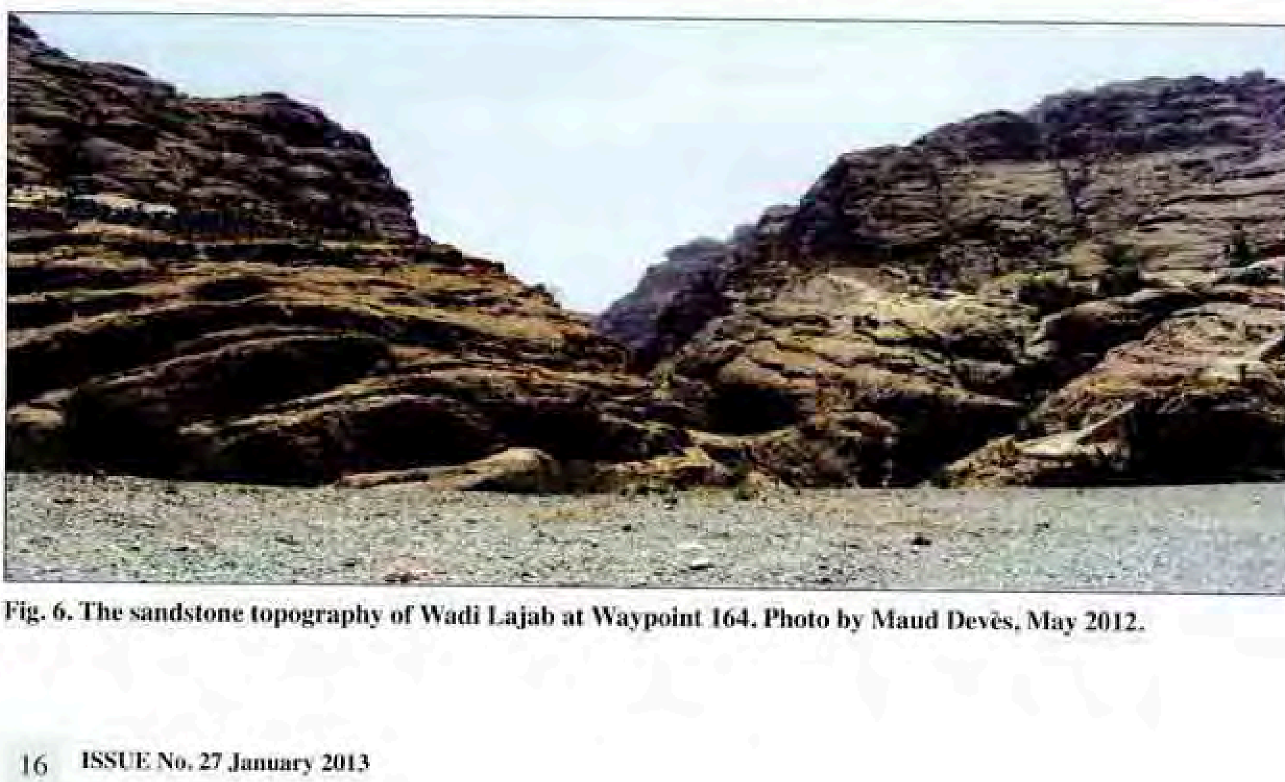

Fig. 6. The sandstone topography of Wadi Lajab at Waypoint 164. Photo by Maud Devès, May 2012.

Fig. 7. Waypoint 167 looking east to the escarpment foothills, with a Palaeolithic scraper and a retouched flake from the surface of the terrace above the wadi. Photos by Robyn Inglis, May 2012

Sea level change over the last 2my would have dramatically altered the landscape as experienced by human populations, and is something which urgently requires further research as part of DISPERSE, following on from sea level modelling carried out in previous research (Lambeck et al. 2011). Several levels of emerged coral terraces were observed along the coast (e.g. WP 287/288, Appendix 1), which correspond to eustatic changes, but which may have also been affected by tectonic and isostatic deformation.

The landscape of the region extending northeast and inland from Al Birk to the escarpment is dominated by folded schists cross-cut by one main wadi, which flows from the escarpment. In Muyahil, an isolated Quaternary volcanic cone occurs in the middle of an enclosed sedimentary flat, located on one of the few N–S routes through the deformed schist, which elsewhere forms a barrier to movement.

The Escarpment

The escarpment receives consistently higher rainfall than elsewhere, and therefore may have provided an attractive environment for past human populations. However, its steep valleys and eroded hillsides reduce the likelihood that archaeological material will have been preserved, except in valley-floor sediments. The schist geology is also inhospitable, relieved only by smaller areas with different geological formations that may have been more attractive, such as the area of Nubian sandstone around Wadi Lajab (Figure 6) and the granite areas near Ar Raith, which contain springs, as well as smaller enclosed sediment basins within the escarpment. However, these areas are removed from the broad coastal plain and relatively inaccessible. Areas closer to the edge of the escarpment or the front folds are potentially better targets for archaeological investigation into the human use of the landscape. No detailed observations were made in the escarpment zone during this fieldwork, and future investigation will require careful planning given the difficulty of the terrain.

The Arabian Platform

The Arabian platform is vast, and exploration of the area around Khamis Mushayt was limited. The region receives more rainfall in comparison to the coastal plain, which is testified in the more abundant vegetation. The geology is dominated by old crystalline rocks

Fig. 8. Stone flakes from on top of coral terraces overlying basaltic lava in the area of Waypoints 287/288. Photos by Robyn Inglis, May 2012

Fig. 9. Comparison of basaltic lavas at Waypoint 41: upper, fine-grained basalt, which has been used to make stone tools; lower, coarse-grained basalt in the same location. Photos by Geoff Bailey, November 2012.

Fig. 10. The volcanic jebel at Waypoint 41: upper, general view looking west from the Muhayil road – the stone tools were found on a flat area near the summit of the jebel, indicated by the arrow, to the left of the main cinder cone; lower, close-up view of the area of fine-grained basalt where the stone tools were found. Photos by Geoff Bailey, November, 2012.

such as pre-Permian granites, granodiorites, with rare outcrops of Nubian sandstones. It was briefly observed that the landscapes associated with these different lithologies exhibit different features, such as rockshelters in sandstone areas, but a more detailed survey is needed to go further in landscape characterization. From the edge of the escarpment, the topography slopes gently eastward, which controls the drainage pattern. These areas are important because they are ideal places for water catchment and therefore may have been attractive places for people.

Archaeological Reconnaissance

Lithics and artefacts were observed at 33 Waypoints during the course of this fieldwork as surface finds (selected locations and waypoint descriptions are listed by landscape area in Appendix 1). Many locations yielded tools consistent with Palaeolithic technology, and some stone tools and ceramics attributable to Neolithic or later periods. For the most part, we describe this material as potentially Palaeolithic or potential Neolithic, since the quantity of artefacts recovered limits the confidence with which we can assign material to specific periods. Neolithic and later material is usually identifiable by the fresh nature of the flake scars on stone tools, and by the presence of potsherds. The fact that potentially Palaeolithic and potentially Neolithic or later material sometimes occur in the same areas indicates that the surface scatters are often palimpsests. Palimpsests, representing the mixing of material from different time periods, are a regular feature of archaeological deposits (Bailey 2007). They are significant because they indicate locations that have been repeatedly used over long periods of time, and which therefore must have enduring attractions for human settlement.

No artefacts have yet been found in stratified deposits. At the same time, it is clear that there is a low-density scatter of lithics, most likely from a range of periods, across the landscape in a variety of settings. Sites were recorded on terraces overlooking wadis, e.g. WP163, WP167 (Figure 7), and WP220, associated with lava flows and volcanic jebels both inland next to wadis e.g. WP41, WP168/9, WP310, as well as near to the coast associated with coral terraces, e.g. WP287/28 (Figure 8). A single find-spot was located close to a seasonal lake/potential sinkhole near to the coast (WP212).

With such brief, broad-scale fieldwork, the find locations observed so far have necessarily been biased towards areas of potentially high artefact visibility, such as deflated surfaces on wadi terraces and lava flows, rather than towards areas where artefacts may be buried under sediments. More time-intensive survey of exposed sections through stratified sequences in wadis, road cuttings and quarries will be required to locate stratified material. Some promising locations for the latter have already been identified, and new fieldwork is underway to explore them further.

Palaeoenvironmental Reconstruction

A number of areas of exposed Quaternary stratigraphy, primarily facilitated by bulldozing or quarrying, have been observed throughout the fieldwork, which have potential for palaeoenvironmental and local-scale landscape reconstruction, as well as for the future location of stratified archaeological sites. These sequences include a potential low-energy alluvial sequence underlying terrestrial sediments at the eastern edge of the Al Birk lava fields, which has been sampled for sedimentological and palaeoenvironmental analysis and OSL dating, close to Hajambar (WP304), and a series of profiles exposed through wadi floodplain sediments in an area downstream of the Wadi Jizan dam (around WP157), one profile of which has been sampled for OSL dating. Observations of sediment sequences close to the coast consisting of cycles of marine sedimentation and coral development (WP292 and 299), as well as coral terraces overlying lava flows (WP287/288), will provide key information for the dating and identification of palaeoshorelines, and their relationship to local landscape evolution and artefact distributions.

Fig. 11. 'Chopping tool' with flake scars at one end, found at Waypoint 41. Photo by Geoff Bailey, November 2012.

Discussion: Key Areas and Themes

Whilst the identification of areas to target for future work is an ongoing process, at this

Fig. 12. Rockshelter at Waypoint 49, showing talus deposit in front and basaltic lava flow above. A second rockshelter is present to the right of this one (not shown in the photograph). Photo by Geoff Bailey, November 2012.

Fig. 13. Laminated sediments at the base of the quarry section at Waypoint 304. The arrow shows a diagonal unconformity in the laminated sediments caused by tectonic movement. Photo by Robyn Inglis, June 2012

Fig. 14. View of Waypoint 310, showing circular structures in foreground. Palaeolithic artefacts were observed on slopes in the background. Photo by Robyn Inglis, June 2012.

preliminary stage, the reconnaissance fieldwork has identified a number of specific areas for further archaeological, palaeoenvironmental and geological/tectonic/volcanic investigation.

Further Volcanic and Tectonic Research

The 'magmatic belt' in the region of Jizan and Abu Arish is a key area of study to understand the tectonic and magmatic processes occurring in the region and their impact on human landscapes. The coast of Al Birk, because of its proximity to the coastline, is an important area to understand the role of sea level changes. During this fieldwork, we did not have the time to explore properly the processes occurring on the Arabian Platform but this would be important. Future work will therefore require undertaking further visits to each of these areas.

Further Archaeological and Palaeoenvironmental Research

Al Birk Lava Flows

The lava flows around the Al Birk area appear to have been heavily exploited for their raw materials during the Palaeolithic, as noted during earlier surveys. A number of localities on the edge of the lava flows have been explored to assess the spatial patterning of lithics and sites. It is notable that the quality of the basaltic lava for making artefacts is highly variable, ranging from coarse, heavily weathered, vesicular basalt at one extreme, to fine-grained material at the other. The latter has far superior flaking qualities, and its distribution is quite localised and occurs as small patches in more extensive lava flows of coarser material (Figure 9). One of these (WP 41), on top of a volcanic jebel (Figure 10) was clearly targeted as a factory site and has produced a range of flakes and cores, as well as a chopping tool (Figure 11). It is clear that Palaeolithic people were aware of the locations and differing qualities of raw material outcrops in the wider landscape. The discovery of rockshelters around the inland edges of lava flows (e.g. WP49) also holds out particular interest for further investigation (Figure 12). More intensive survey of visible palaeoshorelines, as marked by coral and marine terraces near the modern coastline, is also a high priority in the search for in situ artefacts, in close cooperation with the geomorphological mapping and dating of coral terraces and marine sediment sequences, in order to improve an understanding of the relationship between the development of coastlines and Palaeolithic occupation.

Alluvial sediments at WP304

Water laid sediments are a key palaeoenvironmental indicator in semi-arid environments as they mark periods in which there was greater humidity than at present, indicating water courses and areas of standing water that would have been attractive to animal and human populations. The laminated sediments identified at WP304 (Figure 13), if demonstrated to be the result of low-energy alluvial deposition, are therefore of considerable interest both for environmental reconstruction and archaeological exploration. The cleaning and sampling of existing sections within the quarry has been undertaken to provide a clearer understanding of the nature and formation of the sediments and their chronology.

Magmatic Belt and Upper Coastal Area

The topography and complex drainage patterns of the area, as well as abundant sources for raw material and numerous observations of archaeology on exposed surfaces, indicates good archaeological potential for locating both further surface sites on wadi terraces and lava flows as well as stratified sites within wadis. The barrier to drainage caused by the topography of the Magmatic Belt may also have blocked and re-routed wadis through tectonic and volcanic processes, trapping water and producing lakes and conditions attractive to human and animal occupation. Further systematic survey has the potential to locate additional surface sites as well as in situ deposits for archaeological and palaeoenvironmental reconstruction, tied to volcanic-driven landscape changes.

Palaeolithic Factory Site and Neolithic Structures WP310

The site at WP310 holds what appears to be extensive evidence for Palaeolithic and Neolithic occupation on the plateau/platform (Figure 14). A more extensive investigation of the valley is required to identify a range of Palaeolithic sites within their landscape settings, as well as evidence for past environmental conditions in the form of potential seasonal lakes observed at the southern end of the valley.

Al Bathah Sandstone Landscape

The sandstone area on the escarpment close to Al Bathah, Asir, incised by wadis, holds great potential for the existence of rockshelters that may yield archaeological sediments. The location of these valleys on the platform is within an area currently more relatively humid than the coastal plain, and thus rendering it potentially more attractive during periods in the past to human occupation. Further survey should be carried out to assess the archaeological and palaeoenvironmental potential of the area.

Conclusion

This reconnaissance fieldwork has allowed us to understand and begin to characterise landscape units on the basis of geomorphological, tectonic and lithological observations, as well as the timescales at which the underlying tectonic and volcanic processes act on the landscape. Field observation of these landscape zones and their distinct sedimentary environments has allowed a basic understanding of the sedimentary taphonomy of these areas, and the potential impacts this has on the location, visibility and potential preservation of archaeological sites, which will be key in planning more detailed survey and interpretation.

We have also located a number of sites with significant archaeological and palaeoenvironmental potential. Some of these sites are represented by very small numbers of artefacts, but they are nevertheless significant indicators of areas with potential for more detailed exploration. The larger quantities of material recovered in some locations, for example the basalt outcrop at WP41, demonstrate the presence of centripetal cores, large flakes with plain striking platforms, and at least one 'chopping tool', which are consistent with what we would expect for both Early Stone Age (Lower Palaeolithic) and Middle Stone Age (Middle Palaeolithic) material. Later prehistoric material, probably of Neolithic or later date, is also well represented. We conclude that the landscape of the region as a whole has been an attractive one for human populations throughout the prehistoric period, extending from the Early Stone Age through to recent times, and that more detailed exploration in the light of our preliminary results will be fruitful in terms of discovering more detailed and better dated evidence.

The methodology we have developed for exploration in the field and the recording of field observations and the occurrence of archaeological sites has proved flexible, easy to implement, and capable of providing a detailed archive, which will provide a foundation for future investigations, both ours over the coming years, and our successors in a more distant future. We have not attempted to present the full archive in this paper, but rather to provide a selection of descriptions and photographs that illustrate the potential of a digital archive, and its usefulness both as a descriptive record, and as a basis for evaluation, interpretation, and the planning of future fieldwork. Our intention is that the full and final archive will ultimately be made available in digital form through the Archaeological Data Service (ADS), based at the University of York, UK, and through other digital and online media.

Overall, the above report outlines the

substantial potential for the development of future research foci and directions in southwest Saudi Arabia, and how this will contribute both to the wider understanding of the archaeology of the Arabian Peninsula, and to the DISPERSE project's aim to investigate the impact of dynamic landscapes on early human evolution and dispersal.

Acknowledgements

We thank HRH Prince Sultan bin Salman bin Abdul Aziz, President of the Saudi Commission for Tourism and Antiquities (SCTA), Professor Ali Al-Ghabban, Vice-President, and Mr Jamal Al Omar, Director General, for granting permission to undertake the fieldwork and for making available personnel, vehicles and other resources to support our research. Grateful thanks are also extended to the staff of the SCTA from Riyadh and the regional offices in Jizan, Sabya, Farasan and Abha, who accompanied us in the field, notably Mr Hussein Mofareh (Sabya Museum), Mr. Abdu Aquli (Farasan SCTA) and Mr Mohammed al Halawi (National Museum, Riyadh). We also thank our colleagues on the DISPERSE project, Niklas Hausmann, who participated in the November survey, Isabelle Winder, and Geoffrey King, for discussion and advice. DISPERSE – Dynamic Landscapes, Coastal Environments and Hominin Dispersals – is an Advanced Grant (Grant No. 269586) awarded by the European Research Council (ERC) for a 5-year programme of research (2011–2016) involving collaboration between Prof. Geoff Bailey at the University of York and Prof. Geoffrey King at the Institut de Physique du Globe de Paris. This is DISPERSE publication xxx.

Appendix 1. Waypoint Descriptions by Landscape Area1

1 The precise GPS locations of all Waypoints will be lodged with the Saudi Commission for Tourism and Antiquities, and are available in our digital archive, which is not yet publicly available.

The Magmatic Belt and Upper Coastal Area

The magmatic belt forms a major topographical feature which divides the coastal plain into two areas. The area of the Magmatic Belt and Upper Coastal Area, between Al Shugayri in the north and Ahad Al Masariyah in the south was extensively explored during this fieldwork in order to understand the complex magmato-tectonic history of the region. The landscape of the magmatic belt is characterised by folded schists and deformed granites which enclose a number of sedimentary basins, and is associated with a number of isolated volcanic cones to the west of the line, such as the Sabya volcanoes.

The landscape in the Upper Coastal Area is characterised by broad sedimentary plains with older rocks showing on the surface from place to place. The whole area is incised by numerous rivers, and, closer to the magmatic belt, enclosed areas of sediments surrounded by rough lava fields.

WP147, 149, 151, 152 - The Sabya Volcanoes

The two volcanoes at Sabya are marked topographic features in an otherwise flat landscape, and occurring slightly west of the main magmatic belt. Whilst no finds were recorded from the CASP survey, lithics were observed by Dr Anthony Sinclair during previous visits to the area. During the current fieldwork, the southern side of the southern volcano was visited, as well as the wadi valley between the two volcanoes, although sandstorm conditions during the latter visit hampered observations. The area directly to the south and east of the southern volcano is undergoing extensive development, including the building of an electricity plant, which will destroy any archaeology except that closest to the volcano slopes. The presence of xenoliths gives important insights into magmatic processes suggesting involvement of the mantle of the lithosphere or of the asthenosphere.

WP 147

A single well-weathered basalt flake, possibly of Palaeolithic age, was found on a sandy substrate c.100m from a break in slope at the base of the volcano, close to a wadi cut.

WP149

A single quartzite flake was observed stratified in colluvial deposits at the foot of the volcano exposed by a road cutting. It was associated with a smaller flake of quartzite, yet it is unclear as to whether these are clearly artefacts rather than natural pieces.

WP151 & WP152,

A number of basalt flakes of potential Palaeolithic age were observed on deflated surfaces at the base of lava flows associated with the volcano. The area is dissected by small wadis and gullies and is one of the few areas undisturbed by development to the south of the volcano.

WP154

A single well-weathered basalt flake was observed in the lava fields to the east of Abu Arish, in the vicinity of CASP site 217-81.

WP155, 157, 172, 173, 174, 175, 176

2x1 km area around WP157

A number of profiles of up to 10m of sedimentation, underlying lava flows, were recorded in the area of WP157. Whilst no artefacts were observed, the profiles show shifting environments in the wadi floodplain, and may preserve both archaeological material and palaeoenvironmental information. A sample of sediment was removed from the top of profile WP157 for OSL dating.

WP163/164

A lithic scatter was observed on the deflated surface of the wadi terrace, c.50m from the wadi. Artefacts consist of four or five potentially Neolithic flakes on green-grey sedimentary rock, relatively fresh, spread over an area of 10m. A scatter of very fresh knapping debris of greyish metamorphic material was also visible close to one or two sherds of ceramics.

WP165

On a terrace overlooking a wadi now flooded with the building of Wadi Bayish dam, extensive lithic scatters were observed on a deflated surface, with finds including basalt flakes and cores of potential Palaeolithic age, and Neolithic chert flakes.

WP167,

A heavily-weathered Palaeolithic endscraper and a basalt flake were found on the deflated surface of a wadi terrace, 500m from the main channel. This scatter also yielded flakes of green chert and pale sedimentary/metamorphic rock. The freshness of the fractures indicates that these are of Neolithic age or younger.

111111 169

A low-density scatter of lithics was observed across slopes at the northern end of a lava flow that extends down to the wadi edge. There are rare well-weathered Palaeolithic basalt flakes, with some sharper, Neolithic flakes on greenish chert, as well as occasional pottery sherds.

WP220

A scatter of multi-period artefacts was observed covering an area of sediment immediately at the southern edge of the volcanic cone, dissected by small wadis and gullies. These include well-weathered basalt flakes of probable Palaeolithic age and Neolithic flakes on chert and quartz, as well as decorated pottery rim and body sherds.

Lower Coastal Area

The Lower Coastal Area was not extensively surveyed during the reconnaissance given its disturbance by modern development and agriculture, as well as relatively low potential for archaeological visibility, given the massive quantities of Quaternary sedimentation (including sand dunes and cultivated wadi sediments), and lack of major topographic features. The only noticeable topographic features are the salt dome of Jizan and several kilometre-wide depressions as observed from Google Earth and in the field. The latter might be sinkholes created by karst processes of dissolution of the underlying carbonate layers.

WP212

A single well-weathered flake of potentially Palaeolithic age was found near the edge of the dry lake/sinkhole, as well as a scatter of sharper, more recent flakes in the dunes closer to the road.

Al Birk Area

The landscape around Al Birk is dominated by multiple lava flows, which appear to contain an almost continuous low-density scatter of heavily-weathered Palaeolithic artefacts on the local basalt, as observed by the CASP. Given the low resolution of the CASP maps it was not possible to locate the exact sites identified by the Survey. Instead, the edges of the lava flows were examined at a number of points along the coast and inland, where they could be linked to other geomorphological features such as coral terraces which inform on changes in the coastal environment, and which may preserve *in situ* stratigraphy and archaeological sites.

There are also extensive lava flows extending inland between Al Birk and As Shugayig, and we conducted a number of surveys around the edges of the lava flows and in transects across the adjacent terrain.

WP275 and 276

Artefacts were observed overlying and surrounding a tufa outcrop in a wadi adjacent to a lava flow. These consist of potentially Palaeolithic basalt flakes and cores, as well as a granite hammerstone.

WP287/288

A coral terrace on a small promontory south of Al Birk was investigated as a potential location for the CASP site of 216-208. Whilst this could not be confirmed, due to the difficulty of accurately re-locating the CASP sites, the setting does share some geomorphological features with the site, although Bailey *et al.* (2007) place the location of 216-208 further south along the coast. This is probably a result of the relative abundance of artefacts along the shoreline and a consistent coral terrace height within the area, as identified by previous surveys. Extensive disturbance by road building, new trackways and other developments has also impeded the identification of sites observed in the 1980s.

At WP287/288, a coral terrace exists about 1–2m above the sabkha sediments, around 50m from the current shoreline, marked by mangrove vegetation. This terrace overlies a lava flow (e.g. Bailey *et al.* 2007, contra Zarins *et al.* 1981), the contact between which can clearly be seen at WP289, 300m away, where the terrace is cut by a small wadi.

On top of the coral terrace there was a medium density scatter of basalt flakes, showing heavy or moderate weathering. On the slopes of the lava flow above the coral terrace, there was a low-density occurrence of heavily-weathered Palaeolithic basalt flakes, usually visible in small sediment basins trapped between the boulders, including one which may be a point (and may have once had a tang, although this is uncertain given its heavy weathering). This distinction in weathering between the two areas (the lava flow and the terrace) may represent a difference in age (as suggested between Acheulean and MSA, Zarins *et al*. 1981), but this cannot be confirmed without more comprehensive survey and technological analysis.

WP292

A 5m section of sediments at the base of a lava flow c.500m from the present coastline has been exposed through quarrying. The profile appears to be capped by coral, which forms the top 1m of the sediments, below which there are 2m of marine sand, another 1m band of coral, and further marine deposits to the base. The top layer of coral extends across the landscape for around 400m, with outcrops visible to the West and East of the main section.

A small number of weathered basalt flakes and cores of potential Palaeolithic date were observed on top of the coral terrace, along with a core of likely Neolithic age made on greenish chert.

WP299

A sediment profile is exposed in a quarry cut below a lava flow, and capped by 50–75cm of coral. The stratigraphic relationship between the lava flow and coral is unclear from the observations made. On the boulders of basalt which make up the lava flow, four or five circular structures were observed, 6–7m in diameter, and of Neolithic age or later. These are constructed out of basalt boulders, and are associated with pottery sherds. Isolated basalt flakes, potentially of Palaeolithic age, were scattered on the lava flow and also on the coral terrace, although these may have been disturbed due to the presence of a modern track.

WP302

Attempts to locate the CASP site 216-211 in a 'volcanic plug' were hampered by the bulldozing of large quantities of sediment in the area at the foot of the volcano. Yet, the removal of large amounts of sediments by such bulldozing has exposed large profiles through cross-bedded sands of unclear origin, potentially preserving an entire landscape beneath the lava flow, which could be dated and investigated for archaeological and palaeoenvironmental reconstruction.

WP303

This location was a site visited by Geoff Bailey in 2004, and marked as equivalent to the CASP site 216-216. A small wadi cuts the eastern edge of the lava flow, which itself marks the easternmost edge of the area of lava flows in the region. One or two basalt flakes of potential Palaeolithic date were observed on the edges of the lava flows, with many fragments of quartzite scattered across the surface and foot of the flows, some showing evidence of flaking.

WP 304

WP304 is a disused quarry adjacent to the highway, approx.130 x 80m across, and 12m deep. The top 0.5m is characterised by alluvial sediments. These are highly variable and in places extend to 1.5m in depth, ranging in composition from fine layers of silt to sorted gravels. There is considerable carbonate concretion of these layers, forming a calcrete. Below this, there is up to 7m of silty sediment dominated by rhyzolith formation and concentrations of carbonate concretion. At the base of this sequence there are c. 2m of sediments with a horizontal laminated structure, which appear to represent low energy deposition (Figure 13). This lower sequence was sampled in detail with the removal of a stratified column of bulk sediment samples for sedimentological analysis, intact blocks of sediment for soil micromorphological analysis, and sediment samples for OSL dating.

In the centre of the quarry there is a lava outcrop at the same depth as the sediment exposure (rising up 4m from the base of the quarry). Although obscured by section collapse and quarrying activity, it is suggested on the current observations that the laminated sediments may have butted against the lava outcrop. The lava is coarse grained and none of the flakes and fragments on its surface is certainly an artefact. The same uncertainty applies to a small number of quartzite pieces recovered from the alluvial gravels in the upper part of the quarry section. Some of these pieces (about 10 in total) were collected for future inspection.

WP40/41

WP41 is a concentration of basalt flakes and cores on the flat top of a volcanic jebel at an elevation of approximately 100 m asl (Figure 10). Most of the basalt boulders on the jebel comprise coarse-grained material, but the artefacts are associated with a smaller area of particularly fine-grained basalt (Figure 9). Similar material is present on the eastern slope of the jebel (WP40), and a few worked pieces were found here amidst a larger number of large flaked pieces that had broken naturally on the slope. There are shallow rockshelters at the foot of the slope but with no artefacts visible on the surface or within the shallow fill. The artefacts at the top of the slope extend over an area of at least 30 x 20m, and comprise large cores and large flakes with plain platforms, the largest being about 10cm in the longest dimension, and a 'chopping tool' comprising a rounded basalt nodule with flaking at one end (Figure 11). A total of 51 artefacts were collected for future inspection.

WP45

This is a linear jebel of basalt and granite in an otherwise flat landscape of low energy alluvial gravels containing rolled nodules of basalt, chert and quartz. Some of this material around the base of the jebel could have been artificially worked, but much of it could have been flaked by natural processes, and there are few convincing artefacts. Twenty-six pieces including two thick-walled pottery sherds were collected for later inspection.

WP49/WP50

Two small rockshelters in laminated volcanic sediments under lava exposed by a wadi were observed at WP49 (Figure 12). They occur at the edge of the lava field, near the foot of the lava slope and some 3–4m above the floor of a broad sand-filled wadi. The talus slope of one of these rockshelters yielded 3 undiagnostic lithics, and may be a good target for future excavation. An additional 6 worked pieces were found on the basalt outcrop above the rockshelters. Similar rockshelters in the same lithological setting were noted in cliff lines around the edge of the lava field, tracking to the north and west along the wadis leading to the coast. The artefacts observed here were collected for future inspection.

WP55/WP56/WP57

This is an area of sites west of the Hajambar/Muhayil road, clustered around a linear outcrop of quartz, schist and basalt in an otherwise gently undulating landscape of shallow wadis. A total of 66 worked pieces was recovered from these locations and retained for future inspection.

Arabian Platform Area

The area of the Arabian Platform around Khamis Mushayt and Abha was only briefly visited, and aside from the general observation that there are distinct geologies associated with distinct landscapes and sedimentary settings, few conclusions can be drawn as to its nature and formation. The locations which were visited, however, showed good potential for the preservation of many more archaeological sites than were recorded in the CASP, as well as a number of interesting features related to the volcanic, geological and tectonic history of the area. Areas targeted focussed on topographic features such as granite outcrops and wadi valleys.

WP306

A granite outcrop was visited to locate the CASP site 217-218. This area is now under military control and inaccessible. However, brief survey of a small area close to the perimeter fence yielded a number of flakes on exposed bedrock with very little sediment cover.

WP309

An area of sandstone extends along the edge of the escarpment, near to Al Bathah. Although the area visited had been heavily disturbed in its use as a tourist destination, a single, weathered Palaeolithic flake of basalt was observed close to the viewpoint over the escarpment, providing a tentative indication of past occupation. The topography of the area, especially where wadis have cut through sandstone, holds good potential for the presence of rockshelters containing sediments and archaeological material.

WP310

On the eastern slopes of the western edge of a valley that cuts through a granite outcrop, there is a smaller sub-valley between the main sloping valley walls and a linear outcrop of granite. This outcrop has been extended artificially to dam the small tributary that flows from the slopes into the main wadi, forming a pool. Multi-period finds were observed, with a high-density of flakes and tools of potentially Palaeolithic age (and lower density Neolithic finds) spread across the slopes of the valley walls for at least 300m. These slopes are covered by boulders and cobbles of igneous rock of unknown character. This site may represent a Palaeolithic factory site, with lithics ranging from large flakes to cores.

On the surface of boulders of igneous rock, at the base of the small sub-valley and on the footslopes of the granite outcrop, there are a number of round enclosures constructed out of the boulders. These structures, 5 or 6m across, contain knapping debris and artefacts made from schist, greenish chert and quartz. These structures are visible on Google Earth and clusters of them continue along the granite outcrops that run along the eastern edge of the main valley. A low density scatter of lithics is present on the top of the granite outcrop which overlooks the main wadi, with a single undiagnostic flake made from granite, as well as smaller, potentially Neolithic flakes on greenish chert and schist. Upstream, close to the entrance of the main wadi into the valley, potential lake-basin deposits were observed from the road.

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ملخص: يتناول هذا البحث نتائج أعمال المسح الأثري لمواقع ما قبل التاريخ في جنوب غربي المملكة العربية السعودية، الذي أُجري عام ٢٠١٢م، ضمن برنامج مشروع دراسة آثار البحر الأحمر وجزر فَرسان، بإشراف فريق علمي من بريطانيا وفرنسا والسعودية. تتمثل أهداف المشروع بشكل أساس في وضع أسس منهجية، لإعادة تصوّر التغيّرات الطبيعية التي مرت بها المنطقة، نتيجة لحركة الصفائح الأرضية، والنشاطات البركانية، وتغيّرات مستوى سطح ماء البحر، عبر المكان والزمان، وأثرها على انتشار الجماعات البشرية وتنقلهم خارج إفريقيا؛ وذلك باستخدام مناهج الاستشعار عن بعد، وإجراء مسوحات أثرية وجيولوجية على اليابسة وتحت الماء. يستعرض الباحثون في هذا البحث المنهجية المستخدمة لتحديد المواقع الأثرية وتسجيلها، ضمن بيئاتها الأثرية والجيولوجية. وفي الوقت نفسه، يتضمن البحث استعراضاً وتقييماً أولياً للنتائج الأولية للمسح، والذي يُعد جزءاً من منظومة مشروع علمي واسع النطاق.

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