High-resolution geospatial surveying techniques provide new insights into rock-art landscapes at Shuwaymis, Saudi Arabia

Many parts of the Arabian Peninsula contain rock art that has received minimal archaeological attention or has not yet been thoroughly surveyed. In 2001 an extensive rock-art complex called Shuwaymis, Ha’il Province, Saudi Arabia was brought to the attention of the Saudi General Commission for Tourism and Antiquities. This paper sets out the results of the first high-resolution geospatial mapping and recording of rock art at this remote site. The research saw the innovative use of a differential GPS to record rock-art panels to within 5 mm of accuracy at the site of Shuwaymis-2, the first time that such technology has been used to record rock art in the Arabian Peninsula. With such technology it was possible to show which of eighty-three late prehistoric rock-art panels surveyed were in their original position and which had fallen, and to demonstrate that there was spatial homogeneity of rock-art styles and composition across the site. The mapping recorded multiple panels of cattle, ibex, equid, large cat and other animals. The depictions of lions and cattle in particular indicate that the rock art must have been engraved no later than the early Holocene humid phase (c.10–6 ka BP).

Keywords: rock art, Shuwaymis, Saudi Arabia, DGPS, GIS, late prehistoric, landscapes

Introduction

The interpretation of activity variation across landscapes setting is becoming an increasing focus of rock-art research. Advances in geospatial survey techniques, increased availability of satellite and photographic imagery and the development of spatial datasets for mapping and analysis open up new possibilities for studying rock art and human behaviour in its wider environmental contexts, particularly in remote locations (e.g. McClure, Balaguer & Auban 2008; Aubry, Luis & Dimuccio 2013; Bourdier 2013; Jennings et al. 2013; Olsen 2013). Such techniques have great potential to build on existing rock-art research in Saudi Arabia, which has traditionally focused on the interpretation of rock-art styles and inscriptions rather than on the systematic evaluation of rock-art panels from a landscape perspective (e.g. Anati 1974; Khan 2007; Al Talhi 2012).

One key locality in northern Saudi Arabia is Shuwaymis, Ha’il Province (39°53’30”E, 26°09’02”N; Fig. 1).
Shuwaymis contains some of the finest and most numerous rock-art panels in the whole of the Arabian Peninsula. The locality first received recognition as a site of exceptional importance in rock-art research only as recently as 2001, when a local schoolteacher, Mahboub Habbas al-Rashheedi, who was shown the rock art by local Bedouin, brought it to the attention of the Saudi General Commission of Tourism and Antiquities (Bednarik & Khan 2002). Such is the significance of the Shuwaymis rock-art locality that after preliminary surveys of Shuwaymis-1 and Shuwaymis-2 (Al-Saud & Khan 2005; Bednarik & Khan 2005), two rock-art sites situated on sandstone escarpments on either side of a relict river valley, this region together with the Jubbah rock-art complex in the Nefud desert were put forward in 2012 by the Permanent Delegation of Saudi Arabia to UNESCO for World Heritage status. A selection of its panels has also been recently photographed using advanced image technology techniques (Olsen 2013).

A considerable amount of research lies ahead in terms of recording the rock art of the Shuwaymis region, including mapping the whole site extent, which is currently unknown. In recognition of this fact, the Saudi General Commission for Tourism and Antiquities commissioned Oxford University’s Palaeodeserts Project, a major multidisciplinary research project currently investigating links between Pleistocene and Holocene environmental change and human dispersals in the Arabian Peninsula, to undertake a detailed field survey of Shuwaymis-2 and to place the entire rock-art locality in its wider geographical context. The Palaeodeserts team had undertaken a similar project in the Jubbah region in 2011, where the relationship between rock art, palaeolakes and prehistoric archaeological sites was explored (Crassard et al. 2013; Jennings et al. 2013).

Fig. 1.
The location of Shuwaymis in relation to major wadi systems and to the Jubbah rock-art complex, a major location where the same style of Late Prehistoric art is found.
In this paper we present the results of the first high-resolution survey of late prehistoric panels (c.12000–6000 BP) of the Shuwaymis-2 site, which was undertaken in March 2013. Panels engraved in later periods will be reported in future publications. Our aim was to record the precise position of each late prehistoric panel at the site. This was an important exercise not least because Bednarik and Khan (2002) reported that some panels at Shuwaymis-1 and Shuwaymis-2 were inverted and had been displaced from their original position as a result of erosion or tectonic activity, which had caused many boulders to dislodge and fall down on to the lower slopes of the escarpment and on to the valley floor. They hypothesised that some of panels had fallen in the Late Prehistoric period and others afterwards in the mid-Holocene. Our focus was thus to map precisely all late prehistoric panels at Shuwaymis-2 and record if they were in a primary or an altered or secondary position. We also sought to identify if spatial and temporal variations existed in the composition, style and positioning of the rock-art panels along the escarpment. Finally, we undertook a comparative survey of a region 10 km to the north-east to evaluate the nature of the rock art in a related area.

Geology and environmental setting
The Shuwaymis area is characterised by exposed Cambrian sandstones of the Siq member, over lain in places by a cover of aeolian sand, and is positioned between the extensive extrusive basalt lava fields of the Harrats Ithnayn and Khaybar (Roobol & Camp 1991), situated to the north-east and south respectively (Fig. 1). Valleys incised through the Siq member provide exposed sandstone faces which host the rock art discussed here (Fig. 2). Reticulated wadi courses from former periods of increased precipitation comprise depressions filled with fluvial silts and clays, which form claypan deposits known as Khabra (Edgell 2006: 351–359).

A number of palaeoenvironmental records attest to increased precipitation throughout Arabia during the Holocene (e.g., Parker et al. 2004, 2006a, 2006b; Davies 2006; Lézine et al. 1998; Preston et al. 2012; Groucutt & Petraglia 2012). During these humid periods, increased precipitation would have led to the activation of wadi courses incised through the local basalts and in the Siq sandstone areas. It is likely that endorheic wadi discharge into Khabra areas would have resulted in shallow marsh conditions with increased vegetation growth capable of supporting regional fauna. Indeed, even during current arid conditions, minor vegetation growth can be observed on Khabra following seasonal rainfall, with extensive grassland development observed during this study where impermeable basaltic flows forced localised ponding of fluvial discharge.

The Shuwaymis-2 rock-art locality lies at the southern end of a broad north–south trending valley that is incised through the Siq member (39°53.30′E, 26°09.02′N). The site is located on the east side of the valley on an 800 m-long sandstone escarpment that rises steeply and moderately up to a plateau 30 m above the valley floor. Shuwaymis-1 is located opposite on the west side of the valley. A large number of boulders are littered along the lower slopes of the escarpment and on the valley floor. The boulders have formed as a result of the combined effects of tectonic activity and the erosion of fracture points within the sandstone, which weakens the escarpment and dislodges the large boulders.

A distributed relict network of ephemeral wadi channels occupies the valley floor, while several small Khabra are present along their course (Figs. 3 & 4). These wadis join up with larger relict systems. The valley hosting Shuwaymis-2 lies at the catchment divide between the headwaters of two major Arabian drainage systems, Wādī Ar Rimah/Batin, draining to the east, and Wādī al Hamd, draining to the west (see Fig. 1). The valley itself drains into the headwaters valleys of Wādī al Hamd, which has deeply incised upper catchment valleys c.10 km to the west and which can be followed all the way to its mouth at the Red Sea. Approximately 5 km to the east, drainage direction shifts and wadi courses form the headwaters of Wādī ar Rimah. This former pan-Arabian drainage system extends for c.500 km until its former Pleistocene course is severed by the dunes of the Ad Dhana. Remotely sensed evidence for palaeolakes upstream of these dunes suggests that this connection was already severed before the last Holocene wet phase. Beyond a c.50 km hiatus, in which dunes obscure drainage channels, the wadi course continues unbroken to Kuwait as Wādī Batin. During the wettest phases of the Holocene and late Pleistocene, reactivation of these drainage systems may have meant that the Shuwaymis region was accessible by following hydrological systems along a broadly east–west belt stretching from the Red Sea to the Ad Dhana and, more tentatively (if intertidal water sources or water storage allowed crossing of the dunes), potentially as far as the Arabian Gulf.

Furthermore, c.5 km north of the Shuwaymis valley lies a further catchment divide, which if crossed and drainage is followed (with several subsequent short catchment divide crossings) connects to the southern Nefud, where
further instances of rock art similar to that of Shuwaymis are known, such as the Jubbah rock-art complex (Khan 2007; Jennings et al. 2013).

Methodology
The study utilised a form of differential Global Positioning System (DGPS) known as a Real-Time Kinematic Global Navigation Satellite System (RTK-GNSS) to record the location of rock-art panels at Shuwaymis-2. This survey method enables highly detailed and accurate (c. 5 mm) collection of geospatial data, which may then be analysed using Geographic Information System (GIS) software. This represents a significant advance over conventional GPS survey devices, which can only record spatial points to a 5 m level of accuracy. This has significant implica-
tions for rock-art studies as the position and orientation of individual panels can now be recorded on a single boulder. A Leica Viva GNSS system was employed, comprising a Leica GS10 base station and rover connected to a Leica GS15 controller.

Shuwaymis-2 was selected for the survey because it contains a dense concentration of rock-art panels and because it has never been systematically mapped before. Given our ability to record panels to 5 mm accuracy levels, each boulder and escarpment face was thoroughly and comprehensively inspected for evidence of rock art. Numerous variables were recorded for each panel. The variables derived from those used in the Jubbah rock-art survey (Jennings et al. 2013). Key ones included panel composition, style, number of phases, evidence of superimposition, coordinates, elevation, extent, density, orientation, condition (variation in the degree of weathering or patination), completeness (whole, fragmented or dislodged fragment of a larger panel) and its setting, which involved determining whether a panel was in a primary or an altered position. If a panel was engraved directly into a rock face or was upright on a boulder, it was classed in most cases as being in a primary position. A panel on a boulder was classed as being in an altered position if it was inverted, was a fragment of a larger panel, could be refitted to an existing panel or a boulder with rock art had fallen in such a way that the panel could not have been engraved from its current position.

The range of variables used in this study allowed for an objective and quantitative interpretation of the spatial variation of rock art at Shuwaymis-2. Sites were grouped into clusters according to whether they were situated within 30 m of each other. ArcGIS 10.1 was used to analyse the data and base maps derive from Bing Maps. Each panel was photographed and linked to the spatial database.

A number of rock-art styles are present at Shuwaymis. As is the case for elsewhere in Arabia, none has yet been directly dated. Khan has put forward the most detailed relative chronology for Arabian rock art (2007: 341). He identified four key phases: Neolithic, Chalcolithic, Bronze Age and Iron Age. He devised these phases based on the style and superimposition of rock art at multiple localities across the Peninsula, as well as from observations of patina and animal ecology. Our paper focuses on his Neolithic and Chalcolithic phases which, because of the lack of dating we call ‘Late Prehistoric’ (see Jennings et al.)
Late Prehistoric rock art is characterised by incised and pecked depictions of animals such as *Bos* (wild or domesticated cattle), canid (wild or domesticated dog), caprid (ibex and goat), equid (wild horse, wild ass or onager) and felid (lion and cheetah), as well as humans. Later phases at Shuwaymis belong to Iron Age or Thamudic periods and include scripts, depictions of camels, ibex, horse and ostrich. More recent rock art, such as tribal markers and Arabic writing, is also present.

The use of patination for relative chronology can be problematic because it is a localised phenomenon (Ziolkowski 1998; Anati 1999; Zerboni 2008). Differences in the degree of patination were recorded at Shuwaymis-2, however, because its rock-art panels are all in a consistent position on the west side of the same escarpment, with the exception of some of the rock art on fallen boulders. The underlying rock surface itself is patinated homogeneously and the rock art is depicted at similar elevations along the escarpment. Late Prehistoric art is always fully or near fully patinated, that is, it has become similar over time to the colour of the bedrock on which the art was engraved due to weathering processes, or has stained black or dark grey. In contrast, much of the imagery of later phases, which is superimposed on many of the Late Prehistoric panels, is yellow in colour because of its more recent age. Very occasionally, however, some later imagery is fully patinated, particularly in the case of small depictions of ibex, thus patination alone was never used to assign animals to specific phases.

**Survey results**

Eighty-three Late Prehistoric rock-art panels feature at Shuwaymis-2. They are either located on vertical or near vertical sandstone faces of the escarpment (n = 32), in a primary position on boulders that lie on the lower slopes of the escarpment or valley floor (n = 34) or in an altered position on boulders that had dislodged after the rock art was engraved (n = 17). The panels are not distributed evenly along the study area (Figs. 3 & 4). Those engraved on the escarpment itself are located between 6 and 10 m above the valley floor where intermittent vertical sandstone exposures were exploited by the engravers. The eighty-three panels were grouped into twelve clusters (see Table 1 and Figs. 5 & 6).

Given the nature of the topography of the area, all the major panels were engraved directly on to the escarpment and overlook the relict river valley and out across to Shuwaymis-1 on the other side of the valley. The larger panels where animals are >1 m long are easily visible from the valley base. It was rare for any of the panels on boulders to face inwards, unless they were in an altered position. Many engravings on the boulders were small, however, and not designed to be seen from the valley floor.

Cluster 1: the southernmost rock-art panel cluster at Shuwaymis-2 is also the densest, with twelve panels within its group. Six are in their original position on the escarpment and six are on boulders, two of which are in an altered position. Those engraved onto vertical panels range in elevation from 1301 to 1312 m, or from 6 to 17 m above the valley floor. The highest is SH2-16, where one scene shows a man with a bow and eight infilled hunting dogs and a second shows a man with three dogs (Fig. 7). The panel itself measures 8 x 4 m. Panels SH2-10, 12, 13, 14 and 15 to the south of SH2-16 contain no human depictions. Instead *Bos*, felid, oryx and ibex are represented. Panel SH2-13 is particularly interesting because two Late Prehistoric phases are visible. Three *Bos* are superimposed upon an earlier panel that depicts two oryx. There are no differences in style, content or patina to indicate a significant temporal difference between the two phases (Fig. 8).

With regard to the panels on boulders, SH2-1 contains the horns of a *Bos*, while SH2-17, 18 and 20 are three sides of the same large boulder. All of the panels are the right way up but some of the scenes are buried by dune sand. All panels are dominated by small depictions of ibex. In contrast, SH2-23 and SH2-24 are clearly inverted. SH2-24 contains a single *Bos* but SH2-23 is very significant as it contains two inverted Late Prehistoric phases. The earliest is of a large 1.3 m-long inverted goat, and the latter shows *Bos* with piebald coats as well as small and medium sized ibex (Fig. 9).

Cluster 2: this cluster contains five panels carved into the vertical bedrock, all of which show images of men with bows. The most impressive is SH2-32, where a hunting scene is depicted with three men, one holding a dog on a lead, two ibex and two *Bos* with piebald coats. Another scene shows a man shooting an arrow at two cattle. Another scene shows a well-defined *Bos* (Fig. 10). SH2-34 and SH2-35 contain a man with a bow and a man with a bow and a hunting dog, respectively. In SH2-36, a man is carrying a bow next to a vertically aligned *Bos*, while in SH2-37, a man with a bow stands next to a cat and an unidentified creature. Two panels on boulders on the jebel base show a cat with claws and a tail (SH2-27) and a *Bos* (SH2-28).

Cluster 3: the focal point of this cluster is panel SH2-44. It is situated on a large expanse of vertical bedrock at
ROCK-ART LANDSCAPES AT SHUWAYMIS

Table 1. The eighty-three Late Prehistoric rock-art panels are grouped into eleven clusters to help interpret their spatial distribution. The table shows which rock-art panels were found in situ on the rock face, in situ on a boulder on the rock face or on a fallen boulder and out of context.

<table>
<thead>
<tr>
<th>Cluster number</th>
<th>Number of panels</th>
<th>Cluster extent</th>
<th>Major panels</th>
<th>Panel on escarpment face</th>
<th>Panel on boulder and in primary context</th>
<th>Panel in altered context</th>
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<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>90 m x 55 m</td>
<td>16, 23</td>
<td>10, 12, 13, 14, 15, 16, 1, 17, 18, 20, 23, 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>50 m x 20 m</td>
<td>37, 32</td>
<td>32, 34, 35, 36, 37, 27, 28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>33 m x 20 m</td>
<td>44</td>
<td>41, 44, 67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>26 m x 6 m</td>
<td>68, 69, 72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>35 m x 12 m</td>
<td>83, 82</td>
<td>83, 82, 90, 92, 91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>14 m x 1 m</td>
<td>98</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>12 m x 8 m</td>
<td>103, 101</td>
<td>103, 101, 102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>40 m x 25 m</td>
<td>105, 129, 114</td>
<td>105, 129, 106, 107, 113, 114, 115, 116, 120, 122</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>2.5 m x 1 m</td>
<td>134</td>
<td>134</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>25 m x 25 m</td>
<td>144, 146, 155</td>
<td>144, 146, 156, 140, 145, 147, 148, 149, 151, 153, 155</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td>12 m x 15 m</td>
<td>161, 165</td>
<td>161, 162, 163</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>25 m x 25 m</td>
<td>182</td>
<td>175, 176, 178, 182, 177, 183, 190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>83</td>
<td></td>
<td></td>
<td>32, 34, 17</td>
<td></td>
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</tr>
</tbody>
</table>

an altitude of 1306 m, some 8 m above the valley floor. The escarpment here is strewn with boulders and there are a few vertical faces to the left and right of this panel. SH2-44 shows an impressive infilled ibex and a vertically drawn Bos, both of which are obscured beneath a scene of later camels (Fig. 11). Fragmentary panels on boulders in an altered position below and up to 10 m to the north were probably once part of this panel. These include an eroded human figure (SH2-64), a man with an equid (SH2-49) and a man with a Bos (SH2-56 & 58). Panel SH2-57, which shows the fragmented horn of a Bos and an infilled equid, cannot be in its primary position as the rock art is partially obscured by a large boulder on which it rests. It is same for SH2-52, where an ibex is partially hidden behind an adjacent boulder in an altered context.

Other panels in a primary context in cluster 3 include an equid on panel SH2-41, which is on the same contour as the main panel, an infilled cat on panels SH2-54, which is located on a boulder on the valley floor, and a man standing behind a Bos higher up the escarpment on panel SH2-67. Conceivably, the boulders in an altered position in this cluster could be associated with SH2-67 given the repetition of the scene here of a man and a Bos with long horns. Elsewhere there are also a few smaller boulders with rock art that appear to fit the boulder size and are thus unlikely to have become detached from another panel. These include SH2-43, 47, 60 and 63, which contain small images of equid, Bos and ibex.

Cluster 4: two low-density south-facing panels with images of ibex (SH2-68 and SH2-69) and a third isolated but larger panel also containing an ibex (SH2-72) make up this cluster. Good-quality vertical rock surfaces are sparse in this area. No rock art was found on any of the surround-
Cluster 7: between clusters 6 and 7 Late Prehistoric rock art is absent for 114 m. The reason for the absence of rock art here is likely to be geological: this section of the escarpment contains many small boulders and few of the large vertical rock surfaces on which panels are typically found. This changes at SH2-103 where there is a detailed depiction of a Bos with very large horns and exposed ribs engraved onto a sheer rock surface (Fig. 13). Two panels are found on large boulders 8–12 m below the Bos. These are similar to SH2-103 in terms of their realism. SH2-101 shows a dog chasing an equid, a hyena chasing an equid with forward-facing horns and an equid with a mane being...
bitten by a dog, while SH2-102 shows a piebald *Bos* with forward-facing horns.

Cluster 8: arguably the most visually impressive Late Prehistoric rock-art panel of the study area is SH2-105, which marks the start of a dense concentration of ten panels within a 40 x 25 m section of the escarpment. This 2.5 m-long x 1.5 m-high panel contains the striking depiction of a highly detailed equid surrounded by eleven dogs and a man with a bow (Fig. 14). The deep incisions of this style resemble panels seen at Shuwaymis-1; otherwise it is rare on this escarpment. SH2-129, an equally rich rock-art panel located on the same contour line as the equid (1313 m above sea level or 10 m above the valley floor), marks the northern extent of the cluster. This panel contains three *Bos* but these are almost undetectable beneath numerous camel depictions from a later era. Both
SH2-105 and SH2-129 face south-west directly towards Shuwaymis-1. The eight other panels of the cluster are found on large boulders located between and below SH2-105 and SH2-129. The rock art on panel SH2-106 is very eroded but is on the inside of a boulder facing the cliff. It contains five medium-sized ibex and two dogs. Two small ibex follow the horizontal bedding planes of a boulder in SH2-107, as do a small ibex on SH-115 and a medium-sized ibex and a dog on SH2-120. A large dog 1 m across is prominent in SH2-116 while a large equid with two dogs feature in SH2-114. The last two boulders of the cluster are on the foot of the escarpment and, as a result of being so exposed to the elements, are heavily weathered. SH2-113 is of three heavily eroded people with slightly bent legs, while SH2-122 contains faint ibex horns and traces of a man. Another man in the panel with his hands above his head could potentially be Late Prehistoric but may be of a later period. Iron Age and later imagery also cover the panel.

Cluster 9: this cluster is in fact made up of only SH2-134 because this panel is more than 30 m from the next nearest in situ Late Prehistoric panel. The panel is fairly well preserved and highly visible on a large section of rock face 7 m above the valley floor. It is a hunting scene comprising a man with a bow, hunting dogs on leashes and their presumably dead prey, a vertically positioned equid (Fig. 15). The realistic style of the panel is the same as SH2-105 in cluster 7, although its preservation is not as good.

Cluster 10: eleven rock-art panels form part of this cluster. The geology in this part of the escarpment is conducive to the formation of large vertical surfaces ideal for rock art. Three panels are located on a sheer cliff face 6–7 m above the valley floor surface at an altitude of c.1314 m. Panel SH2-144 is one of the most impressive of the site. It features a large lion measuring 2 m long and almost 1 m high (Fig. 16). The claws, open mouth and penis are all visible, while its coat is a speckled colour owing to it being re-pecked, probably during the Iron Age, as its moderate patination resembles that of camels from that era. A man with a bow and at least two dogs accompany the lion on the panel. Further along the same contour, up to five small dogs attacking two ibex are on panel SH2-146, while a Bos, a small ibex, dogs and schematic humans are visible on SH2-156 beneath a series of dense Iron Age imagery.

This cluster contains a panel with indisputable evidence of Late Prehistoric rock art in an altered context. The panel in question, SH2-155, is situated on a large fallen boulder that rests on the escarpment 6 m above the valley floor (Fig. 17). The panel measures 4 x 1.5 m and contains two finely pecked ibex facing each other, with one being pursued by two dogs. While the ibex are accessible and upright and could conceivably have been engraved after the boulder had fallen, the panel actually continues behind an adjacent fallen boulder. In this hidden part of the panel, three ibex in a similar style to the two visible ones can clearly be made out behind the concealing boulder. This proves that at least the concealed part of the panel was engraved before the boulder had fallen.

Seven other panels on boulders appear to be in situ because the rock art is orientated the right way up and the depictions are generally smaller to fit proportionally with the size of the boulder surface. Interestingly, panel

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*Fig. 7.*
Panel SH2-16 showing a man with a bow and numerous dogs. The panel is incomplete, but based on other panels on the site this represents a hunting scene.
SH2-148 contains two phases of Late Prehistoric activity. The evidence takes the form of a large infilled *Bos* and adjacent infilled ibex being superimposed over stylised ibex horns, with other ibex in a similar stylised form present elsewhere in the panel. SH2-145 shows the outline of an equid on the up side of boulder, while four small ibex and two equid are similarly positioned in SH2-149. Small ibex and *Bos* on SH2-151 cross the bedding plane of a boulder to be the right way up, while small ibex are similarly aligned on SH2-147 and on SH2-153. Finally, at least five dogs are depicted on panel SH2-140, which is located on a boulder surrounded by dune sand on the valley floor.
Cluster 11: the largest Late Prehistoric panel at Shuwaymis-2 falls in this cluster of eight panels. SH2-161 extends across a large rock face measuring 12 m across and 8 m high and is 4 m above the valley floor. The panel is actually three closely aligned rock faces but because the rock art is contiguous over them it is treated as a single panel. Face ‘A’ contains a hunting scene with four humans with bows, five dogs and a Bos all drawn following the bedding planes of the rock; face ‘B’ shows three large felid, each 1.5 m long and drawn one on top of the other (Fig. 18); and face ‘C’ contains multiple depictions of ibex. SH2-162 is the only other panel engraved into the rock face in this cluster. It is a much smaller panel and shows two donkeys and a man seemingly shrugging his shoulders.

The remaining six panels of this cluster are on boulders, with four of these regarded as being in an altered context. The most impressive and convincing is SH2-165. This panel measures 6 x 3 m, is engraved on a large boulder on the valley floor (Fig. 19) and contains two phases of rock art. The earliest phase consists of up to five Bos measuring up to 0.7 m. These are upside down and follow the bedding planes of the boulder. The second phase of rock art consists of three ibex, at least one man with a bow and two dogs. This scene partially overlaps the Bos scene. These are engraved perpendicular to the bedding plane of the boulder so were most likely drawn prior to the collapse of the boulder as a hunting scene when, as has been shown at SH2-134, animals are drawn vertically when dead.
Of the remaining panels, SH2-163 contains the faint traces of two large fully patinated ibex and other animals. Given that the panel is on a relatively small and fragmented boulder it is possible that it had fallen from above. While the panel is face up and could have been engraved on in its current position, a second panel on the side of the same boulder, SH-164, is inverted by 180°. It depicts two small ibex, three equid and a dog. These all fit neatly into the extent of the boulder and do not appear fragmentary, but they are nevertheless inverted so the boulder must
surely be in an altered position. Whether both panels were engraved before the rockfall is not certain. Inverted and fragmentary elements also exist on panels SH2-167 and SH2-168, where only the horns of an ibex survive.

Cluster 12: a distance of 63 m separates this cluster from the rich panels of cluster 11. The cluster comprises four panels that are engraved into the rock face and three on boulders below. The most impressive of the panels on the rock face is the northernmost of the group, SH2-182. It shows two vertically engraved ibex observed by four men including one with a bow. SH2-176 and SH2-178 are located within 15 m of this panel on the same elevation.

Fig. 14.
Panel SH-105 showing an equid, probably a donkey, in either a varied stage of completion or with combined outline and infilled styles. The presence of a man with a bow and dogs makes this a hunting scene. The equid measures 1.5 m from nose to tail.

Fig. 15.
Panel SH2-134: a man with a bow and dogs, two of them on leashes, feature on this panel. In the foreground is a vertically drawn equid, a position possibly indicating that the animal is dead.
some 6 m above the valley floor. These comprise single ibex and Bos depictions. Panel 175 on a slight higher contour shows two ibex, with one being bitten by a felid.

Of the panels on boulders, SH2-177 is probably in a primary context as two small ibex are on the front face of a boulder, but an incised line on the panel ends abruptly to suggest the boulder may have fallen. Panel 183 appears to be in an altered context as an infilled Bos and a dog follow the bedding plane of the sandstone boulder, which because it is fallen is at 45°. Likewise, panel SH2-190 is in altered...
context because two men with bows are completely upside down. The panel also displays two Late Prehistoric phases elsewhere on the boulder, with the incised outline of a Bos covered over by a human accompanied by a dog spearing a Bos with forward-facing horns. Both scenes are inverted and therefore both phases took place prior to the rockfall.

Discussion

A number of observations can be made in light of the survey. Here we discuss three in detail: the spatial distribution of the rock-art panels across the escarpment, the question of chronology and the placement of the site within its regional setting. Discussion of related topics, such as the interpretation of the rock-art panels, their ecological significance, the description of later phases of rock art and the placement of sites within the wider research of rock art in the Arabian Peninsula will be reported on in forthcoming publications.

Our analysis shows that rock-art panels at Shuwaymis-2 are unevenly distributed across the escarpment. This pattern can to a large extent be explained geologically, as the main panels in a primary position on the rock face cluster in areas where the sandstone bedrock provides excellent vertical surfaces for hosting rock art. For instance, such panels are absent between clusters 2 and 3 and clusters 6 and 7, where numerous boulders dominate the slope of the escarpment. Erosional processes may contribute to the uneven distribution, as panels exposed to the elements or those on weak sandstone faces may have simply not survived. They may also be lying face down and undetected on the escarpment or valley floor, out of position and undetected. In terms of visibility, the main panels overlook the valley but again, this is a product of the rock formation, which faces east over the valley. More survey work is required on the other faces of the escarpment to determine whether there is link between the rock art and the visibility of the relict river system.

Animal imagery was reported on eighty Late Prehistoric panels and human depictions on twenty-eight panels. The animals depicted are ibex (43 panels), Bos (39), canid (37), equid (19), felid (12), oryx (4), gazelle (1), goat (1), hyena (1) and a selection of unidentifiable animals. On some occasions, hunting scenes and possible scenes with dead prey are evident. There are occasional variations in animal styles. For instance, four panels with felids in detailed and realistic poses, such as the large lion in SH2-144, are so similar that the same artist may have engraved them, whereas other panels with cats are in a different style. The unique deeply incised and highly detailed equid and canid seen in panels SH2-105 and 134 also seem distinct from all other rock art at Shuwaymis-2, although similar to Shuwaymis-1 panels. Apart from these examples, the panels show no major variance in styles and composition. For instance, a map of hunting scenes shows that they occur in most clusters along the escarpment (Fig. 20).

Having established that after taking into account geological factors there is good spatial homogeneity across the site in terms of the style and composition, the next question to ask concerns the chronology of the Late Prehistoric art. Based on relative chronologies put forward by scholars such as Khan (2007), the rock art reported in this study is certainly Late Prehistoric. More research is needed, however, to confirm such hypotheses and the age of the panels within this phase, as the Late Prehistoric
spans 6000 years. Micro-erosional dating techniques have been applied to the rock art at Shuwaymis (Bednarik & Khan 2005) but the approach does not lead to radiometrically measurable dates. To this end, Optically Stimulated Luminescence (OSL) and cosmogenic nucleotide dating methods are being applied to Shuwaymis-2, particularly to boulders on the valley floor, which appear to have a considerable depth of dune sand banked up against them. The results of these analyses are forthcoming (Clark-Balzan, in preparation).

Ten panels in the study area contain inverted Late Prehistoric rock art (SH2-23, 24, 52, 57, 58, 164, 165, 166, 168 & 190) and a further seven are regarded as in an altered position. It is unlikely that the panels were intentionally drawn inverted because the only instance where elements of a panel are drawn inverted are in hunting scenes, where one animal is drawn vertically with the hunters and associated dogs drawn the right way up (for discussions on hunting scenes in Arabian rock art see Anati 1999; Nayeem 2000; Khan 2007, 2013). Instead, the ten panels are on boulders that have been displaced from the sandstone face above and have tumbled down onto lower slopes or the valley floor. This is especially apparent at SH2-52, 57, 58 and 155 where rock art is not in its original position because it is on the underside of boulders. Panel SH2-183 can also be refitted to the rock face above in cluster 12.

There is no definitive evidence that any panels fell during the Late Prehistoric phase and were engraved again during the same phase, as was reported by Bednarik and Khan (2002) at Shuwaymis-1, but six panels indicate that Late Prehistoric rock art in the study area was not all drawn at the same time. One Late Prehistoric scene overlays another at SH2-13, 14 and 23 in cluster 1 at the southern end of the site, and on panels at SH2-165 and 190 in clusters 11 and 12 at the northern end of the site. The presence of two phases of late Prehistoric rock art on panels SH2-23, 165 and 190 is important as these three panels are inverted on fallen boulders on the base of the rock exposure, meaning that both phases must have taken place prior to the tectonic activity or erosion which dislodged the boulders. One can only speculate why superimposition only occurs at the limits of the site. Perhaps these areas were important because they would have been the first rock-art panels seen by people entering into the valley from either direction.

Closer examination of the artistic styles of the six panels with superimposition suggest that it is difficult to attribute a particular artistic style or animal presence to an earlier or later episode of the Late Prehistoric phase. Looking at the early phases of these six panels, SH2-13 shows two large stylised outline engravings of oryx and a smaller infilled depiction of a Bos; SH2-14, two small infilled animals, an oryx and a Bos; and at SH2-23 a large infilled goat with
elaborate forward-facing ribbed horns. Given that oryx is only recorded at four sites in Shuwaymis-2, the fact that two belong to the first phase is potentially significant but otherwise there is nothing to link these panels together. The second phase also sees both infilled and outlined styles and a range of animals present. At SH2-13, two large *Bos* with stripes and forward-facing horns are superimposed over the earlier oryx, while at SH2-14 a large ibex with ribbed horns almost identical in style to the goat horns at SH2-23 is partially engraved over the small infilled *Bos*. At SH2-23, there is a clear increase in intensity in animal imagery with two large *Bos* in outline style, including one with piebald decoration, being superimposed over the large goat.

At the northern end of the site, inverted panel SH-165 contains at least three *Bos* with flared horns and at least one with a piebald coat in its first phase. These were drawn parallel to the pronounced grain line of the boulder.
when it was in its original position. Today they are the opposite way up. This scene is then partially overlain by a hunting scene containing four dogs, two humans and three ibex, which when drawn would have been in a vertical position. A similar pattern is evident on the inverted boul-

dibex, which when drawn would have been in a vertical

hunting scene containing four dogs, two humans and three opposite way up. This scene is then partially overlain by a human and pursued by hunting dogs. Again, the presence of incised and infilled styles and of the same animals in both phases makes it hard to distinguish any significant cultural or temporal differences between them. The only points one could raise is that the panels with humans and hunting scenes are in the second phase in both instances. Furthermore, none of the big cats are overlain on the site, indicating they were either from the latter phase or were from the first phase but were left untouched.

To provide an initial assessment of the potential for further concentrations of rock art in the Shuwaymis region, a single valley of comparable geological and geomorphological character to that hosting the Shuwaymis-1 and Shuwaymis-2 sites was investigated (see Fig. 1). This valley and its tributaries (at 40°01′43″E, 26°12′17″N, c. 14 km to the north-east of SH-1) are incised through the Cambrian Siq sandstone for a distance of c.8 km in a broadly west–east orientation, and potentially formed as part of the initial headwaters of palaeo-wadi Ar Rimah/Bati. A rapid assessment was performed to estimate rock-art localities within the surveyed areas of the valley, but because of time constraints only the southern face of the primary east–west valley (c.5 km in length) was investig-
gated, along with a shorter stretch of the northern face. Despite the rapidity and limited extent of the survey, a total of seventeen rock-art localities were identified within the valley (sites SH-17, 19–20 and 22–35), many consisting of multiple panels exhibiting several periods of rock art. Late Prehistoric rock art included Bos and equid represen-
tations comparable to those of Shuwaymis-1 & Shu-
waymis-2, along with abstract human figures, and was identified at five locations (SH-17, 22, 23, 27 & 30) with dense panels present at SH-17 and SH-23 being similar to those at Shuwaymis-2. Our results highlight the need for many more rock-art surveys to be undertaken at Shuway-

mis. That the area is so extensive and rich in panels makes it a highly significant location of Late Prehistoric rock art in Arabia.

Shuwaymis is certainly of importance geographically as it is situated on the confluence of the Wadi Ar Rimah/Batin and Wadi al Ham drainage systems, which flow east into the Euphrates River and west into the Red Sea, respectively. Jubbah palaeolake is also accessible to the north (Garrard, Harvey & Switsur 1981; Jennings et al. 2013). Indeed, there are many similarities between Late Prehistoric rock-art representations at Jubbah and Shuway-

mis. Most of the animals and human imagery at Shuway-

mis-2 are in the ‘Jubbah’ realistic style, a name first given to Late Prehistoric rock art from this neighbouring region (Parr et al. 1978). There are some differences in content, however, such as the paucity of hunting dogs and absence of large cats at Jubbah compared to Shuwaymis. Both rock-art localities are similar in their links to water sources: Shuwaymis, as we have seen, overlooked a river valley while rock-art panels at Jubbah overlooked lacustrine environments (Jennings et al. 2013). Overall, it is very plausible that populations may have moved through the Shuwaymis valley in Late Prehistory, when the early Holocene climate was more humid than today, and the range of animal species depicted in the rock art could be sustained in the valley and in neighbouring geographical areas, such as Jubbah.

In addition to the rock art, numerous megalithic struc-
tures in the Shuwaymis region stand testament to dense periods of human occupation in the area in late prehistory. One impressive tomb is visible on the plateau above the escarpment, and there are many more, including a mega-
lithic cemetery at Al-Ha’it, which contains thousands of structures. Owing to the remoteness and inaccessibility of the region and the recent discovery of the rock art, how-

ever, none of these monuments has been investigated. Moreover, no archaeological excavations have yet taken place to attempt to place rock art into its wider cultural landscape. All of this lies ahead. Surface inspection at the base of Shuwaymis-1 revealed numerous lithic artefacts ranging from Middle Palaeolithic to Iron Age, and previ-

ous surveys indicated the presence of numerous stones appropriate for engraving the rock art (Bednarik & Khan 2002). Middle Palaeolithic finds included a Levallois flake while Neolithic and later assemblages were characterised by a proliferation of raw material types, with quartz and siliceous stones being the most common. There were no Neolithic arrowheads in the collection, such as those found close to rock-art localities at Jubbah (Crassard et al. 2013).

Conclusion

The high-resolution spatial rock-art survey of Shuwaymis-

2 presented in this study represents the first detailed
mapping of one of the Arabian Peninsula’s richest petroglyph localities. The use of DPGS survey equipment to record each individual panel represents a significant advance in recording rock art in its spatial setting and enables accurate intra-site spatial comparisons between different rock-art elements at the site. The combination of intensive survey and photographic recording also provides an invaluable record for further study; without requiring physical travel to the remote site itself, these data will allow any interested scholars to undertake primary research.

DPGS recording has enabled individual precision recording of eighty-three Late Prehistoric rock-art panels as well as many more from later periods, which will be the focus of further research. For the first time individual panels can be interpreted in their landscape setting, in terms of how they relate to rock art around them and whether they are in a primary or an altered position. The results show that seventeen panels are no longer in their original position as a result of rockfall stemming from erosion and tectonic activity in the region. The in situ panels all overlook a relict river valley which, given evidence from elsewhere in Arabia, would have been active and supporting grassland and shrub-land habitats in the early Holocene. It is this type of environment that we must interpret in order to understand the human populations that left indelible and unforgettable reminders of their world on the sandstone rocks of the Shuwaymis region in late prehistory.

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