

PHOTOGRAMMETRIC DOCUMENTATION AND PHASING OF A ROCK-CARVING GALLERY AT AL-ḤUMAYMAH

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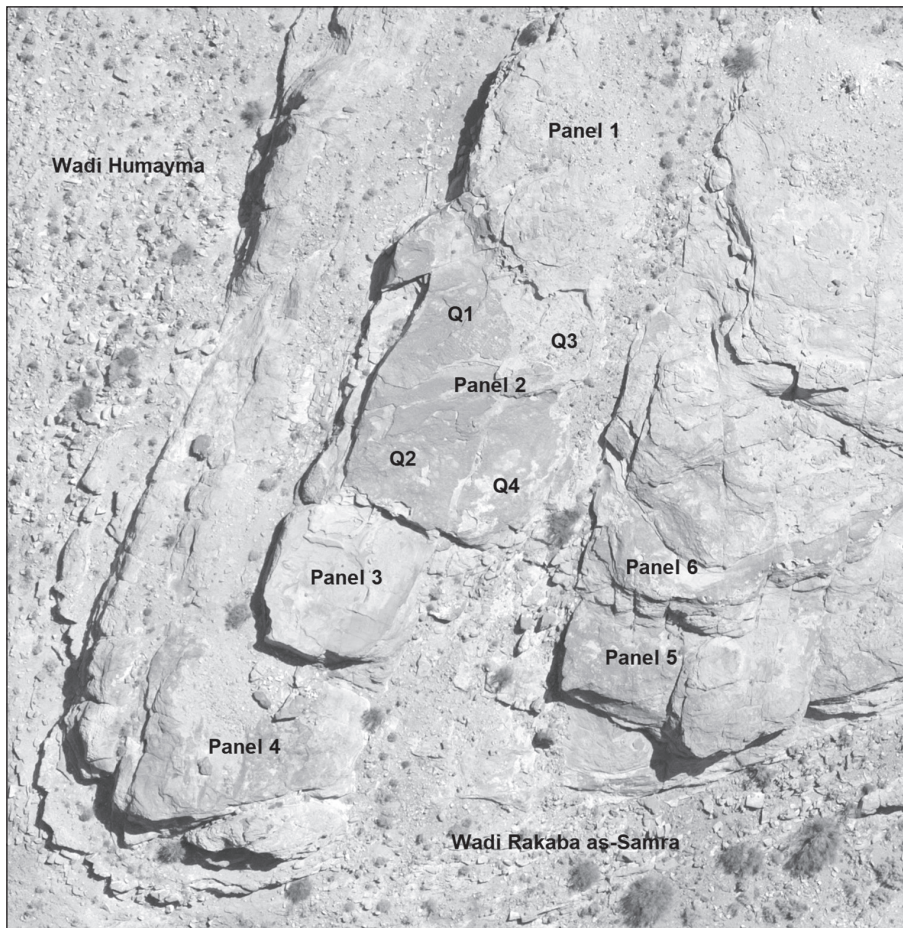
The 2014 season of the al-Ḥumaymah Excavation Project was devoted to surveying rock-carved graffiti and other human activity areas on Jabal Kalkhah and the sandstone ridges west of al-Ḥumaymah's Nabataean through early Islamic settlements (Reeves, Harvey and Seymour 2018). In the course of this survey, a local resident, Swaylem al Manaja, directed our attention to a natural sandstone pavement on the slopes of Jabal Kalkhah that was covered in more than a hundred rock-carved images and texts. This is, by far, the largest known concentration of rock carvings in the al-Ḥumaymah area and thus suggests a place of great significance in the local environment. That impression is supported by a corridor and stairway leading to the site from Wādī al-Ḥumaymah, additional rock art, texts and a *betyl* niche in the vicinity, and by the dramatic natural location (Fig. 1). This pavement/panel is part of Jabal Kalkhah's Eastern Cascading Plateau Site, a triangular plateau of descending bedrock panels that cascade from south to north down the eastern flank of Jabal Kalkhah. The triangular front of the plateau has been carved by two run-off *wadis* (Wādī al-Ḥumaymah and Wādī ar-Raqabah as-Samrā) that merge below its lowest (northern) tip. Run-off water now (and possibly in ancient times) also pours down the hill across the panels, causing erosion and the buildup of sediment and rocks which has obscured some rock carvings and possibly other traces of human activity. The site provides excellent views of the surrounding terrain, and from its highest elevations it is possible to look over the intervening ridges to the ancient settlement and Roman fort. None of the surrounding slopes are as dominant, however, as the notched peak of

Jabal Kalkhah which towers above the site to its northwest, across the open expanse carved by Wādī ar-Raqabah as-Samrā. Ancient evidence suggests that this high peak with its distinctive notch served as a focus of local cult and civic identity in al-Ḥumaymah's Nabataean and Roman periods (Reeves 2016).

An aerial overview of the bottommost sections of the Cascading Plateau Site (including some of the panels we surveyed, the *wadis*, and the entrance corridor and stairs) is shown in Fig. 2. Many of these sandstone panels have exposed surfaces covered in a dark desert varnish. This thin but durable natural patina, which can be carved through (by pecking, abrading or incising) to reveal the light stone beneath, has provided a popular canvas for rock-carved images and texts throughout desert regions for thousands of years. Several horizontal and vertical surfaces at the Cascading Plateau Site have received rock-carved graffiti, but by far the greatest concentration of carvings has been on the large, horizontal and black-covered surface of Panel 2. This panel



1. View down Jabal Kalkhah's Eastern Cascading Plateau towards people standing on Panel 2.



2. Northern tip of Jabal Kalkhah's Eastern Cascading Plateau (Detail of APAAME_20171001_REB-0814. Photographer: Rebecca Banks. Courtesy of APAAME).

is *ca* 14m wide \times *ca* 18m long. As shown in Fig. 2, the panel is best conceptualized in terms of four distinct quadrants. Quadrants 2 and 4, at the front of the panel where it overlooks Panel 3 and Wādī ar-Raqabah as-Samrā, have a flat surface representing the top of one sandstone stratum (Fig. 3). In contrast, Quadrants 1 and 3 to the rear have undulating surfaces incorporating the tops of many different sandstone strata. As for the panel's other natural division, Quadrants 1 and 2 are divided from Quadrants 3 and 4 by a seam in the sandstone that bisects the panel. This seam has been heavily eroded between Quadrants 2 and 4 with the result that some of the carvings there have partially disappeared. An even larger zone of erosion, associated with a runoff channel, runs down the right side of Panels 1 and 2 and likely contributed to the nearly complete erosion of the sandstone section between Panels 3 and 5. It has also resulted in a great deal of erosion to the varnish and rock carvings in Quadrant 4 of Panel 2.

Given that the natural qualities and preservation of Panel 2's four quadrants differ, it is

no surprise that the number of rock carvings discovered in each quadrant was very different. Humans had chosen to carve graffiti predominantly into the flat surfaces of Quadrants 2 and 4. Nature had best preserved the carvings in Quadrants 1 and 2. As a result, Quadrant 2 now has the highest concentration of well-preserved carvings on Panel 2, which itself has the highest concentration of carvings at al-Ḥumaymah. Given the number of carvings and subsequent erasures, the frequency of overlap, and obvious differences in patination and inscribed languages, it is apparent that this concentration of carvings has been added to and subtracted from for thousands of years. As such, it has functioned as a rock-carving gallery, an ongoing record of the interests, beliefs and behaviours of human contributors from various cultures and time periods (*cf.* Polkowski *et al.* 2013: 114-15).

In order to record and analyze this gallery properly, we needed to be able to preserve as much context about each carving as possible. We needed to be able to document accurately the relative sizes, patinas, locations,

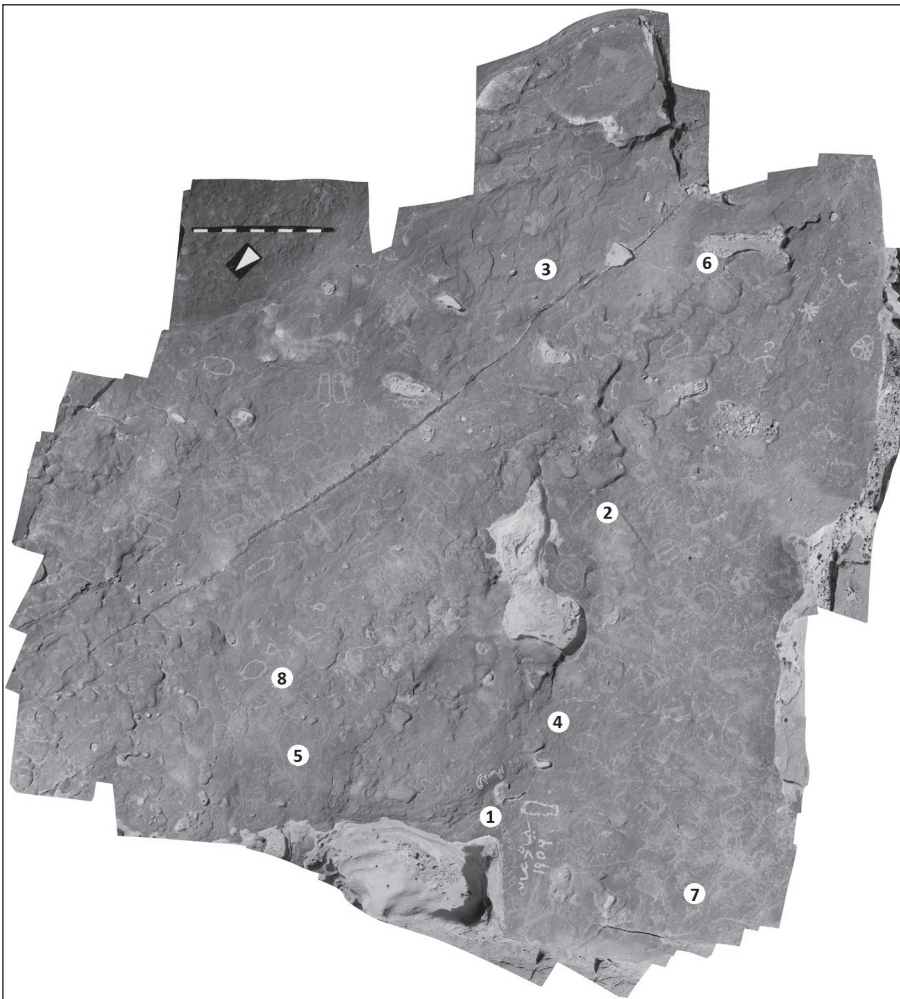
orientations and micro-environments of the carvings so that we could study them back in our offices. Conventional photographs, consisting of vertical shots of interesting carvings and oblique shots across the panel, would not be able to record this contextual information adequately, and close-range aerial photography (e.g. by drone or kite) was not an option during our survey. We therefore decided to employ a



3. Panel 2, Quadrants 2 and 4 with Panel 3 below.

land-based photogrammetric technique involving the merger of hundreds of high-resolution digital images. The field technique was to have one team member walk across this area taking overlapping vertical photos from a constant height (ca 1.5m). 240 photos were taken, each comprising an area of ca 0.9 × ca 0.6m. All photos were taken using natural light during a one-hour period in the afternoon when the whole panel was in full sun. A Nikon D200 digital camera was used with ISO set at 200, the f-stop at f/10, and focal lengths of 18 or 30mm. Each resulting photo was ca 7MB in size with a resolution of 300×300dpi. No scales were included in the individual photos; instead, a meter stick and north arrow were placed just beyond Quadrant 2's boundary with Quadrant 1 and photographed *in situ* as part of the overlapping documentation. Following the fieldwork, the images were merged using Agisoft PhotoScan.

The resulting merged image/stitch is shown in Fig.4. Its shape conforms to Quadrant 2's



4. Photogrammetric stitch of Panel 2, Quadrant 2 with rock carvings discussed: (1) Fig. 6; (2) Fig. 7; (3) Fig. 8; (4) Fig 9; (5) Fig 10; (6) Fig. 11; (7) Fig. 12; (8) Fig. 13.

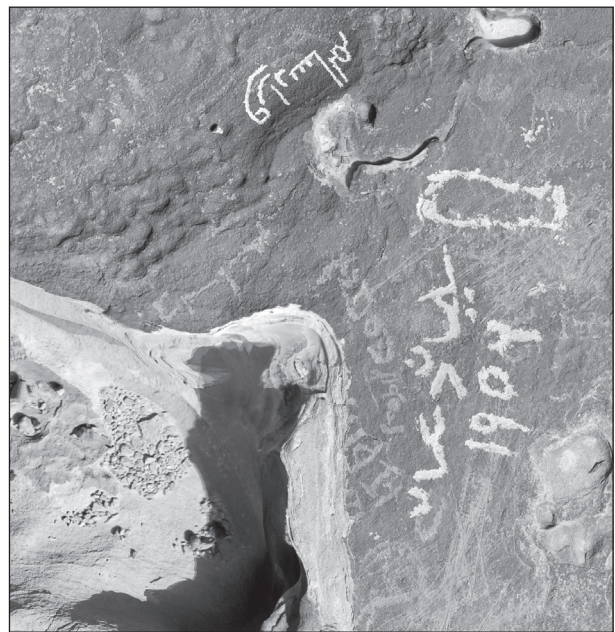
basic shape and its jagged edges reflect its creation from the merger of rectangular photos. The stitch is 6.95m long \times 6.38m wide and provides excellent resolution of details down to *ca* 0.05m across. The meter stick and north arrow can be used in Photoshop to measure and check the orientation of both individual and associated carvings. By using the merged image in conjunction with aerial photos and site-context photos, it is also possible to examine whether individual carvings were pointing towards particular landscape features. Relative patina is also easy to assess across the merged image. This is especially important as the area of the stitch comprises the top of a single sandstone stratum. Side views (**Fig. 5**) and eroded sections within this flat-topped stratum further reveal that it is part of the Honeycomb layer of the Umm ‘Ishrīn formation (*cf.* Rababeh 2005: 37-39). As noted above, carving through the stone’s hard dark surface varnish exposes the unpatinated natural white colour. New carvings would have originally stood out as white against the desert varnish and then become progressively darker through time as a new patina/varnish formed. Relative patina can consequently be used on this panel in conjunction with superposition, inscriptional information and subject matter for the purpose of relative dating. A caveat that should be acknowledged here is that although comparison of patinas is a traditional method by which archaeologists have assessed the relative age of rock carvings (Anati 1999; Bednarik and Khan 2009; Eisenberg-Degen and Rosen 2013), the technique is subject to error if, for example, the underlying



5. View of Panel 2 from Panel 3. Note light colour and honeycombed nature of sandstone beneath and above Panel 2’s desert varnish.

stone is not homogenous, if erosion patterns across the panel are not uniform, if photographs are taken with different cameras or at different times of day, or if comparisons are attempted between carvings situated on different surfaces (*cf.* Bednarik and Khan 2009; Betts 2001: 97-98). In the case of our photogrammetric survey of Panel 2, the combination of a homogenous stratum of sandstone and the controlled photographic conditions should have mitigated most concerns. Still, given that some local variations across the panel could affect patination (*e.g.* areas more impacted by erosion than others), our assessment strategies involve considering micro-contexts when evaluating relative patination and focusing on clear differences in patination rather than subtle variations.

A couple of examples serve to illustrate the relative-dating possibilities and limitations across the panel. **Fig. 6** shows a cluster of Arabic and Thamudic inscriptions at the bottom edge of the panel. The bright white inscription at the top of the photo is almost assuredly the most recent. It was added after the slightly darker Arabic inscription that includes a 1950s date. The 1950s inscription is, however, much lighter than the Thamudic inscriptions beneath and around it. There is another Arabic inscription visible immediately above the eroded quadrant. Its patina is much darker than the other Arabic inscriptions or the repatinated eroded surface.



6. Cluster of Thamudic and Arabic inscriptions and erasures at the bottom of Panel 2.

Indeed, its patina is most similar to that of the Thamudic inscriptions, which probably date no later than the fourth century AD (*cf.* Graf 2018). It is thus likely that this is an early Arabic text, which in northwest Arabia date as early as the sixth century AD (*cf.* Nehmé 2017).

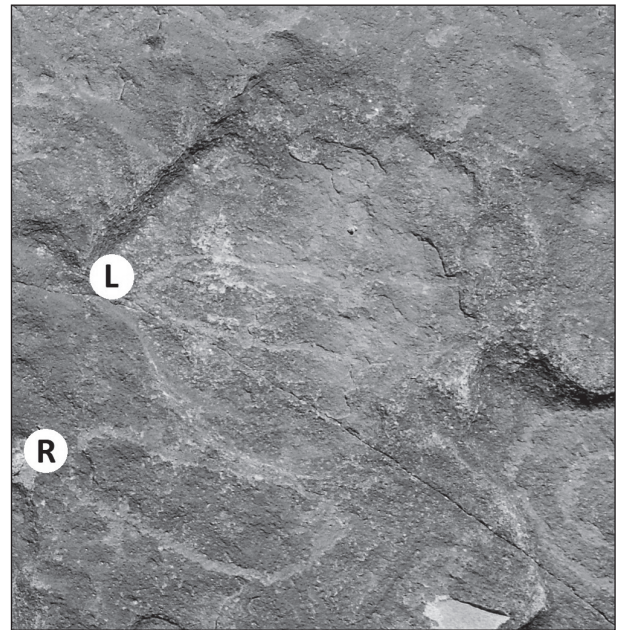
In the case of the above example, all of the inscriptions were located in a small area with consistent erosion factors (except for the eroded-out quadrant). A different situation can be seen in the case of a pair of shoeprints that, given that they share the same basic shape and were placed side by side at shoulder width, were most likely carved at the same time (**Fig. 7**). Their micro-environments differed, however. The left shoe was carved into a small, shallow hollow that would have trapped water and sediment, and subsequently caused it to age differently than the right image. Local erosion patterns in that hollow have washed out the colour of the left carving and its background stone. Thanks to the high resolution across the photogrammetric stitch, such micro-contexts are easy to spot and to account for in the overall analyses.

Turning now to the rest of the panel, it is apparent that the medium-dark patinas on the aforementioned Arabic and Thamudic inscriptions are similar to those of more than a dozen other Thamudic and Nabataean inscriptions. Although, as previously mentioned, it is problematic to use slight variations in patina to date this set of inscriptions more precisely, the medium-dark patina provides a benchmark for phasing carvings across the panel. Inscriptions and images with a medium-dark patina constitute the largest group of easily visible carvings on this panel. They reflect a several-hundred-year-long period when people of different cultures were coming to this site and leaving written or pictorial marks of their presence.

In order to understand this period when a high volume of carvings of a multi-cultural nature were deposited on this panel, it seems best to turn to the local context (*cf.* Oleson 2010: 50-62; Reeves 2019). A Nabataean town was founded at al-Ḥumaymah in the first century BC on a pre-existing trade route. The town was on the desert plain, but elevated sites such as this one on Jabal Kalkhah and others on the adjacent ridges were used for cisterns, tombs and religious purposes. A Roman garrison took up

residence at al-Ḥumaymah in the early second century AD to control access along the trade route, rebranded as the *Via Nova Traiana*. Soldiers and civilians subsequently co-existed at al-Ḥumaymah for more than two centuries. By the fifth century Christianity had developed into a major cultural influence at al-Ḥumaymah as seen by the construction of five churches. Islam subsequently supplanted it as the dominant religious force, particularly after the Abbasid family bought the land and lived in a *qasr* with an adjacent mosque from the late seventh to mid eighth century. After the Abbasid family left to take up the caliphate, al-Ḥumaymah was never again the site of a large or important settlement. There are likely several reasons for al-Ḥumaymah's decline, including a decreased water supply after the aqueduct built by the Nabataeans stopped flowing. It should also be noted that even when the aqueduct was flowing, al-Ḥumaymah only ever had a small population (Oleson 2010: 401-4), although this was supplemented by those passing through on the transregional road.

Based on this historical overview, it seems most likely that the Nabataean, Thamudic and Arabic texts with medium-dark patinas come from the heyday of the ancient settlement in the first century BC through eighth century AD, although they could also be slightly before or after. Pictorial carvings with the same

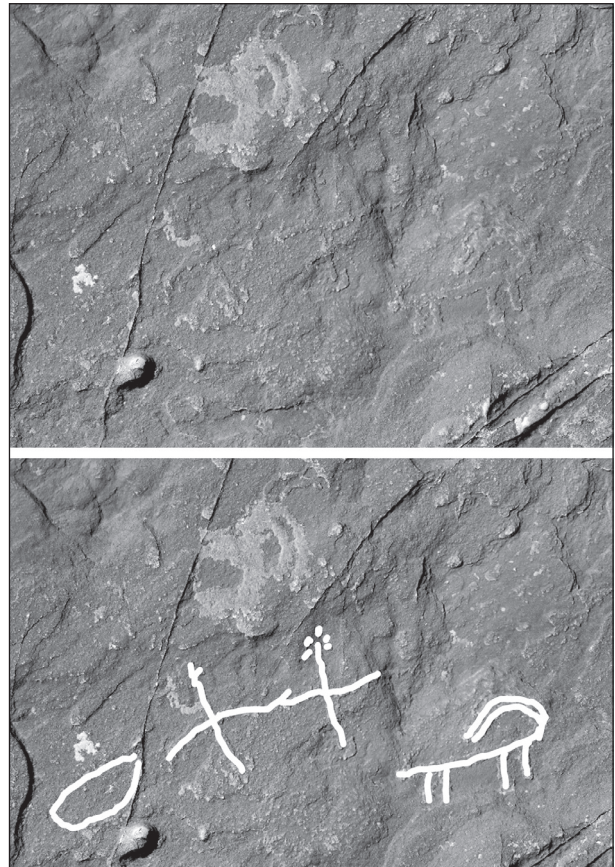


7. Phase 2 shoeprints with differential preservation owing to different micro-contexts (photo contrast enhanced).

medium-dark patina are roughly contemporary with these inscriptions. We will refer to the period in which they were carved as Phase 2. Other carvings on the panel (mostly Arabic texts and symbols) that are much lighter are apparently much more recent. They are hypothesized to date to the period of sporadic occupation in and around the ancient settlement between the Abbasid family's departure and the present day. Moreover, given the lightness of these carvings in comparison to those of Phase 2, they are more likely from the later part of this period. We will refer to this period as Phase 3. Finally, there is an obvious group of images that are much darker than those with the medium-dark patina or have patinas that are indistinguishable from that of the background stone. These Phase 1 carvings are hypothesized to predate the foundation of the Nabataean town by a considerable time. Although the oldest carvings here are possibly contemporary with the Palaeolithic activity areas on al-Ḥumaymah's hills and ridges (Henry 1995), especially nearby sites on Jabal Kalkhah (J406a-b; J405) and Ridge 2 (J403; J407), it seems unlikely that such very old carvings would survive on a panel so exposed to wind, sun and rain (*cf.* Bednarik and Khan 2009: 17). It thus seems more likely that the images were left by people passing by al-Ḥumayma in subsequent millennia. Although there is no other evidence of human activity anywhere at al-Ḥumaymah between the Palaeolithic and Nabataean periods, there was, as already mentioned, an ancient transregional route on the nearby plain as well as Neolithic (Simmons and Najjar 2007: 234, fig. 1), Chalcolithic (Abu Azizeh 2013a: 115, fig. II.12), Bronze Age (Abu Azizeh 2013b: 118, fig. II.14) and Iron Age sites (Jouvenel 2013, 126, fig. II.18; Oleson 2010: 50) elsewhere in southern Jordan.

Carvings attributable to Phase 1 are the hardest to discern on this panel. Some underlie later carvings that have obscured their images. Many also have patinas that are almost indistinguishable from the background stone. It is very hard to see the details of such carvings. It is also difficult to be certain that an image that matches the background stone was carved by humans rather than created by nature. When images from this phase can be seen it is usually because they stick out as anomalies beneath

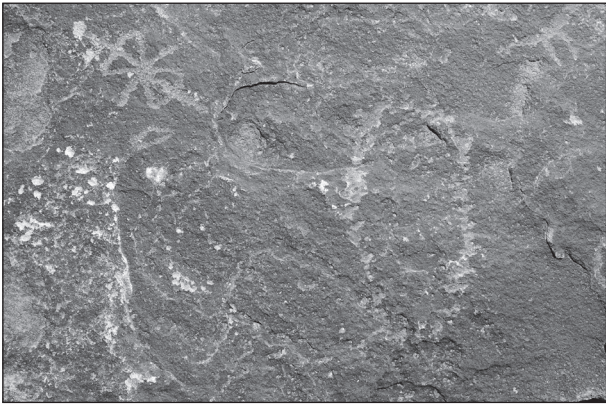
later carvings or in otherwise uncarved areas. Images that can be assigned to this period include animals, footprints, geometric forms and as yet indeterminate shapes. **Fig. 8** shows some very dark figures from this phase next to a bovid and symbol(s) from later phases. The darkest figures, with patinas indistinguishable from the background stone, consist of two linked upright crosses (or schematic anthropomorphs [*cf.* Anati 1972: 39-42]) with radiating lines emerging from one end and possibly details (unsketched) in the lower half. Also from this period, but with a lighter patina, is a stick-figure ibex and an outlined oval or footprint. **Fig. 9** shows another outlined oval with a patina matching the background stone (L) next to which another oval was later added (R), probably to suggest a pair of shoes. There is also a smaller outlined shoeprint bridging the space between the previous two. Its patina matches that of the left shoeprint but its shape, size and the direction it points towards are all different, suggesting a different intent. Another shoeprint (a right outline with rectangular sides) also likely dates to



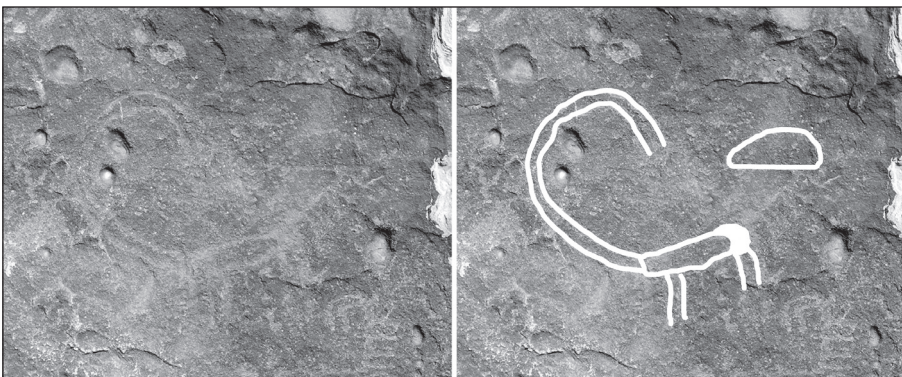
8. Phase 1 carvings with very dark patinas and tentative sketch of details.

Phase 1, given that its patina closely matches the background stone (**Fig. 10**). It is next to a bovid with a similar patina, also drawn in outline. This is the largest bovid on the panel (0.58m high × 0.41m wide). It should be noted here that although some scholars have assigned large outlined animals to a very early chronological period (Anati 1972: 11-12), Betts (1987, 2001) has shown that outlined animals appear in archaeological contexts in Jordan ranging from the seventh millennium BC to the Islamic period. The chronology of rock-carved outlined shoeprints seems to be similarly broad. Those from Jordan's Ḥismā desert are hypothesized to range in date from at least the fourth millennium BC until the present (Inglis 1988: 71, 74; Borzatti 2005: 71). In addition, there are variations in form and size between the bovids and shoes from this panel that, based on patina, seem to date to our first phase. Such variations are a good reminder that the panel's Phase 1 extends over thousands of years and likely encompasses diverse cultural groups and artists with individual stylistic preferences.

The second phase of rock carvings on this panel, Phase 2, encompasses all of the Naba-



9. Three shoeprints (two from Phase 1; one from Phase 2) and Phase 2 symbols (photo contrast enhanced).



10. Phase 1 carvings and tentative sketch of details. The ibex's tail is obscured by a canine carved at a different time.

taean, Thamudic and early Arabic inscriptions and most of the visible carvings (*i.e.* those with a medium-dark patina). Many of the carvings on adjacent panels at the Cascading Plateau Site, especially those accompanied by Greek and Thamudic inscriptions, probably also date to this period. Inscriptions were clearly an important element of the overall significance of the rock-carving gallery during this phase. Approximately 18 inscriptions, plus 18 erasures of what are probably other inscriptions, correspond to this period in the photogrammetric stitch. They appear alone or in combination with images such as footprints. Only one of these inscriptions has been published at present (**Fig. 11 center**). It is a Thamudic E text, accompanied by a pair of footprints, that is hypothesized to have been written by an officer in al-Ḥumaymah's fourth-century unit of *equites sagittarii indigenae* (Graf 2018). Most of the other extant inscriptions appear to be in the Thamudic scripts, although the longest and most elaborate inscription on the panel is written in Nabataean. The patinas of both the erasures and the underlying carvings suggest that they also both date to this phase (**Figs. 6 and 12**). Erasures are concentrated on the back-left section and front-right section of the stitch. Some were located next to other inscriptions, some next to footprints, and some next to figures on camels and horses. Why anyone went to the trouble of crossing out 18 previous carvings is unknown, but at that time bright white erasure marks with traces of letters poking out beneath would have made a very dramatic addition to this age-old gallery of the settlement's history. There are several historical events that could relate to a local redefinition of the site's identity, including the Roman acquisition of the Nabataean Kingdom, events surrounding

a (temporary) departure of the Roman garrison in the third century, and subsequent Christian and Islamic cultural domination. Work on identifying the time of the erasures is ongoing and being done in collaboration with the analysis of the extant inscriptions.

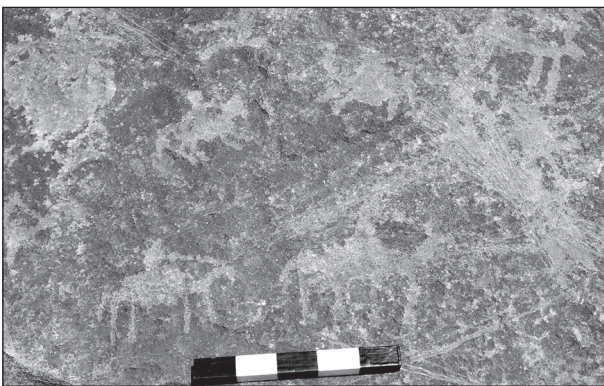
There were also many footprint images across this panel during Phase 2 (and the other phases). Their form, orientation and significance is the subject of a forthcoming paper (Reeves in preparation). Other images that were carved during this period include wild horned bovids (predominantly ibex), images of humans on camels and horses, canines hunting bovids, an anthropomorphic figure in the orant position, and abstract symbols (Figs. 8-9, 11-13). It is interesting that the frequency and location of each type of image varies. For example, footprints are very common and appear right across the stitch whereas riders are less common and are concentrated in the bottom-front corner.

The final phase of rock carvings on this panel, Phase 3, reflects a period of relatively little carving activity. Only *ca* 20 carvings (and

no erasures) correspond to this period. This is in sharp contrast to the high concentration of carvings and erasures from Phase 2. The scarcity of Phase 3 carvings is consistent with there being only small-scale and sporadic human activity in the al-Ḥumaymah region during this period. It is also quite likely that this particular site, with an exposed bedrock surface and no rock shelters or cisterns nearby, had little functional value and had lost the special significance it had during the previous phase. The two inscriptions already discussed constitute the latest additions to this panel, both dating to the twentieth (or possibly twenty-first) century (see Fig. 6). The footprint signed and dated in the 1950s is especially interesting as it likely reflects someone coming upon this unique site, seeing all the footprints and inscriptions, and deciding to add his own. In doing so he seems to have interacted with the pre-existing gallery by choosing to place his name below (and partially over) ancient texts. Likewise, the carver of the other modern inscription seems to have interacted with the gallery not only by aligning the angle of his text with that of the early Arabic inscription, but also by partially carving over another ancient (non-Arabic) text. Interaction with the gallery is also apparent in the case of the *wusum* (abstract tribal symbols) that were added beside and over pre-existing images and texts (Figs. 11 and 13). In one case (Fig. 11) someone has even selectively recarved three parallel lines within a Thamudic letter, possibly to reveal and emphasize a particular *wasm* (cf. Khan 2000: 52-53, 89). It is not presently known whether these Phase 3 *wusum* represent families that lived in this area or people traveling through who wanted to commemorate their



11. Phases 2 and 3: inscriptions, footprints, shoeprints, ibex and *wusum*.



12. Phase 2 horse and camel riders and erasures (photo contrast enhanced).



13. Phase 2 orant figure and inscriptions; Phase 3 *wusum*, bovid and possible shoeprint.

presence. It is also unclear whether a couple of outlined ovals with one flat end and one pointed end from this phase are intended to represent *wusum* or footprints (Fig. 13). A couple of other footprints and some straight-horned bovids were also added to the gallery during this final phase.

Although there is still a great deal of work to be done in analyzing this panel, this paper provides an introduction to the type of analyses that photogrammetric documentation supports. The analysis of relative patinas across this homogenous rock stratum has allowed us to divide the history of this rock-carving gallery into three major phases. Unlike most other rock carving sites in Near Eastern deserts, this gallery is also special in that it is adjacent to a major archaeological site that has been excavated and surveyed for several decades. Drawing on the archaeological evidence of human activity at al-Ḥumaymah, we have tentatively associated each of these phases with a broad period in the site's history. But the creation of a high-resolution image incorporating most of the panel has been, and will continue to be, essential for comparing the patinas, locations, orientations and overlap of carvings across this rock-carving gallery. The photogrammetric stitch allows us to study the whole panel over and over again and to zoom in on small details. Thorough examination will allow us to study the interests and priorities of the people adding to, and subtracting from, this important rock gallery over many thousands of years. In a future season, we hope to return to the field in order to extend our photogrammetric documentation to the full surface of this carved gallery and to the carvings on adjacent panels.

Acknowledgements

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