THE SAUDI ARABIAN ROCK ART MISSION OF NOVEMBER 2001

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Abstract. The principal purposes of this project were to evaluate the susceptibility of some Saudi Arabian rock art to direct dating techniques used successfully elsewhere in the world; to evaluate its potential for the application of a variety of research methods; and to examine the field conditions under which such research would be conducted. The research team studied eleven petroglyph sites and succeeded in securing preliminary age estimations from nine motifs at six of these locations. These are the first scientific rock art dating results ever reported in the Middle East. The mission also found Saudi Arabian rock art to be of a quality and quantity that is generally not realised even by the specialists in the rest of the world. The present report concludes with some recommendations.

Introduction

Whilst the Arabian Peninsula possesses one of the four largest rock art concentrations of the world (besides those of India, southern Africa and Australia), this vast cultural patrimony has so far not received the attention it clearly deserves. Research has been patchy, opportunistic and concerned with local rather than generic issues for much of the time Arabian rock art has been investigated. For instance the major seminal work on Arabian rock art, consisting of four volumes (Anati 1968a, 1968b, 1972, 1974), has been presented by an author who had not been to the sites he described, who used, interpreted and 'analysed' the photographs others had made. More recent authors have in many cases relied on the notional stylistic and chronological constructs derived from such frivolous approaches, which renders their work just as unreliable. There are a few notable exceptions, for example Khan (2000) has conducted an in-depth study of tribal symbols which occur both as brands on stock animals and as territorial markers on rock. A good deal of work has also been done on the written inscriptions of Saudi Arabia and nearby regions (e.g. Albright 1969; Bellany 1981; Jamme 1966; Khan 1993a; Livingston et al. 1984; Winnett 1937). The study of the bulk of Arabian rock art, however, has been neglected in comparison to other major rock art regions. In particular, there is a pronounced lack evident of analytical work using modern techniques.

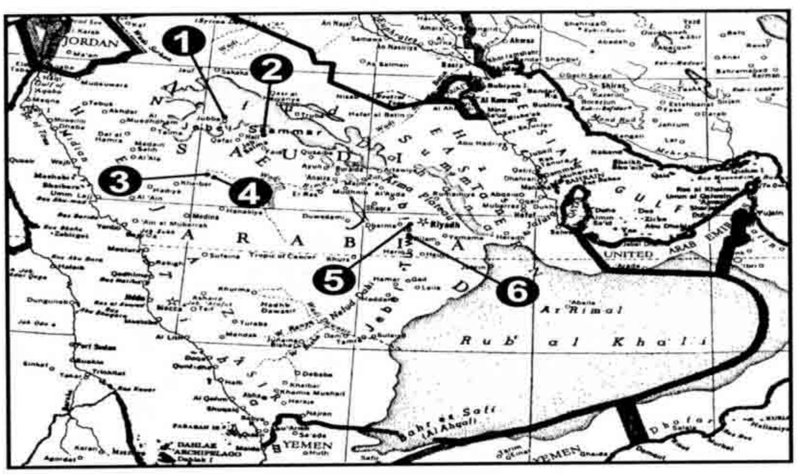
The single greatest inhibitor of developing the research of rock art is generally the need to know its approximate age in order to place it into the cultural and technological framework archaeology provides us with. Although great strides have been made in recent years in rock art dating, estimating the age of rock art remains one of the two most difficult challenges still faced by archaeology (Bednarik 2001a). The other is the need to understand the taphonomy of rock art, because without a consistent effort to do so it is impossible to correctly interpret empirical or quantitative data about this phenomenon (Bednarik 1994).

During 2001 the Deputy Ministry of Antiquities and Museums of the Kingdom of Saudi Arabia organised a project to briefly assess the analytical potential of Saudi petroglyphs. This was envisaged to be a logical extension of the work of the Epigraphic and Rock Art Survey of the country (Khan et al. 1986, 1988; Kabawi et al. 1989, 1990). Because of the importance of facilitating the creation of a chronological framework it was suggested that this mission would focus on the specific aspect of rock art dating. It was decided that a brief but intensive and carefully designed project would be the most effective means of gaining some initial scientific dating information, so the itinerary of the project was carefully tailored to accommodate some pressing research questions. A primary objective was to determine which of the suite of methods currently available for estimating rock art age might be applicable to Arabian petroglyphs. This involves an investigation of the conditions of sample procurement, of calibration, and a determination of which methods could reasonably be employed with any promise of success. Most published information about this vast corpus of rock art lacks comprehensive information of such aspects as geomorphic surface conditions, types of accretionary deposits, rates of exfoliation or repatination, petrographic descriptions or weathering rates, and even relevant details of site morphology and geology are scanty. Yet before preferred analytical approaches could be selected, such basic information was required. Therefore the first objective of the mission was to gather the preliminary data to formulate research strategies that might ultimately lead to a chronology of Arabian rock art based on 'direct dating' methodology.

While the mission considered also various other aspects of rock art research, such as conservation and site management, clear priority was given to the dating of carefully chosen key motifs at a series of selected sites. This intentional bias is also reflected in the present preliminary report, and we are well aware that considerably more systematic work is essential than can be presented here. Indeed, we acknowledge that this work was no less opportunistic than much previous work in the region, but we are fully aware of the need to conduct more comprehensive studies. We did, however, examine the potential of introducing new methodology, and we even managed to present some very preliminary results.

The sites

Eleven sites were selected for examination, two to the west and south-west of Riyadh, the others in the north of the country, in the southern Nafud Desert, the western Najd and to the east of Ha'il (Fig. 1). Seven of them are of sandstone (Umm Asba`, Al- Usayla, the two Umm- Samnan sites, Milihiya and the two sites at Janin), Yatib is on a partially metamorphosed sandstone, Qilat-al-Hissan on a tuffaceous rock with large clasts of basalt, Jabal al Bargh on a sandstone with fine conglomerate veins, and Shuwaymas on a sandstone containing occasional pebble-grade grains. The absence of granitic facies from this list rendered the application of microerosion analysis difficult, limiting it to where well-developed fractures were present on grains greater than sand fraction (although we managed to secure data also from a coarse sand fraction grain at one site, Shuwaymas).



(Fig. 1) Map showing the sites splected for dating

Figure 1. *The sites forming part of this study: 1 – Umm- Samnan main complex and northern complex; 2 – Janin Cave, Janin main site, Milihiya, Yatib; 3 – Shuwaymis complex; Jabal al- Bar; 4 - Qal`a`t al- Hisan; 5 - Umm Asbae; 6*

Al- Usayla.

Primary patination as well as repatination of petroglyphs had occurred at all sites, but degrees of rock varnish deposition varied considerably and such accretions were in all cases relatively weakly developed. Only one site, the Janin main site, was judged to possess sufficiently substantial varnish cover on petroglyphs to encourage sampling for radiocarbon analysis. No well-developed silica, carbonate or oxalate accretions were observed on petroglyphs at any of the eleven sites examined.

Umm Asbae

This site is located c. 85 km west of Riyadh, 3 km from the village of the same name, in flat to slightly undulating sand desert. It consists of a very prominent, widely visible mushroom-shaped sandstone column of about 6 m height on an eroding rocky hill with occasional Upper Palaeolithic stone tools. Petroglyphs occur on and around the column, on sand- to small pebble-sized grains. They consist of *Wusum* (tribal marks), abraded grooves and several inscriptions. One of the latter, on a vertical panel on the western base of the column, presents a two-line Islamic text, datable by its content to about 1120 years BP. The upper line is on sand-fraction rock, which at 500 – 800 μm grainsize is unsuitable for microerosion analysis, but the lower line is on much coarser material, with grains reaching 15 mm size.

Al- Usayla

About 115 km south-west of Riyadh, just north of the highway to Makkah, a distinctive escarpment forms the background to an isolated rocky hill of about 40 m height. Thousands of petroglyphs occur on its cliffs and eroding boulders. The rocky shelves and plateaus of the nearby escarpment seem almost devoid of rock art, and there is evidence that Bedouin tribesmen still today use the shady recesses and shelters around the base of Al-Usayla. It is also in the lower reaches of the knoll that the *Wusum* seem to predominate. The largest decorated panel is a flat vertical cliff facing south, on the upper part of the hill, densely covered with petroglyphs over a length of 7 m and to a height of 4 m. These 400 – 500 motifs bear a thin and very patchy coating of rock varnish, whose consistency suggests that the figures were made in a relatively short time span, perhaps within 250 years or so. They consist of numerous zoomorphs, anthropomorphs and early written characters. The rock facies is homogenous, of well-sorted grains among which the 400 – 800 μm fraction dominates. However, there are occasional grains of up to 1.5 mm. Several motifs were examined microscopically, but were found to offer no suitable conditions for microerosion analysis. Weathering evidence suggested that the writing symbols are at least twice as old as the Arabic text at Umm Asba'a. However, good data could be secured from a figure resembling an ibex, on the lower part of the panel (Fig. 2).

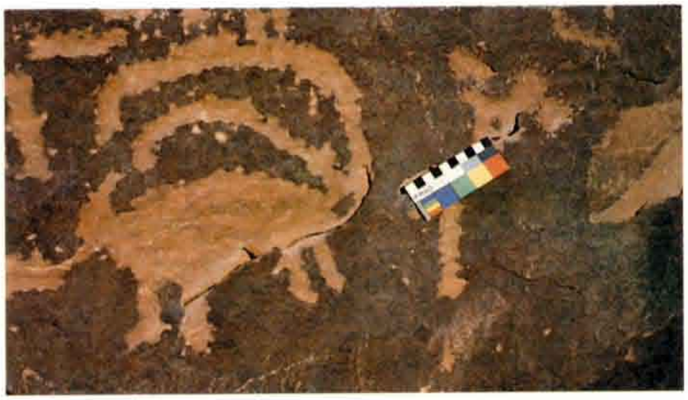


Figure 2. Microerosion sampling site at Al-Usayla, a zoomorph resembling an ibex.

Umm- Samnan main complex

Located in the huge Nafud Desert, near the township of Jubbah, runs a distinctive rocky escarpment roughly in a north-south direction. Near the remains of a former lake is a major petroglyph site complex, extending along the foot of the escarpment for about 4.5 km. It is thought that the lake vanished in mid-Holocene times. The aquifer level is now about 50 m below the plain, but the extensive occupation evidence suggests the former existence of settlements in what is now certainly a desert. Several concentrations of rock art were inspected in this complex, and Neolithic and other stone tools were located near some of them. One of the most prominent genres of art is expressed in large, elongate and detailed anthropomorphs, of the so-called 'Jubbah style'. Of the four localities examined closely, the southernmost provided a calibration site, while a second place some hundreds of metres to its north offered suitable conditions for microerosion analysis. The entire Umm-Samnan main complex is enclosed by a well-constructed steel-mesh fence over its entire length, erected by the Ministry of Antiquities and Museums. The site also has a resident caretaker and is well managed. Despite the close proximity of Jubbah, no fresh graffiti are being produced.

Umm- Samnan northern complex

A few kilometres to the north of the main complex lie a morphologically different group of sites, which also have markedly different motif ranges. Rather than being at the foot of the rock escarpment, numerous petroglyph clusters occur well above the plain, among the peaks and hills of the mountain range. Pre-Arabic scripts are numerous, as are zoomorphs and anthropomorphs, but more recent inscriptions as well as the large Jubbah figures are absent. Use of the site complex seems temporally more confined, and since it is less accessible and some distance from even ancient water sources, it may be related to people who crossed the mountain range at this locality. The complex extends over several hundred metres and stone tools are again present on the surface. At one of the major concentrations of petroglyphs, among several Thamudic inscriptions, two written characters were selected for microerosion analysis.

Janin Cave

In the absence of carbonate facies that would promote the formation of caves, this is the only known example of cave art in northern Saudi Arabia. Janin Cave, located about 30 km east of Ha'il and north of the highway to Buraydah, was formed in light-coloured sandstone. The tectonic adjustment of a large portion of rock on the south face of a steep mountain along a vertical fault line created a cleft, which erosion enlarged to a horizontal passage that is up to 20 m high and 10 m wide. It can be followed for about 100 m, its floor of sand and a few boulders progressively steepening until the passage ends in a scree slope. Petroglyphs are numerous along both walls as far as faint daylight can reach, but then peter out and decoration is lacking in the deepest and permanently dark part of the cave. There are no accretionary deposits on the petroglyphs and the latter are unsuitable for microerosion analysis. The cave is located about 15 m above the sand plain, and access to it is controlled through a fence closing off the approach from the plain, and through the care of a nearby resident Bedouin custodian.

Janin main site

A few kilometres to the east of Janin Cave, located at the foot of a prominent vertical cliff and on large boulders on the upper part of the slope below the cliff, is a major concentration of rock art. It consists mainly of petroglyphs but the vertical rock face also bears a series of red pictograms. The latter are too faded to permit ready recognition of motifs. Significantly older rock art also occurs at the site, which appears to have been in use over a long period of time. On the upper surfaces of some floor boulders immediately adjacent to the cliff occur a few groups of large cupules, of up to 25 cm diameter and 15 cm depth, and fully repatinated. They number about one dozen and seem to predate any other rock art present at the site. The fine-grained sandstone is generally unsuitable for microerosion analysis, but the rock varnish covering many of the petroglyphs is better developed here than at any other site examined as part of this project. A sloping flat panel, 3 m high and 2.4 m wide, bearing more than fifty fully patinated petroglyphs was chosen. A quadruped figure resembling an antelope near the bottom of the panel was selected for destructive sampling of the ferromanganous accretion covering it.

Milihiya

Closer to Ha'il and about 12 km north of the highway, the topography differs greatly from the Janin mountains. The hills at Milihiya are flat and mesa-like, consisting of various facies of sandstone. Petroglyphs occur on some of the low cliffs and on boulders below them, and stone tools abound around the base of such rises, including lithics of archaic appearance. The sandstone is fine grained and is readily affected by granular exfoliation. These sites are therefore unsuitable for microerosion study.

Yatib

This spectacular petroglyph site consists of a rocky hill, rising about 60 m above the plain and almost one kilometre long. A sturdy wire-mesh fence encloses the entire hill and there is a guard's building at the usually locked entrance, just below the main concentration of rock art. The site is located about 20 km east of Ha'il and is protected by a local site custodian. Thousands of often-spectacular petroglyphs occur on the prominent cliff face and especially on the boulders strewn over the hill's slopes. About 20% of motifs were fashioned with metal tools rather than stone hammers, and in view of the relative hardness of the facies at Yatib it would appear that steel tools were involved. The sandstone has been partially metamorphosed and it is much more weathering resistant than at the previous sites. However, the grains are mostly only between 100 and 200 μm, which renders the rock unsuitable for microerosion analysis.

Qal`at al- Hisan

This minor petroglyph and inscription site is located just outside the township Hayeed, about 250 km SSW of Ha'il. This region is geomorphologically dominated by recent basaltic lava flows and other evidence of volcanic activity. The site occurs on volcanic tuff that contains occasional basalt clasts, a lithology offering no dating evidence in terms of the available methodology.

Jabal al- Barq

Jabal al- Barq is a minor petroglyph site close to and south of Shuwaymis village, on a cliff formed along a wadi in the Harrat al-Khaybar region of Najd. It was found to be of particular interest because some of the rock art occurs on well-developed veins of conglomerate embedded in the coarse sandstone. A vertical panel includes a prominent 'date palm' motif of over 2 m height. The time of the introduction of the date palm in Saudi Arabia remains unknown, and it was hoped that by attempting to estimate the age of this motif we might succeed in throwing some light on the matter. Smaller figures on the poorly patinated panel resemble quadrupeds such as cattle and ibex.

Shuwaymas Site 1

The Shuwaymas site complex was discovered very recently and at present its spatial extent can only be conjectured. The remote area far to the west of Showaymis village features several Pleistocene lake beds and a series of widely spaced, eroding cliffs. The area is now unsuitable for human habitation, but even at mid-Holocene times it was still densely settled, as shown by the abundance of archaeological evidence, such as numerous megalithic burial sites. So far only a very few of these cliff localities have been examined and they are all rich in rock art. During this project only Site No. 1 was studied and it is easily the most spectacular of the sites listed here. It consists of a slope of jumbled boulders, mostly 5 to 10 m in size, on which many thousands of motifs occur. Some compositions bring to mind monumental masonry work, in that the very detailed and meticulously pounded figures of one or two metres are rendered 15 – 20 mm deep. The groups on many of these huge boulders are no longer right way up, and as they changed their orientation every time the boulders moved down the slope new compositions were added at various times. These are all orientated differently, some of them entirely upside-down. The boulders are of a weathering-resistant facies supported by an argillaceous, more readily decomposing sandstone stratum. As the latter deteriorates it can no longer support the rock mass above it, large portions of the decorated upper layer break off through gravity and roll a few metres, only to be engraved again in their new position.

Figure 3. *Cupule panels and footprints at Shuwaymas Site 1, almost certainly dating from the Late Pleistocene.*

The site has been in use over a prolonged period if time, certainly for many millennia. On one sloping flat upper surface, about 15 large cupules of 8–14 cm diameter occur. They appear to be the oldest surviving component of the site, and they are almost certainly of Late Pleistocene age (Fig. 3). The same panel bears also a series of archaic geometric motifs, such as circles, followed by 'hoof-prints' and superimposed larger motifs. Much of this panel is no longer accessible to work on because of a boulder now placed above it. This boulder in turn has petroglyphs on its vertical surface, which clearly postdate its positioning in its present orientation. One of these relatively recent motifs offered conditions suitable of microerosion analysis, as did two more figures at a boulder 25 m to the west. Because of the extraordinary density of petroglyphs at this major site petroglyph-making stone tools (hammer stones) can be found readily. They were mainly made with a dark siliceous contact-metamorphic quartzite occurring locally. These tools were in every formal respect similar to such stone implements found and studied in many other countries around the world (Bednarik 1998). Other stone implements occur also and seem to be of archaic types.

Shuwaymis 1 appears to be entirely free of recent petroglyphs (say, <3000 years) and inscriptions, and there are no images apparently depicting camels or date palms. Similarly, recent graffiti are notably lacking. This confirms the strong impression that the site, and perhaps the site complex as a whole, comprises only early rock art traditions. There are conspicuous stylistic elements bringing to mind northern African traditions, such as the Bubaline genre of the Sahara.

Dating methods

The techniques we considered for estimating the ages of petroglyphs at these sites were direct methods, such as carbon isotope analysis of rock varnish, microerosion analysis, uranium series analysis, optically stimulated luminescence determination, degree of granular exfoliation (surface retreat) and development of macro-wanes. Traditional methods such as the apparent iconographic content of the imagery, relative repatination of motifs and stylistic considerations were at best used in subsidiary roles, if at all. The iconography of rock art provides only non-scientific information, because our notions about pictorial content cannot be falsified. Repatination is a useful general guide to approximate antiquity, but it is not a reliable indicator. Style, too, is a non-falsifiable factor, and can only yield meaningful data in combination with direct dating information.

Of the direct methods considered for application in this project, OSL could not be applied as no suitable deposits (such as mud-daubing wasp nests) were observed at any of the sites examined. Similarly, none of the uranium-based radiometric methods, such as $^{230}Th/^{234}U$ analysis, found any use on this occasion, because the sites lacked any suitable carbonate accretions over petroglyphs. Surface retreat does offer a viable means of estimating petroglyph age on these predominantly sandstone facies, but its use remains seriously hampered by the lack of comprehensive basic research as well as certain analytical problems (Bednarik 2001a: 137). More promising is the measurement of macro-wanes, especially in combination with facture-surface weathering and other direct methods. However, such a study would require extensive fieldwork, which on this occasion it was not possible to invest. Moreover, as in other rock art dating work, the data base currently available is inadequate, but it should be emphasised that this kind of 'integrated' approach would be particularly suited for the conditions found at Arabian petroglyph sites.

We are well aware of the limitations of radiocarbon results from accretionary deposits, including rock varnish (Bednarik 1996, 2001a: 111-2, 134-5). Among them are not only those inherent in all radiocarbon data, but more specifically the qualifications applying to any claimed relationships between such data and the date of rock art production. This complex subject has been considered in some detail, and until radiocarbon sampling can be focused on either specific compounds or substances, i.e. at the object or molecular level, or on specific objects, e.g. pollen grains, we cannot know what it is we are dating (Bednarik 1996). Most importantly, the ubiquitous presence of datable carbon in rock substrates, together with the openness of the carbon system, limits reliability of this approach. Nevertheless, it has provided many useful results in several parts of the world, and as long as the tentative nature of such results is appreciated and they are not over-interpreted, there can be no objection to utilising this popular method.

Of the eleven sites we investigated, only one, the main site of Janin, offered rock varnish of an adequate thickness to render physical sampling advisable. There are numerous decorated panels at this location, their orientation ranging from vertical via inclined to horizontal. The antelope-like zoomorph selected for sampling is 26 cm long. The rock varnish coating was found to be poorly developed and consolidated, showing no nanostratigraphy. An area of 9 cm^2 had to be sampled because the varnish cover was thin and discontinuous, occurring only in depressions between quartz grains. The sample was collected with dental tools under sterile conditions and sealed in an airproof glass phial (Fig. 4). It is being processed at the AMS facility in Lucas Heights, Sydney, but results are not available at the time of going to press. After the sample removal was completed, the scar left in the varnish coating was repaired by a procedure similar to that established by Elvidge and Moore (1980), using chemicals prepared specifically for this purpose.

Figure 4. *Radiocarbon sampling site at Janin main site, a zoomorph resembling an antelope.*

OZF900 yielded the following analytical results –25.0%   13C, 79.77% of modern carbon at 1 sigma

Error, or 1820+ 50 years BO. Bearing in mind the inherently open carbon system of rock varnishes (Bednarik 1979) this is to be viewed as a most conservative minimum bulk of mean age of the accretion. Depending on the rate and degree of rejuvenation (e.g. from micro-organisms) its true age could be as much as two or three times the measured radiocarbon age, and this in turn must be less than the age of the petroglyph covered by this deposit. Thus the age of the petroglyph cannot be determined in this way, except that it must be significantly greater than 1820 years and could quite realistically be as much as 4000 to 6000 years.

Microerosion analyses

Despite the often-stated reservation about the use of sedimentary rock (including sandstone) in microerosion analyses, this method has emerged as the most suitable under the circumstances of this project (i.e. lithologies encountered and time available). Sandstones of the former Gondwana plates, where well over half the world's rock art is located, are typically of well-sorted, fine-grained facies, which are usually unsuitable. In both central and northern Saudi Arabia, however, coarser grades are frequently available, at least as banded deposits or random inclusions. Where they are incorporated in pounded designs, such grains may feature abundant evidence of impact damage, including conchoidal fracture facets, crushing and step-fractures. Any edges formed by one or two surfaces dating from the time the petroglyph was made are suitable for analysis, provided that the angle between the surfaces forming the edge is of a nominated standard range. In our work we used only angles of between 85° and 95°. The width of the micro-wane (*A*) is measured in microns and recorded for tabulation, using field binocular microscopy (Bednarik 1992). The method has been used successfully on granite and quartz inclusions in other facies. On granite and similar rock types it can have a range of several tens of millennia, especially in arid environments (Bednarik 2001b). It has been applied to rock art in all continents, and calibration curves are now available from six regions. The method's strengths are its superb reliability; ease of use; that it involves no physical and destructive sampling; and that it remains the only direct method of rock art dating that addresses the actual age of petroglyphs, rather than the age of some substance related physically to the rock art (which inevitably must be either younger or older than the art). Its weaknesses are that its results lack significantly in accuracy, as reflected in large tolerance margins; that it can only be applied where remnants of the fractured crystal surfaces remain from the petroglyph-making event; that the presence of calibrated minerals is essential (only quartz and feldspar have so far been used); and that it depends entirely on the precision of calibration curves. The latter reservation means that the method can only be used in regions offering geomorphic or anthropogenic surfaces of known ages (such as inscriptions or stone structures of known ages, featuring crystals of the same minerals as those used in the analysis).

Figure 5. *Boulder with Arabic inscription at Umm-Samnan site complex, at Jubbah which provided the microerosion calibration sample.*

We have attempted the creation of two calibration curves for Arabia. At Umm Asba'a, we used the lower of two lines of an inscription to obtain four micro-wane determinations from pebble-sized crystalline quartz grains. They averaged 3.25 μm, but in view of the very small sample we regard this result as highly preliminary. It relates to an inscription of about 1120 years BP, suggesting a wane width growth rate of 2.9 μm per millennium. This is by far the lowest recorded anywhere so far, which is entirely consistent with the fact that the area's annual precipitation is only about one third of that of the region with the next-lowest recorded rate, the Australian Pilbara (Bednarik 2001b).

Moreover, the provisional Umm Asbae value closely matches the more robust calibration value from another site, even though it is 610 km to the north-west. At the extensive Umm-Samnan site complex near Jubbah, an Islamic inscription yielded 25 micro-wane measurements from a long Arabic inscription dating from about A.D. 800 – 850. The prominent inscription is on a slightly concave boulder panel 6 m up from the base of the escarpment slope, facing ENE and sloping 57° from the vertical (Fig. 5). Data are from a character 12 cm from the left end of the fifth line (grain size 2.2 mm), and 28 cm from the right end of the sixth line (grain size 2.35 mm). They provide a mean value of 3.32 μm which yields a wane width growth rate of 2.83 μm per millennium (Fig. 6). This calibration value forms the basis of all microerosion estimates in the present report.

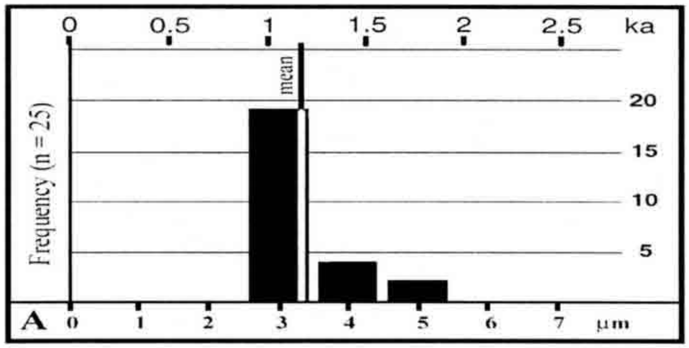


Figure 6. *Microerosion calibration curve for crystalline quartz, Umm-Samnan site complex, Jubbah.*

Conditions at Al- Usayla were not favourable, because the grain size was small, the rock poorly cemented, and some evidence of granular exfoliation was evident. However, an apparent ibex figure offered two suitable edges, one on a grain in the upper 'horn' of the figure, the other in its 'body'. Eight values were taken over 1.5 mm of the first 90° edge, nine over 1.2 mm of the second, yielding a mean value of 7.59 µm (Fig. 7). About ten other fractures observed on the motif were unsuitable, either because the angle was

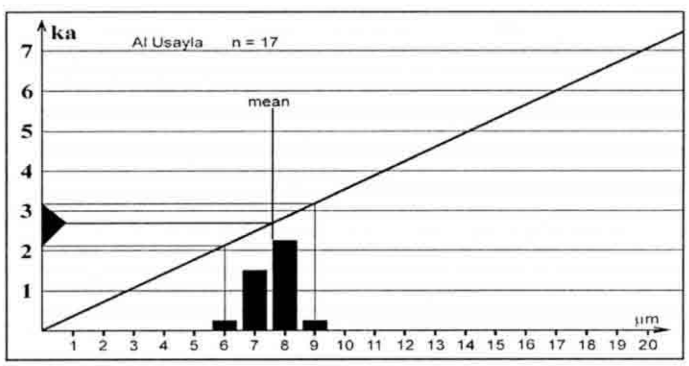


Figure 7. *Al- Usayla, microerosion analysis of the 'ibex' motif in Figure 2.*

between 60 – 80°, or because percussion had resulted in sub-pyramidal fractures. Grains are generally well rounded, of frosted surfaces and tightly packed. Using the Umm- Samnan calibration value (rather than the geographically more relevant, but less reliable Umm Asbae value), the provisional age of the Al Usayla 'ibex' is E2680 + 500 / -560 years BP (the 'E' prefacing all microerosion results indicates that the result is erosion derived). This result can be regarded as *reliable* in terms of its order of magnitude, but is not to be considered as *precise*. It is derived from only one component mineral, quartz, and the calibration conditions are not optimal. In microerosion analyses it is preferred to check one mineral's reaction against another, e.g. quartz against feldspar. This is not possible in a siliceous sandstone. In practical terms this means that if there were any significant climatic changes, they could not be detected and allowed for.

The situation is slightly better with the one determination made at the Umm-Samnan main site, a few hundred metres from the calibration site. It comes from a large anthropomorph with a horned zoomorph facing it from the left. This vertical panel is about 35 m above the base of the escarpment. The human figure is 2.19 m high and is crossed by several bands containing occasional coarse grains, two of which offer good fracture edges. One is an extensively crushed 8.8-mm-long grain c. 10 cm below the figure's right 'knee', the second sample's grain is on the left of the trunk, at the level of the accompanying zoomorph's 'muzzle'. The total of 19 values determined ranged from 12 – 16 μm, providing a mean of 13.84 μm (Fig. 8). This translates into a provisional date of E4890 + 760 / - 650 BP for the large anthropomorph.

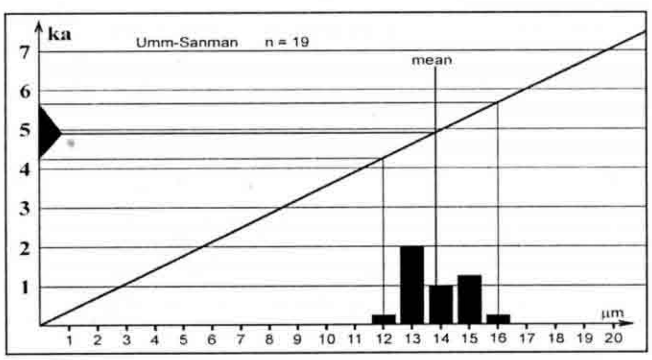


Figure 8. *Umm-Samnan main site, microerosion analysis of large anthropomorph.*

At the Umm-Samnan northern site complex, two Thamudic writing characters, only 1.5 m apart but belonging to two different inscriptions, were selected for detailed analysis after coarse quartz grains were detected in them. The first is the letter 'sh', where a grain of 12.9 mm provided 12 readings from one edge, yielding a mean of 8.0 μm. The approximate age of E2830 ± 700 years BP places this inscription somewhere between the second and the fifteenth centuries B.C. (Fig. 9). The second letter analysed is a 'þ', in which a

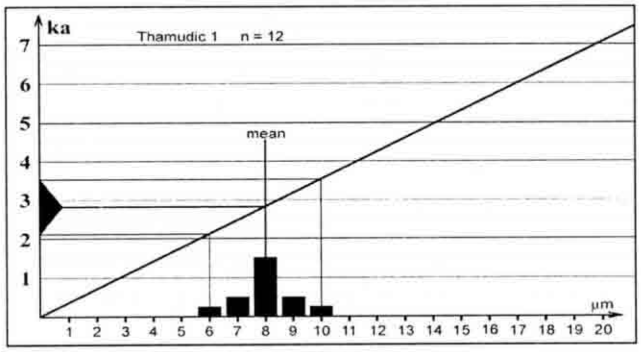


Figure 9. *Umm-Sanman northern complex, microerosion analysis of Thamudic letter 'sh'.*

3.25 mm grain offered only five readings with a mean of 7.2 µm. This date of E2540 + 990 / - 420 B.P. is perhaps less reliable, but it does support the previous result (Fig. 10). Together the data from these Thamudic inscriptions should put to rest some of the controversies concerning early scripts in the Middle East.

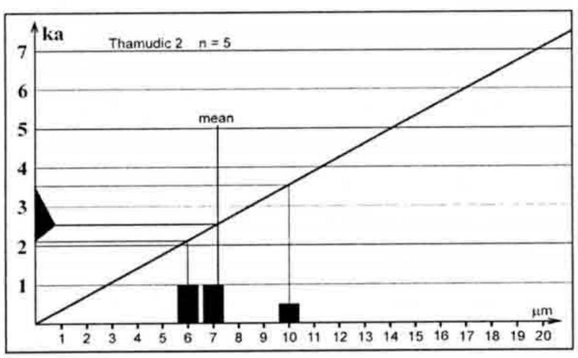


Figure 10. *Umm-Sanman northern complex, microerosion analysis of Thamudic letter 'þ'.*

The conditions at Jabal al-Bargh were excellent for analysis, due to the presence of some large quartz grains on the dominant 'date palm' motif. Two such grains in the motif's exceptionally long 'trunk' offered suitable edges, one a pebble of 21.7 mm (Fig. 11), the other not far above it being a smaller grain. Together they yielded 15 micro-wane widths, ranging from 5 to 9 µm, and providing a mean value of 6.71 µm. The provisional age calculated from these data is E2370 + 810 / - 600 years BP. If this motif does indeed depict a date palm, the introduction of this important species into the region should have occurred before 2500 years ago.

Figure 11. Jal Al Bar, detail of 'trunk' of 'date palm' motif, showing extensively shattered pebble-grade quartz grain that was sampled.

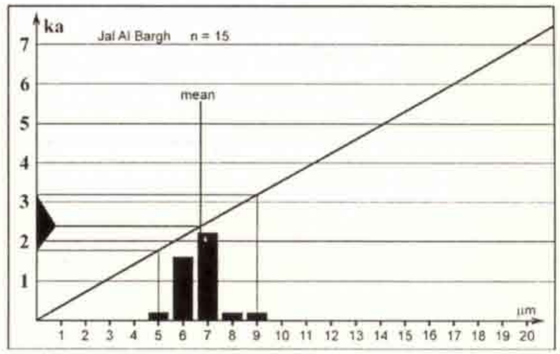


Figure 12. Jabal al-Bar, microerosion analysis of petroglyph resembling a date palm

The main site of the Shuwaymis complex appears to include very heavily weathered Pleistocene petroglyphs, such as cupules, but these are so eroded that microscopic analysis proved futile. Suitable conditions were detected on three much more recent figures, two on a vertical panel 25 m west of the cupules and facing east, and one immediately above the cupules, in a composition of several anthropomorphs. The latter postdate the cup marks by a very long time span, as evidenced by the sequence of boulder movement, weathering and patination. The first two figures are a very tall anthropomorph, in which a quartz grain of 13.0 mm size provided seven micro-wane measurements, and an equally large 'ibex' with most impressive horns to the left of it. A mean wane width of 15.0 µm was secured from the anthropomorph, translating into a preliminary age estimate of E5310 ± 350 years BP (Fig. 13).

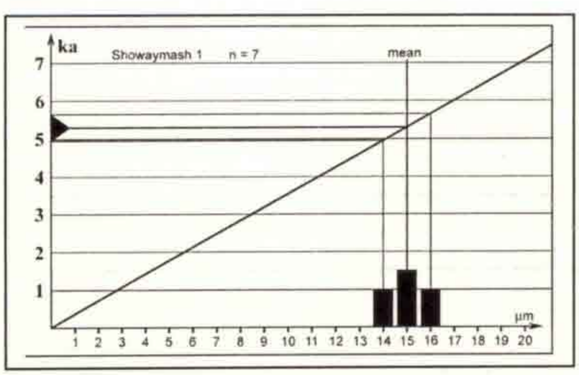


Figure 13. Shuwaymis Site 1, microerosion analysis of a large anthropomorph.

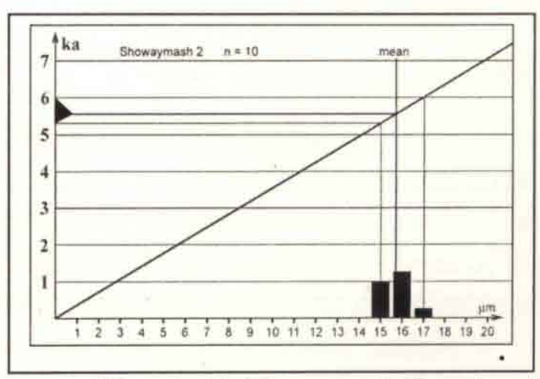


Figure 14. Showaymis Site 1, microerosion analysis of large 'ibex' motif next to the anthropomorph in Figure 13.

The immediately adjacent ibex-like figure, apparently of similar age, provided ten closely ranging readings from edges on a 1.45 mm grain, with a marginally higher mean value of 15.7 µm. This range corresponds to an age of between 6000 and 5300 years, with a preferred estimate of E5550 + 450 / - 250 BP. Since the tolerance ranges of the two motifs overlap by 360 years it remains perfectly possible that the anthropomorph and adjacent 'ibex' image were executed at about the same time. (Fig. 14).

Above the cupule panel, a 96-cm-tall anthropomorph was scanned because it provides a very conservative minimum age for the cupules and subsequent motifs on the boulder below it. Two suitably fractured grains were detected, one of 9.9 mm occurring 28.5 cm from the top of the figure, the other measuring 5.5 mm and located 61 cm from the top. The first grain yielded 13 values, the second seven, with a perfectly narrow range from 12 – 14 mm and a symmetrical histogram. The mean wane width of 13.0 µm corresponds to a tentative age estimate of E4590 ± 350 years, and the measured range suggests that the age is likely to be between 4940 and 4240 years BP (Fig. 15).

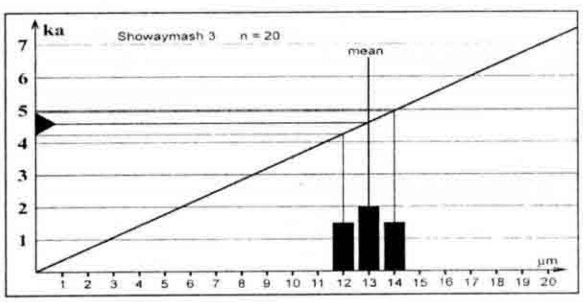


Figure 15. *Shuwaymis Site 1, microerosion analysis of an anthropomorph above the cupule panel in Figure 3 and predating it.*

Discussion

The analytical results presented here need to be immediately qualified by several considerations:

a. These age estimations rely entirely on the veracity of the calibration curve used in calculating them. Although the Umm-Samnan curve appears to be closely matched and thus confirmed by the primary data from the Umm Asbae inscription, this can still be pure coincidence in view of the on epigraphic assumptions, on a rather small sample of measurements, and necessarily on a single mineral. It would greatly bolster confidence if a duplicate curve could be obtained from feldspar, even if the target sites should only provide quartz values.

b. Most of the sample sizes reported here need to be considered as comparatively small, and the scattered histograms obtained from inscriptions at Umm- Samnan north site are probably reflections of inadequate samples. This adds further to the impression that all the age estimates presented here are rather preliminary and tentative.

c. While the age determinations tendered here are certainly reliable in terms of their order of magnitude, much more fieldwork is required to improve their precision, by excluding the possibilities of distortions due to calibration, climate changes in the past, and inadequate sample sizes.

d. Crystalline quartz occurs in different forms. While their solution characteristics are unlikely to differ sufficiently to affect the rather coarse resolution of microerosion analysis, this assumption needs to be tested by analysing surfaces of known age but different quartz types.

e. Since a single-mineral calibration curve provides no safeguard against the effects of major climatic variations in the past the preliminary results listed here may be somewhat distorted. For a period significantly wetter than today, results would be 'too high'.

f. The preliminary dates in Table 1 should not be used to interpret archaeological traditions, occupation duration, or any of the other types of archaeological constructs often extracted from rock art. The few determinations now available tell us nothing about population densities, artistic trends, 'styles' etc. Saudi Arabian rock art will probably yield much older dates in due course, for instance from cupules.

The results offered here do not constitute secure and precise dating of the motifs they refer to. Substantial tolerances are attached to each age determination, reflecting the spread of the primary data. The true ages of the motifs dated do not necessarily lie within the tolerance values, although this is highly probable. Moreover, the motifs were selected randomly, essentially on the basis of suitability, therefore these results have little or no bearing on the dating of 'styles', traditions, and even less of whole site corpora. Many sites include the work of more than one rock art tradition, some were used for many millennia. Therefore these results should not be applied uncritically to whole 'schools' or regions, and they should not be used without an appreciation of the qualifications that apply to all scientific rock art dating methods (Bednarik 2001a).

Nevertheless, the amount of dating work we were able to accomplish in a very short time confirmed the utility of microerosion in the Middle East. We managed to secure a total of nine dates from six sites, and two calibration readings from Islamic inscriptions (Table 1). The preliminary nine dates cover much of the Holocene period, and we are now able to estimate the time of the major rock varnish deposition period in the Ha'il area. It occurred some time between 6000 and 4000 years ago, apparently mostly in the first half of that period. Most certainly very little patination has taken place in the last 3500 years or so. This seems to suggest the occurrence of a period of extreme desertification that commenced just before the middle of the Holocene. It was probably a result of a dramatic lowering of the region's aquifers, and can be assumed to have led to considerable environmental stress in late Neolithic times, and subsequent abandonment of many areas. It is likely that major rock art production phases coincided with such periods of environmental degradation, and the increased incidence of supplication ritual in harsh times. This is of considerable relevance to linking the rock art not only to archaeological data, but also to palaeo-climatological and hydrological issues in the region (such as the disappearance of lakes in the mid-Holocene). In this sense the rock art dating work will have wider scientific implications, being of interest also to questions of demographic and environmental history.

The newly discovered, pristine and most impressive main site at Showaymash held a special surprise for us. It includes one panel that is substantially older than the middle Holocene, and a number of indications suggest that it dates from the Ice Ages, most probably from the very final Pleistocene (perhaps 10 500 – 14 000 years BP). This would make it the oldest rock art site currently known in western Asia (west of central India). No doubt much more of such ancient rock art exists in the region, but at this stage no such antiquity has been convincingly demonstrated anywhere between Egypt and India—or indeed in any Asian country other than India. Unfortunately this very early rock art at Showaymash offered no data suitable for direct dating, and our opinion about its antiquity is based on a combination of spatial and chronological deductions which we are confident about, but which cannot be considered to be proper dating. This is not to say that this particularly ancient art will not be dated eventually, only that on this occasion such evidence eluded us. It is, however, probable that rock art of similar Pleistocene antiquity does exist elsewhere in this huge site complex, and it may offer better analytical conditions. Moreover, we have observed similar very archaic motifs at the Janin main site, where they also precede all other traditions by a very considerable time span.

A principal finding of this project is that, even in the vary arid and unoccupied regions of Saudi Arabia, which offer optimum conditions for the survival of petroglyphs, the taphonomic threshold (for definition see Bednarik 1994) of petroglyphs on sandstone seems to be within the Holocene. It probably occurs around 8000 or so years ago. The threshold for petroglyphs on granites is many times greater, and in arid regions probably beyond 50 000 years ago. This emphasises the importance of focusing in Arabia on regions containing plutonic rocks, including granite, gneiss, rhyolite, quartz porphyry, granodiorite, rhyodacite, plagiophyre, quartz diorite, dacite, andesite, diorite and granophyre. There are two fundamental reasons for this: such lithologies would provide greater accuracy in calibration for microerosion analyses; and they would facilitate a considerable extension of the temporal range of the rock art studied, in that such regions should offer sequences of Pleistocene traditions, covering at least the Upper Palaeolithic period. Such ancient rock art can be assumed to exist in Saudi Arabia, provided that the lithological supports have permitted its survival. But it can be safely predicted that in nearly all situations, it survived only either in deep caves or on weathering-resistant rock facies.

Recommendations

This leads directly to the first recommendation we can formulate on the basis if this project:

1. For a comprehensive evaluation of Arabian rock art it is essential to focus on regions of particularly resistant facies, notably of granite. This will facilitate the discovery of Pleistocene petroglyph traditions and also the acquisition of dual microerosion calibration curves, which are necessary for developing greater precision and confidence in the dating of the art. The radiocarbon dating of accretionary deposits is not only fraught with various uncertainties, the method does not seem to have a great future in Arabia, because varnishes are poorly developed and lack the stratification demonstrated elsewhere. Other methods may be introduced in Saudi Arabia in the future, but in view of the ready availability of dated historical calibration surfaces the best short-term strategy in linking the country's rock art to its archaeological heritage by dating the art is probably through the comprehensive application of microerosion analysis.
2. Concerning the outstanding Shuwaymis rock art complex, we recommend that its perpetual protection be considered as a matter of high priority. The world is desperately short of pristine rock art sites, especially of such outstanding quality. Where sites of this calibre exist elsewhere, they have usually suffered greatly from excessive tourism and even from the attention of researchers. Now that we have globally learned from many previous mistakes, this site complex could become a paradigm of effective site management, by involving local community leaders (such as Mamdouh al-Rasheedi) and creating a long-term management plan. There appears to be good local support for such measures. Highly controlled frequent visitation

is much less damaging than low-incidence uncontrolled visitation.

3. This leads to our next recommendation. The Shuwaymis site complex would be a prime candidate for nomination to the UNESCO World Heritage List. Inclusion in that list would greatly facilitate the appreciation of, and support for, rock art generally, and the need to protect it as a valuable component of the Kingdom's cultural heritage. In any country this tends to have a beneficial flow-on effect on rock art elsewhere.
4. Another effective measure to raise public awareness and appreciation of the photogenic rock art of Saudi Arabia is to foster the creation of television documentaries about this subject. Such projects would preferably be conducted under the supervision of the Ministry of Antiquities and Museums. Provided that such material is of the appropriately high cinematographic standard, it tends to be transmitted worldwide, and it therefore has a major effect on public perceptions.
5. In view of the current plans to conduct a major survey of the Shuwaymas complex it is recommended that special attention be given to locating further occurrences of cup marks and archaic linear motifs in the area. Such panels, especially if deeply weathered and patinated, are likely to date from the Pleistocene.

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Adviser, Deputy Ministry of Antiquities and Museums

Site	Rock type	Calibration	Dating	Range (BP)	Approx. age (BP)
Umm Asba'a site	Sandstone	Inscript-ion		Known age 1120 BP	
Al Usayla	Sandstone		'Ibex' figure	3180 – 2120	2680 + 500 / – 560
Umm-Sanman main complex	Sandstone	Inscript-ion		Known age 1150 – 1200 BP	
			Anthropomorph	5650 – 4240	4890 + 760 / – 650
Umm-Sanman northern complex	Sandstone		Inscription 1 Inscription 2	3530 – 2130 3530 – 2120	2830 ± 700 2540 + 990 / – 420
Janin Cave	Sandstone	Unsuitable		No data	
Janin main site	Sandstone		'Gazelle'	Data not yet available	
Milihiya	Sandstone	Unsuitable		No data	
Yatib	Metam. sandst.	Unsuitable		No data	
Qilat-el-Hissan	Tuffaceous	Unsuitable		No data	
Jabal al- Bargh mountain	Congl. sandst.		'Date palm'	3180 – 1770	2370 + 810 / – 600
Shuwaymas main site	Sandstone with pebbles		Anthropomo-rph 1 'Ibex' Anthropomo-rph 2	5660 – 4960 6000 – 5300 4940 – 4240	5310 ± 350 5550 + 450 / – 250 4590 ± 350

Table 1. *Sites examined and preliminary results from calibration, microerosion analysis and radiocarbon analysis.*

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