Dr Bernd Müller-Neuhof
Deutsches Archäologischers Institut
Orientabteilung Podbielskiallee 69-71
D-14195 Berlin Germany
bmn@orient.dainst.de
www.dainst.org

Dr Norbert Laskowski
Institut für Angewandte
Geowissenschaften Technische
Universität Darmstadt
SchnittspahnspahnstraBe 9 D-64287
Darmstadt Germany
Laskowski@geo.tu-darmstadt.de

Bernd Müller-Neuhof
with a contribution from Norbert Laskowski

Preliminary Results of the 2010 Cortex Scraper Mine Survey in the Greater Wādī ar-Ruwayshid Region (N/E Jordan)

Introduction

A two-year survey project, *Arid Habitats in the 5th to the Early 3rd Millennia BC: Mobile Subsistence, Communication and Key Resource Use in the Northern Bādiyah (North-East Jordan)*, has been exploring human activities during the Late Chalcolithic and Early Bronze Age in the northern *bādiyah*, both in the basalt desert *(ḥarra)* and the region to its east (*ḥamād*). A major part of the project is the exploration of flint mines in the greater Wādī ar-Ruwayshid region, where cortex-scraper blanks were produced on a near-industrial scale during the periods under consideration.

One of the mines was initially discovered by the author during a short reconnaissance trip in 2000 and was revisited and surveyed in 2006 (Müller-Neuhof 2007[1]). In 2010 this region was visited again and a more extensive survey was carried out, the preliminary results of which are discussed below.

Cortex-Scraper Blank Production Beyond the Fringes of Settled Life

The lithic tool assemblages of Late Chalcolithic and Early Bronze Age sites in south-west Asia are characterised by considerable numbers of standardised large tool-types. Among these types, cortex-scrapers, also known as "fan-scrapers", "tabular scrapers", "*racloir en éventail*" or "Jafr tools", played an important role (Rosen 1997: 75).

Although such tools are known from a large number of archaeological sites all over south-west Asia and Egypt, little is known of their sources. Apart from a couple of small quarry sites reported from the Negev and Sinai (Rosen 1983: 80), at which a very small number of cortex-scraper blank cores were recovered, the largest currently known sites are located in eastern Jordan (FIG. 1). Here these blanks were literally mined on an 'industrial' scale.

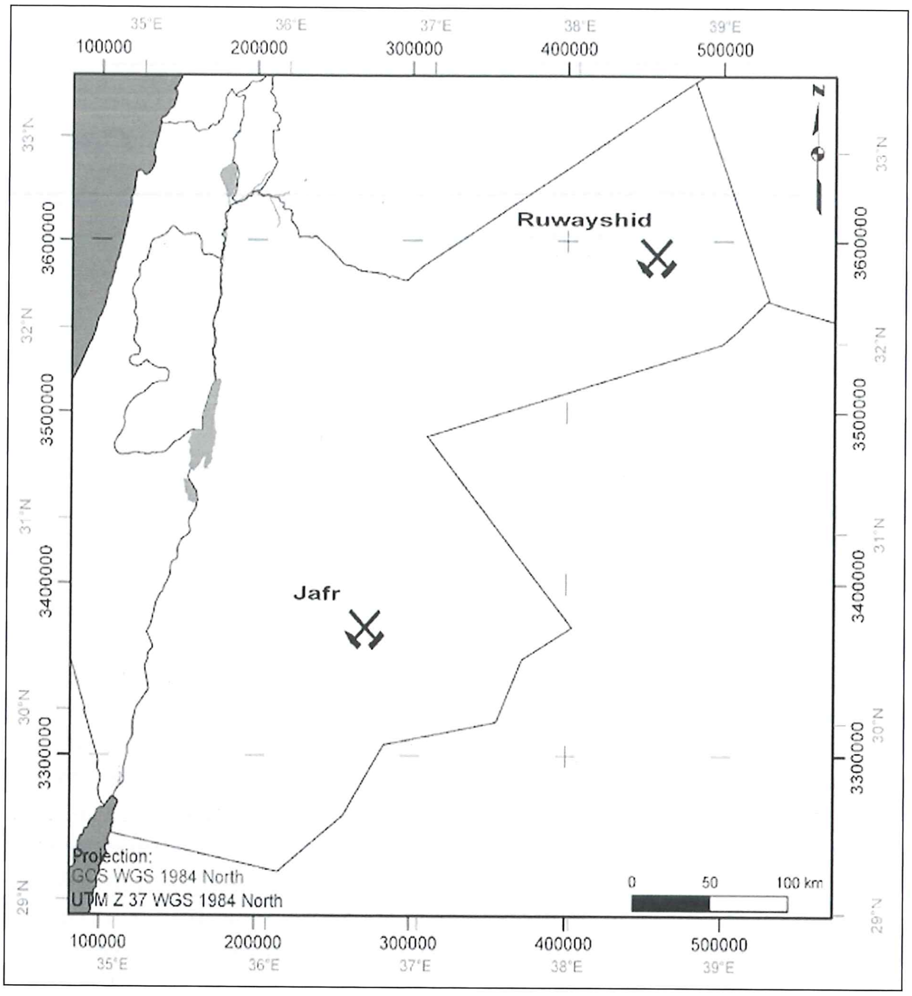
In the late 1970s, the first observation of specialised cortex-tool mines was made on the northern rim of the Jafr basin (Rollefson 1980), but it was not until 1998 when Leslie Quintero, Phil Wilke and Gary Rollefson recognised these sites as flint mines and workshops where cortex-scraper blanks were produced in large quantities (Quintero, Wilke and Rollefson 2002). More recently, comparable sites have been discovered on the north-west margins of the Jafr basin by Sumio Fujii at Qā‘ Abū Ṭulayḥa (Fujii 2000, 2003).

The only other currently known area with evidence for large-scale cortex-scraper blank production is located in north-eastern Jordan. This minesite is located *ca.* 60km from the Jordan - Iraq border, south-east of the modern town of Ruwayshid, and was discovered by Ricardo Eichmann and the author in 2000 (Müller-Neuhof 2007). In March 2010 a more extensive survey was carried out at this location. A large number of additional mines and workshops, all relating to large scale cortex-tool blank production, were identified, suggesting similarities with the industry of the Jafr region.

Nature of the Greater Wādī ar-Ruwayshid Mining Region

The cortex-tool mines and workshops in the greater Wādī ar-Ruwayshid region are located in the so-

[1] In 2000 this mine was designated RU 27. The numbering of this and three additional mines (RUW 28, 29 and 30) discovered in 2006 is based on the numbering of archaeological sites and topographical features identified during the short reconnaissance trip in 2000. This designation was retained in 2006. However, owing to the discovery of further mines in 2010, it was decided to renumber these sites. RU 27 is now RUW 1, RU 28 is RUW 2, RU 29 is RUW 3 and RU 30 is RUW A.

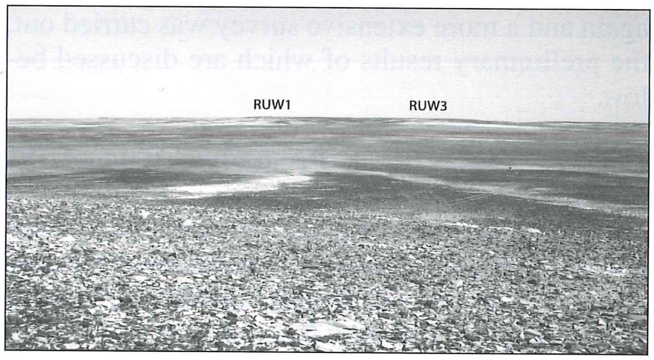


1. Map of Jordan and surrounding areas with the mining regions of Jafr and ar-Ruwayshid (Marquardt and Müller-Neuhof, DAI Orientabteilung).

called *ḥamād* east of the basalt desert (*ḥarra*). They are situated on the western elevations of a ridge of the Rīsha limestone plateau, which ascends towards the south-east. Jabal ʻUnayzah lies at the highest part of this plateau, where the borders of Jordan, Iraq and Saudi Arabia converge.

The region is characterised by wadis draining down towards the west from the ridge. Between them are raised areas with promontories at their western limits. The ground-surface, especially on the raised areas, is characterised by typical *ḥamād* desert flint pavement (FIG. 2).

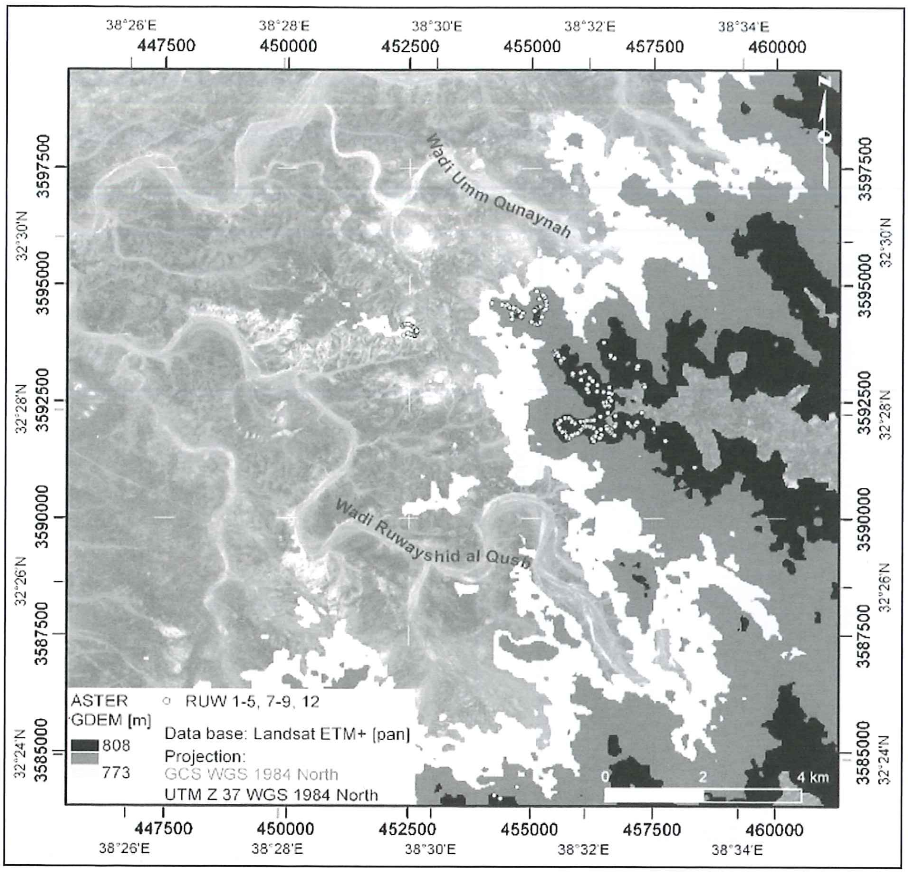
Several layers of finely textured, dark brown Eocene flint outcrop at different levels on the slopes of the raised ground. Survey data indicate that large-scale mining and production activities were restricted to flint sources occurring at elevations of 780 - 830m asl. Indeed, most occur between 810 and 815m asl (FIGS. 3 and 4); it is therefore assumed that these flint sources belong to a single flint layer, even though this layer occurs



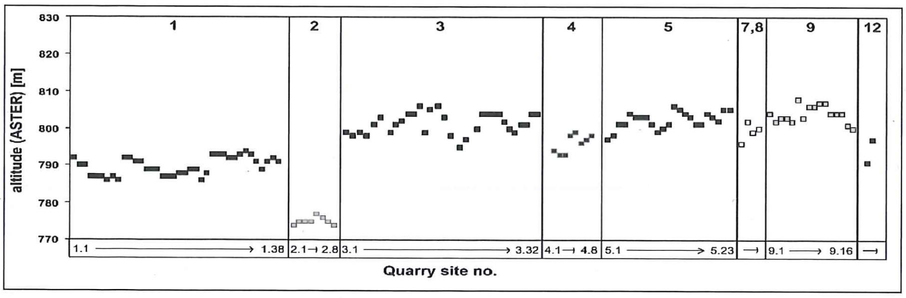
2. Photo of the ar-Ruwayshid region with mining areas RUW1 and RUW3 in the background (Müller-Neuhof, DAI Orientabteilung).

at slightly different elevations on different areas of raised ground. This discrepancy may be linked to post-depositional activities associated with tectonic processes.

Significantly, outcropping flint layers above 830 m asl have - at most - just occasional evidence for *ad hoc* production of cortex-scraper blanks charac-



3. Elevation model showing the distribution of mines and workshops according to altitude (Marquardt and Müller-Neuhof, DAI Orientabteilung).

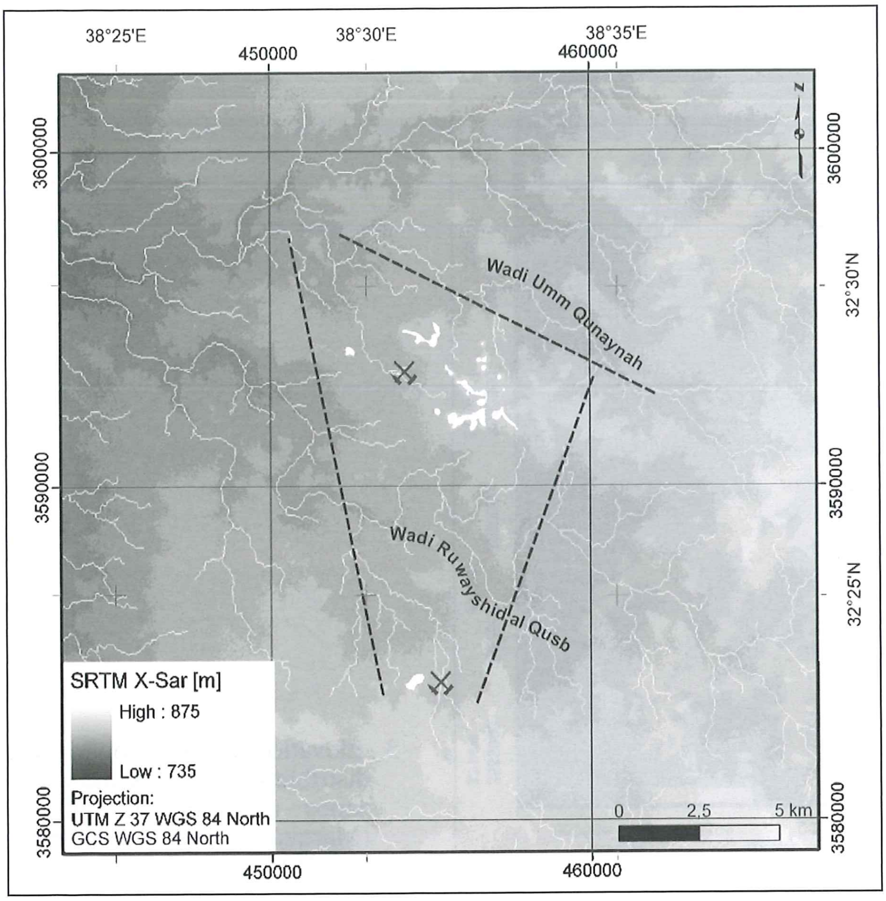


4. Distribution of mines and workshops according to altitude (Marquardt and Müller-Neuhof, DAI Orientabteilung).

terised by very few negative scars on flint nodules, usually not more than *ca* 1 blank per 100 m^2. No evidence for mining and cortex-scraper blank production was observed on visible flint layers below 780 m asl.

This observation enabled us to determine the eastern and western boundaries of this mining region (FIG. 5). Its western limit is defined by the presence of lower elevations with most likely unsuitable, seemingly unexploited flint layers, and the wide plain bordering the basalt desert to the west. Its eastern limit is defined by the ascending ridge, which seems not to contain any suitable flint layers above 830 m asl.

In addition, a northern limit was also identified. This is in the area of Wādī al- Qanayyah; no evidence for cortex-scraper blank production was found north of this *wadi*, even at elevations between 780 and 830m asl. This may be explained by the different topography in this area, which is characterised by gentler slopes created by colluvial processes. These processes have covered the outcropping flint layers with sediment, making them invisible and therefore inaccessible. However a continuation of the mining region could be followed to the south; its southern limit is not yet identified. Owing to time pressure, in the southern part of the mining region we were only able to trace mines close to the south bank of Wādī ar-Ruwayshid al-Qaṣb. Another survey season will be needed



5. Map of the ar-Ruwayshid mining region with its limits (Marquardt and Müller-Neuhof, DAI Orientabteilung).

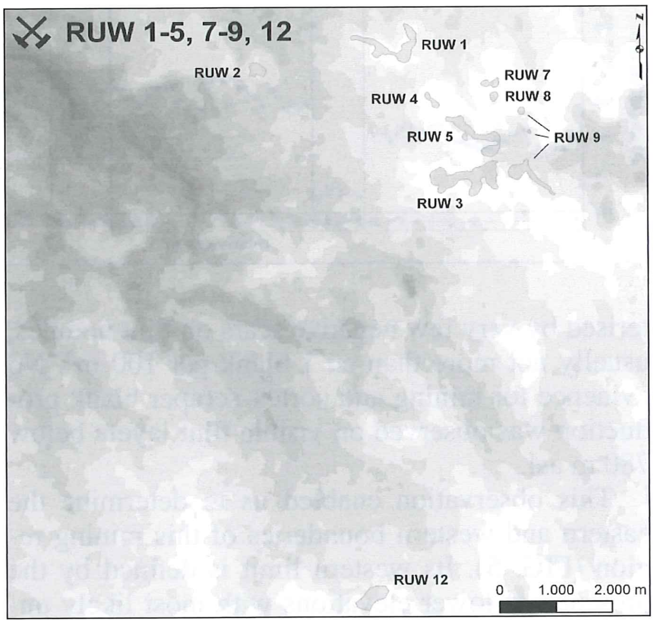
to identify the southern extent of the mining region.

Location and Character of Mines and Workshops

In total, *ca.* 120 mining areas and workshops of varying shapes and size were identified on nine promontories, designated RUW 1 - 5, 7 - 9 and 12 (FIG. 6). Two types of mine could be distinguished:

The first is found on the upper parts of slopes, where the outcropping flint layer - the target of raw material procurement – lies just beneath an upper, *ca.* 20cm thick outcropping limestone layer. Here the overlying limestone was mined out in order to reach the underlying flint nodules, which were then extracted from the flint layer (FIG. 7). Such areas extend along the margins of the ridges, and are 20 - 30m wide and 100 m or more in length (FIG. 8).

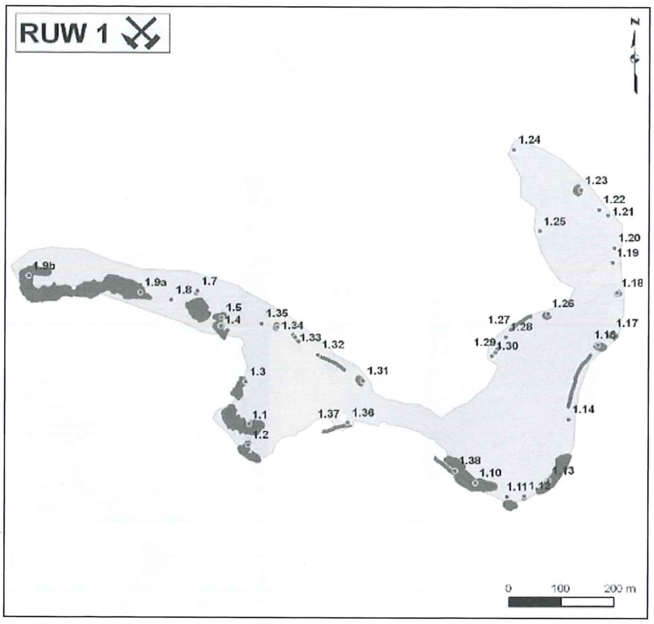
The second is found on top of the promontories at the ends of areas of raised ground. These large sites, extending over areas of up to 0.25 ha (2,500m^2), are covered with broken nodules. In some cases they are located close to the outcropping and exploited flint layers (FIG. 9). However, the number of nodules, chunks and cores in these



6. Map showing the distribution of mining areas along the western end of the Rīsha limestone plateau in the greater Wādī ar-Ruwayshid region (Marquardt and Müller-Neuhof, DAI Orientabteilung).

areas exceeds the resources available on visible outcrops situated on the upper slopes. Therefore,

7. Detail of mine RUW3.5 on the ridge, showing mined flint outcrops and removed overlying limestone layer (Müller-Neuhof, DAI Orientabteilung).



8. Distribution of mines and workshops in mining area RUW1 along the margins of the raised ground (Marquardt and Müller-Neuhof, DAI Orientabteilung).

other techniques of flint mining on these sites can also be expected, which would have occurred closer towards the tops of areas of raised ground and not on the escarpments themselves. Trench mining for flint extraction, which is known from cortex-tool flint mines in the Jafr region (Quintero *et al.* 2002: 26), can however be excluded. The remains of trenches have not been found and, in comparison to the Jafr mines, such trenches would be easy to detect in this region. Instead pit-mining can be assumed. Pit-mining has been recorded by Fujii (2003: 210ff) on a mining site (W-06) at Qāʿ Abū Ṭulayḥa West, located on the north-western margin

9. View of large mining site RUW1.3, showing its extension towards the inner part of the promontory (Müller-Neuhof, DAI Orientabteilung).

of the Jafr plain. These pits were intentionally back filled (or filled up through natural sedimentation) after quarrying ended, making them hard to identify on the present ground surface. This hypothesis will be tested by excavation in a future season.

In addition to mining raw material, primary production – which in some cases included removal of cortex-scraper blanks – was occasionally carried out on these mining sites (FIG. 10). However, the survey also identified specific workshop areas, focused specifically on the removal of cortex-scraper blanks. These sites are located on the tops of some of the ridges, directly above the upper limestone layer under which the exploited flint layer occurs (FIG. 11).

These small sites, usually less than 0.01 ha (100 m^2) in size, are separate from both the mines and the areas where primary production (i.e. core prep-

10. Detail of large mining site RUW1.1 with evidence for blank removal (Müller-Neuhof, DAI Orientabteilung).

11. View of workshop RUW5.22 (Müller-Neuhof, DAI Orientabteilung).

12a. Core-preparation: chunk from RUW5.22 (Müller-Neuhof, DAI Orientabteilung).

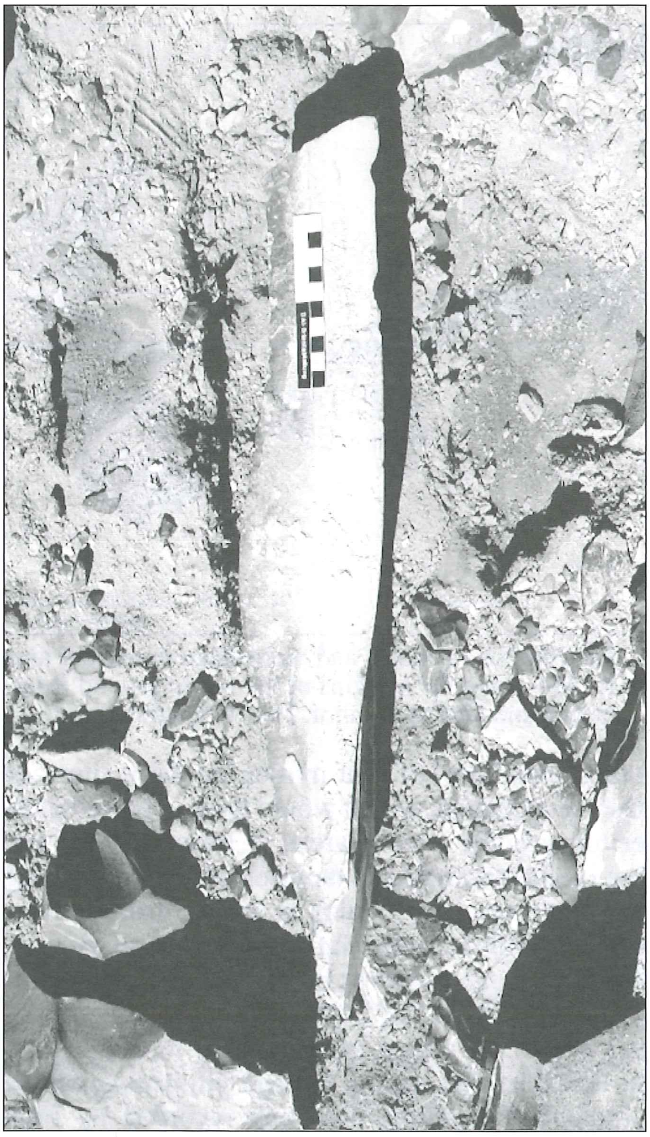
aration) occurred. They are bounded on one side by the outcropping limestone layer, consisting of broken-out limestone rubble which forms a wall-like delineation. On the other sides, the sites extend a few metres on to the ridge-tops, forming a more or less semi-circular area. In contrast to cortex-scraper blank removal, which was carried out almost exclusively here, evidence for primary production was usually identified beyond these workshops on areas down-slope from the mines themselves. It seems that after quarrying and primary production, the prepared cores were brought up to the workshop area, where blanks were removed.

In some parts of the region, a number of neighbouring workshops of this kind are co-located along a single margin, separated from each other by gaps of 10 to 20 metres. Such workshops probably served as working spaces for individuals or very small groups for a short time.

Methods of Cortex-Scraper Blank Production

On the basis of the different primary production elements discovered at the mining sites and workshops, it was possible to reconstruct an almost complete *chaîne opératoire* including mining, core preparation (primary production) and the production of cortex-tool blanks.

The first stage was the quarrying of flint nodules out of the flint layer. The tools which were used for this task remain to be identified. The nodules were subsequently broken up into smaller chunks (FIG. 12a), on which platforms for flake removal were formed by detaching large, spall-shaped platform preparation flakes (FIG. 12b). Sometimes further platform preparation was carried out by chipping



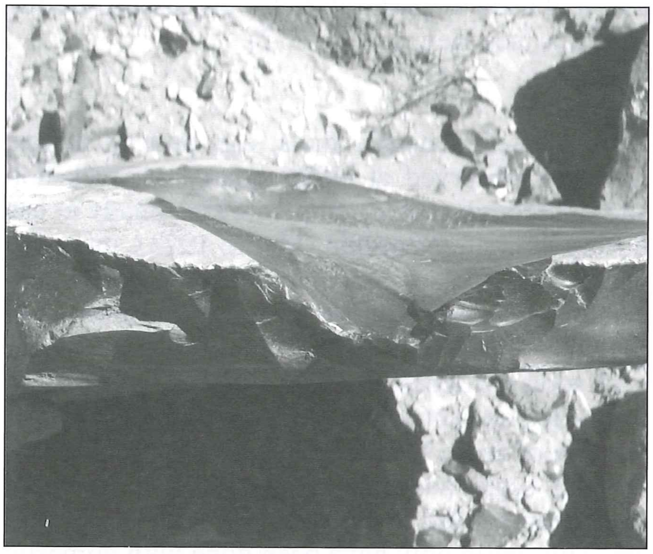
12b. Core-preparation: platform-spall from RUW5.22 (Müller-Neuhof, DAI Orientabteilung).

off smaller flakes.

Hammer-stones must have been used for these tasks, however only one (broken) hammer-stone – made on a flint wadi-pebble – was found during the survey. The scarcity of hammer-stones may be explained by their value as personal tools, which were carefully kept and removed from the site by their owners.

The main task of the knappers was production of fan-shaped cortical flakes which were as large and as thin as possible (FIGS. 13a and b).

Cortex-scraper wastage can been seen on these sites in the form of broken cortex-scraper blanks and also rejected blanks, which were deemed unusable on account of being too thick or small for cortex-scraper production. However, although the successful manufacture of suitable blanks is attested by negative scars on cores, it seems clear that such blanks were usually exported from the locality.



13a. Close-up of core-platform from RUW5.22 (Müller-Neuhof, DAI Orientabteilung).

13b. Core with flake-negative from RUW3.13 (Müller-Neuhof, DAI Orientabteilung).

Scale of Output and Methods of Production

One of the major aims of this survey was to reconstruct the possible scale of production at these mines. Therefore, several squares were randomly chosen within three large mining and workshop sites, and the negative scars of cortex-scraper blanks on the remaining cores were counted. The number of negatives in these squares, which were characterised by similar densities of cores, was between 5 and 11 per m^2.

On the first site, which covers an area of 720 m^2, *ca.* 5,500 cortex-scraper blanks were produced. The second site covers 2,400m^2, so here *ca.* 20,300 cortex-scraper blanks were detached from cores. On the third site, which extends over 2,500m^2, the likely output was at least 24,000 blanks. These numbers only refer to cores discovered on the surface; additional cores lie buried beneath the modern ground-surface, but these are not included here. However, negative scars showing failed detachment of cortex-blanks are included within these numbers.

As well as the mining and workshop sites, one of the small, *ca.* 100m^2 workshops, at which only blank removal took place, was investigated in the same manner. Here the accumulation of cores was less dense than at the sites described above: on the surface of the entire area, 94 cores were identified, displaying 168 negatives of the desired large, thin cortex-scraper blanks. This gives a result of 1.68 negatives per m^2.

Within the entire survey-area, which extended over 25,000 ha (or 250km^2)[2] *ca.* 122ha (1.22km^2) consist of the raised ground on which mining and workshop sites are located. Of these areas of raised ground, a total of 11.2 ha (or 112,000m^2) have evidence for intensive cortex-scraper blank production, representing all production stages.

Taking a mean of 2 cortex-scraper blanks per m^2, which is at the lower end of the scale, the output of the surveyed part of the area was at least 224,000 cortex-scraper blanks. However, it will be recalled that on some of the quarry and workshop sites, cores are buried below the current ground-surface; an even higher output of cortex-scraper

[2] This area also includes valleys and *widyān* in which no outcropping flint layers could be observed.

blanks can therefore safely be assumed.

In sum, and even taking these uncertainties into consideration, it can be stated with confidence that the greater Wādī ar-Ruwayshid region (along with the previously identified Jafr region) was the scene of some of the most intensive cortex-scraper blank production in south-west Asia.

This leads to the question of how and under what circumstances the production of such tool blanks might have taken place? This issue has already been discussed in conjunction with the Jafr mines by Quintero *et al.*, who refer to an "industrial" level of production with a high output of blanks, using the then recently domesticated donkey for transport (Quintero, Wilke and Rollefson 2002: 45f). Fujii, who discovered comparable sites at Qā' Abū Ṭulayḥa close to the Jafr plain, is however of another opinion and argues against production on an 'industrial' scale. He maintains that production was carried out far more slowly, suggesting a smaller output per visit, which could easily be transported by the producers themselves (Fujii 2002: 219). The latter scenario would make sense only if production was carried out by pastoralists for self-supply, in order to meet their own needs for such tool-blanks. This type of self-supply production of cortex-blanks has been observed, for instance, in the Negev (see Rosen 1983: 80). Even in the Ruwayshid area, some small sites have been discovered with evidence for very low numbers of produced cortex-blanks. However, the majority of production sites have evidence for intensive cortex-blank production over large areas. In particular, trench and pit-mining, the existence of large, clearly defined areas covered with cortex-blank cores, and evidence for specialisation in resource identification, mining and blank removal are – in my opinion – indicative of 'industrial' production of cortex-tool blanks in both the Jafr and Wādī ar-Ruwayshid regions. Furthermore, it should be noted that demand for such tool-blanks was high and also came from non-pastoral contexts, such as villages in more fertile regions to the west where, for reasons still unknown, such tool-blanks could not be produced. One possibility is that production of these tool-blanks and utilisation of the resulting tools required high-quality raw material which was not obtainable in the immediate vicinities of all areas of consumption.

A further observation is that mining and production activities could not have been carried out year-round, owing to a lack of water resources during the summer; it is more likely that activity was restricted the winter rainy season. This would have meant that the time-frame for producing blanks was relatively restricted. A large output in a short time was therefore essential and this would only have been possible through large-scale ('industrial') levels of production.

We therefore argue that both mining and blank-production activities were carried out by pastoral groups, who visited this region during the early spring in order to exploit seasonal *wadi* grazing for their herds, while simultaneously producing cortex-tool blanks on the raised ground. Such an assumption is supported by the fact that the cortex-tool is, in its original function, usually interpreted as a tool used by pastoralists for processing animal products (see Henry 1995: 372).

Dating

Unfortunately dateable finds, e.g. pottery sherds, were not observed at either quarry or workshop sites. Although cortex-scrapers were already in use during the Late Neolithic (Moore 1973), intensive use of such tools is associated more with the succeeding Late Chalcolithic and Early Bronze Age periods. This is attested by the high demand for such tools evidenced by their relative frequency at excavated sites of this period. Additionally, if production of these blanks was carried out on an 'industrial' scale, adequate means of transport would have been needed to deliver the blanks to consumers. This could only have been done with domestic donkeys. Therefore, the date of these mining activities is likely to have been restricted to the period between the appearance in this region of the domestic donkey as a beast of burden at the beginning of the 4th millennium, and the end of cortex-tool utilisation at the beginning of the 3rd millennium.

Further Rresearch Perspectives Regarding the Greater Wādī ar-Ruwayshid Quarry-Site Region

Future research in the greater Wādī ar-Ruwayshid region will have three foci. First, we need to establish the southern extent of the mining region under discussion here. Second, detailed questions relating to mining technology need to be considered, especially concerning the possibility of pit-mining. Third, we need to understand why it was that only flint layers located at elevations between 780 and 830 m asl were exploited for cortex-scraper blank production, while adjacent and easy accessible flint layers at higher and lower elevations in the immediate vicinity went unused. By means of petrological analyses, we hope to identify the specific geochemical characteristics of the different flint layers, which may have influenced the selection of specific flint types.

Raw Material Characteristics of the Jafr and Wādī ar-Ruwayshid Mines

(Bernd Müller-Neuhof and Norbert Laskowski)

Since we now know of the presence of two large mining regions, Jafr and the greater Wādī ar-Ruwayshid area, it is now reasonable to consider whether or not the raw material of these two regions can be differentiated.

In order to explore this possibility, XRF analysis was carried out on flint samples from different mining sites in the two regions. These analyses were carried out at the Technische Universität Darmstadt by Norbert Laskowski. Preliminary results suggest that the material of these two mining regions can indeed be differentiated. Significant differences in the concentrations of four chemical elements, *viz.* calcium, phosphorus, nickel and zinc[3], can be used to establish whether raw material samples originate from Jafr mines or from ar-Ruwayshid mines. Although we must consider the possibility that further mining regions existed, which might not be clearly distinguishable in geochemical terms from the Jafr or Ruwayshid mines, these first positive results are a major step towards future provenance analyses of cortex-tool samples from diverse archaeological sites in south-west Asia. In time, this might enable us to trace cortex-tool blank distribution routes from their sources to areas of consumption.

Discussion

Following the discovery of large cortex-scraper production sites, we now have some idea of the circumstances under which many of the cortex-scrapers discovered at Late Chalcolithic and Early Bronze Age settlements may have been produced. A large proportion of these tools may have originated at production sites such as those identified in the Jafr and ar-Ruwayshid regions.

However, many questions remain outstanding. Although flint resources are available over almost all of the Levant and adjacent areas, it remains to be established why such remote locations were chosen to produce these blanks?

One possible explanation may be the specific nature of the flint which occurs in these locations. This raw material may have been ideally suited to the desired function of the tools; sources of appropriate flint may – for some reason – be concentrated in these eastern desert locations.

This raises the question of how such remote locations were discovered and exploited. The most likely explanation is that production and distribution of these blanks was in the hands of transhumant groups who visited these areas in spring-time to exploit available grazing as part of their annual cycle of movement. Perhaps it was during these visits that the suitability of the local raw material for production of such tools was first observed. This is feasible, as these tools may originally have been used for processing animal products – an essential part of any pastoral economy.

It seems clear that production of these blanks was not carried out just to fulfil the needs of local pastoral communities for such tools, but also the needs of more distant communities who had no direct access to these resources. This resulted in the expansion of hitherto pastoral economies to include specialised, large-scale production of cortex-scraper blanks and their distribution to distant consumers through a mechanism of long-distance trade networks.

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Further logistical support was kindly given to us

[3] The results of these analyses will be published in the Journal of Archaeological Science in due course.

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