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To cite this article: Maciej Ehlert, Ju Yong Kim, Young Kwan Sohn, Marzena Cendrowska, Joanna Krupa-Kurzynowska, Eric Andrieux, Simon J. Armitage, Grzegorz Michalec, Ewa Dreczko, Hassan Mustafa Alkhidir, Marcin Szmit & Mirosław Masojć (2022) The Middle Stone Age in the Eastern Desert. EDAR 135 — a buried early MIS 5 horizon from Sudan, *Azania: Archaeological Research in Africa*, 57:2, 155-196, DOI: [10.1080/0067270X.2022.2078561](https://doi.org/10.1080/0067270X.2022.2078561)

To link to this article: <https://doi.org/10.1080/0067270X.2022.2078561>



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Published online: 14 Jun 2022.



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The Middle Stone Age in the Eastern Desert. EDAR 135 — a buried early MIS 5 horizon from Sudan

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ABSTRACT



Middle Stone Age (MSA) lithic artefacts coming from dated layers preserved in their original stratigraphic position are still rare in Northeast Africa in general and in Sudan in particular. This paper aims to present the results of technological and functional analyses of an assemblage coming from a stratigraphic context, i.e. the upper level of the EDAR (Eastern Desert – Atbara River) 135 site, discovered in an abandoned gold mining pit in the Sudanese Eastern Desert, approximately 70 km east of the town of Atbara. The assemblage, which is based on locally available quartz and rhyolite, comes from a layer bracketed by OSL dates of 116 ± 13 and 125 ± 11 kya. Such dating places it within Marine Isotope Stage 5e–5d. Analysis of the assemblage revealed several characteristics that seem to set it apart from other MSA Northeast African inventories. Among these, the dominance of simple, non-predetermined core reduction strategies and expedient tool types, coupled with the lack of traces of Nubian Levallois technique, are the most conspicuous. Micro-traces of use on animal and plant matter were preserved on some of the tools. EDAR 135 is part of a newly discovered complex of sites that confirms the presence of Middle and Late Pleistocene hominins along one of the possible routes out of Africa towards Eurasia.

ARTICLE HISTORY

Received 17 August 2020
Accepted 15 November 2021

KEYWORDS

Sudan; Middle Stone Age; lithic technology; use-wear; quartz; OSL

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RÉSUMÉ

La découverte d'outils lithiques 'Middle-Stone Age' (MSA) provenant de niveaux archéologiques datés et dans leur contexte sédimentologique d'origine est encore rare en Afrique du Nord-Est, et plus particulièrement au Soudan. Cet article présente les résultats d'analyses fonctionnelles et technologiques d'un assemblage lithique en stratigraphie, c'est-à-dire provenant du niveau supérieur du site EDAR 135 (Eastern Desert — Atbara River), découvert dans un puits de mine d'or abandonné dans le désert oriental soudanais à environ 70 km à l'est de la ville d'Atbara. L'assemblage, confectionné à partir de sources locales de quartz et de rhyolite, provient d'un niveau encadré par des datations OSL entre 116 ± 13 et 125 ± 11 ka. Ces dates placent cette occupation dans les stades isotopiques de l'oxygène 5e-d (MIS 5e-5d). Les analyses révèlent plusieurs caractéristiques qui semblent différencier cet assemblage d'autres inventaires lithiques du MSA provenant d'Afrique du Nord-Est. Notamment, l'assemblage est dominé par les outils opportunistes et par l'utilisation de stratégies simples, non-prédéterminées, de réduction des nucléus; on observe aussi l'absence de traces de la technique du Levallois nubien. Certains outils présentent des micro-traces d'utilisation relatives au travail de matières animales et végétales. Le site EDAR135 fait partie d'un groupe de sites récemment découverts qui confirment la présence d'homininiens du Pléistocène moyen et tardif le long d'une des voies possibles menant hors d'Afrique vers l'Eurasie.

Introduction: site location and stratigraphy

The EDAR (Eastern Desert – Atbara River project) sites were discovered in the Eastern Desert in northeastern Sudan, within the Wadi-el-Arab, a large valley system spanning from the Red Sea Mountains in the east to the lower Atbara River in the west (Figure 1, Nassr and Masojć 2018; Masojć *et al.* 2021a). Most of the sites are located approximately 70 km east-northeast of the city of Atbara in a relatively flat and featureless stretch of the desert pockmarked with gold-mining shafts (Figure 2a). Site number 135 (EDAR 135) was located in one of the abandoned trenches on the western edge of a particularly large mine (Figure 2b–c). As with many other EDAR sites, lithic artefacts were found in their original stratigraphic context (Figure 2d), literally protruding out of the profile (Masojć *et al.* 2019: 142).

The sedimentary deposits of the EDAR sites were exposed down to 5 m below the present-day surface and consist of alternating sand and gravel layers on a basement of weathered rhyolite (Figure 3a–c). They can be divided into three main units (Masojć *et al.* 2019, 2021a) associated with successive Marine Isotope Stages (MIS) during the latter part of the Quaternary:

- Unit I, composed of gravel with stratified pebbles (I A, MIS >11) and coarse sand with calcrete nodules (I B, MIS 11–8);
- Unit II, again composed of gravel (II A, MIS 7) overlaid with carbonate-cemented sand (II B, MIS 6);
- and Unit III, silts and soil, with rare pebbles and plant root remains, divided into three consecutive sub-units: III A (MIS 5), III B (MIS 2), and III C (MIS 1).

Units I and II are interpreted as the remains of two separate wet (gravel) and arid (cemented sand) episode cycles that took place in the Middle Pleistocene (see Masojć *et al.* 2019: 144–145, Figure 4, 2021b: Figure 5).

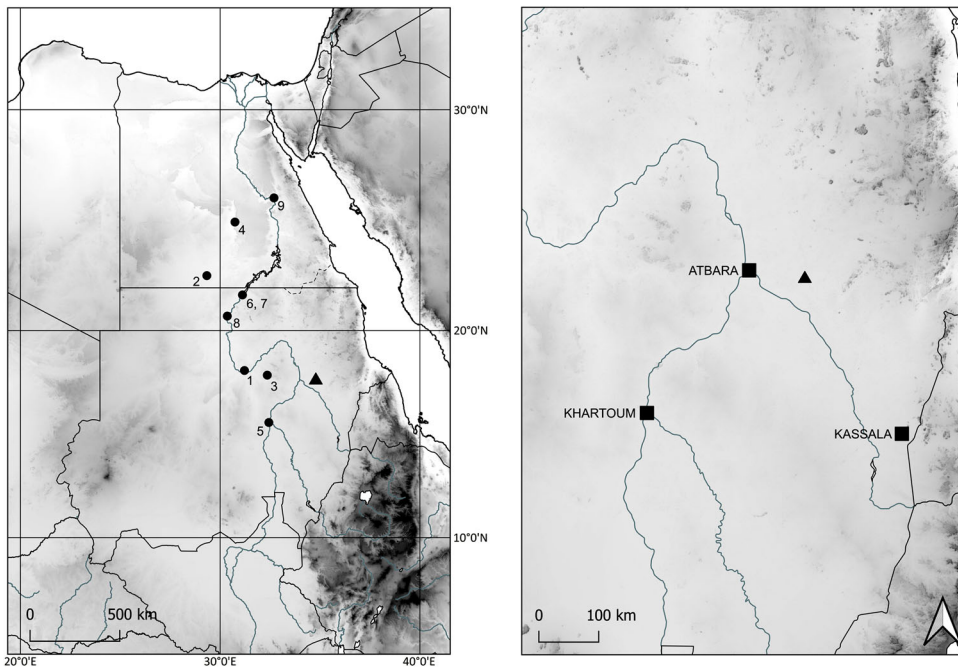


Figure 1. Location of EDAR (triangle) and other MSA sites mentioned in the text (dots). 1 Affad; 2 Bir Sahara; 3 BP 177; 4 Kharga Oasis; 5 Khor Abu Anga; 6 Khor Musa; 7 Maghendoli; 8 Sai Island; 9 Taramsa.

MSA lithic artefacts were found at a depth of $\sim 1.4\text{--}1.6$ m, within a thin erosive layer of sand and pebbles at the interface between the silts of Unit III A and the top of Unit II B. This disconformity — a band of coarse-grained sediment several centimetres deep and lying on sand and silt — is most probably a desert pavement created by deflation of the finest material from the top of Unit IIB. As such, it can be interpreted as the remnant of a short period of severe erosion between the sedimentation of Units II B and III A. Bracketed by two OSL dates of 116.45 ± 13 kya and 125.31 ± 10 kya¹ (Figure 3; Table 1), this layer possibly corresponds to conditions of intense wind activity at the onset of the transition between the cold and dry conditions of late MIS 6 and the warm and humid ones of early MIS 5.

A small late Acheulean lithic assemblage ($N = 737$) was discovered at a depth of 2.4–2.65 m in a layer of gravel formed by a palaeostream and was OSL dated to between 220 ± 12 and 145 ± 20 kya (MIS 7a/6). It consists mostly of quartz flakes and chips and also contains traces of different reduction strategies (*ad hoc* multiplatform as well as discoidal and prepared centripetal cores), as well as three large cutting tools (two handaxes and a chopper). Microwear traces observed on some of the flake tools suggest butchering activities (Michalec *et al.* 2021).

Methods

Fieldwork

Fieldwork at EDAR 135 complied with all relevant regulations and was done after all necessary permits issued by the Director-General of the Sudanese National



Figure 2. EDAR 135 and its vicinity: (a) the site's location (arrow) within a large mining pit complex, seen from W; (b) the site and adjacent mining trenches; (c) two trenches seen from above with the profile in between. Note that the grid of excavated square metres extends from the left-hand side trench; (d) the profile before the upper level excavations, the layer of Unit IIA visible at approximately 2.5 m on the measuring rod; (e) the excavations, with traces from OSL sampling visible on the profile below; (f) the exposed MSA horizon at the top of Unit IIA. Photographs by M. Szmít (a–c) and M. Masojć.

Corporation for Antiquities and Museums had been obtained. It was conducted over three seasons of the project. In 2017, the site was evaluated during a reconnaissance visit. Preliminary geomorphological and geological descriptions were made, a small collection of artefacts was gathered and the first batch of dating samples was taken.

The sedimentary profile of the site was thoroughly cleaned and described during the second season of excavation, which also saw the systematic sampling of units. Among

others, six samples for OSL dating were taken; these provided the main framework for dating the entire sedimentary sequence.

The archaeological excavation of the site was conducted in February 2019. Firstly, the overlying silts of Unit III A were removed with hoes to uncover the thin deflation pavement containing the MSA artefacts. Once this was achieved, a local co-ordinate system was set up using a total station and a grid of square metres was established over the exposed area. The artefact-bearing horizon was then carefully excavated using trowels, brushes and small hammers. All artefacts larger than 15 mm in diameter were given code numbers and mapped in three dimensions. The sediment from each square was sieved, which resulted in the retrieval of numerous small finds (Figure 2e–f). After reaching sterile sediment again, the remainder of Unit IIB was removed by hoe until the upper surface of the Acheulean horizon at the interface with Unit IIA was exposed (Figure 3).

Luminescence dating

Initial luminescence dating results for EDAR 135 were published by Masojć *et al.* (2019). These samples (EDAR-135-1, -2 and -4) were processed in the Korean Institute of Geoscience and Mineral Resources (KIGAM). However, these initial samples yielded ages with relatively large uncertainties, due to the overdispersion of the equivalent dose measurements. To shed new light on the site's chronology a new sample was taken on the north wall part of the stratigraphy and dated at Gliwice Absolute Dating Methods Centre (GADAM), Poland. To ensure that the ages were comparable, data from KIGAM were reanalysed using the same parameters as those used to calculate the GADAM dates. Consequently, the ages for samples EDAR-135-1, -2 and -4 presented in this paper differ from those in Masojć *et al.* (2019).

The new sample (EDAR_135_S3_2017) was prepared following standard procedures in GADAM, using HCl and H₂O₂ to remove carbonates and organic matter. Pure quartz was then extracted from the 90–212 µm fraction using density separations at 2.62 and 2.70 g/cm³, followed by a 40 min HF acid etch (and a subsequent HCl rinse).

Luminescence measurements were made on multi-grain aliquots of quartz using the single-aliquot regenerative-dose procedure (Murray and Wintle 2000). The natural and regenerated signals were measured after a preheating at 260°C for 10 seconds, while test dose signals were made after a 160°C, 10 second preheat. All measurements were carried out on a Risø TL-DA-15 reader, with a Hoya U-340 filter interposed between the sample and photomultiplier tube. The samples were irradiated using a ⁹⁰Sr/⁹⁰Y beta source.

For all samples, curve fitting and equivalent dose (D_e) determination were performed using version 4.57 of the Luminescence Analyst software (Duller 2007). The sample equivalent dose was calculated using the Central Age Model (CAM; Galbraith *et al.* 1999).

Radioisotope concentrations were measured using high resolution gamma spectrometry. Palaeo-moistures of 8 ± 3% were assumed for all samples. Beta and gamma dose rates were calculated from radioisotope concentrations and moisture contents using the conversion factors of Guérin *et al.* (2011). Beta dose rates were corrected for grain size using the attenuation factors of Guérin *et al.* (2012) and an etch attenuation factor after Bell (1979). Cosmic ray dose rates were calculated based on the location of

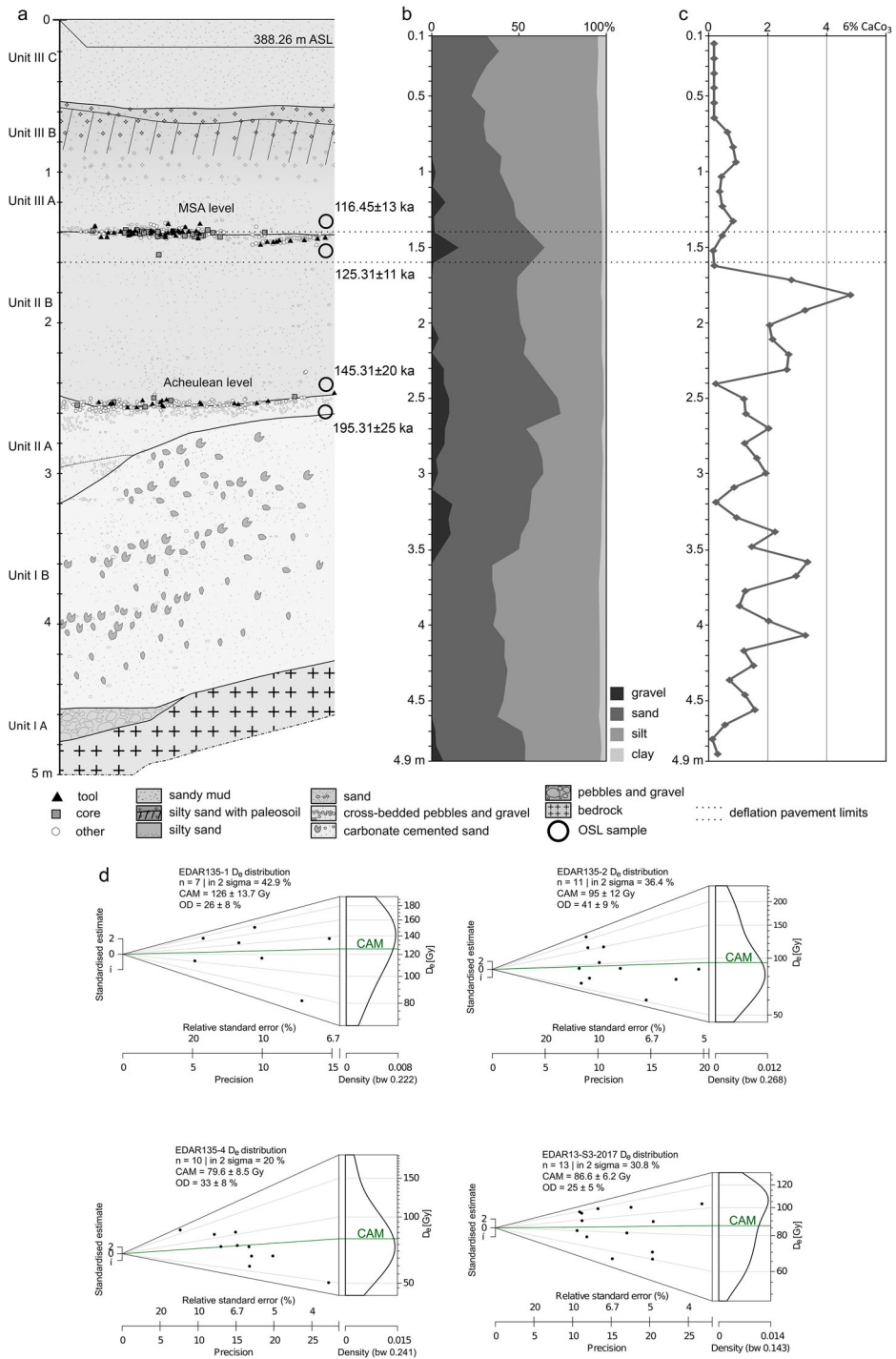


Figure 3. EDAR 135 profile and OSL samples: (a) geological and archaeological levels and units, location of OSL samples; (b) grain size; (c) CaCO₃ content; (d) OSL De, shown as abanico plots with the central lines representing the palaeodose of the sample extracted with CAM indicating the Central Age Model (Galbraith *et al.* 1999) and OD Overdispersion. By J. Krupa-Kurzynowska, M. Ehlert and E. Andrieux.

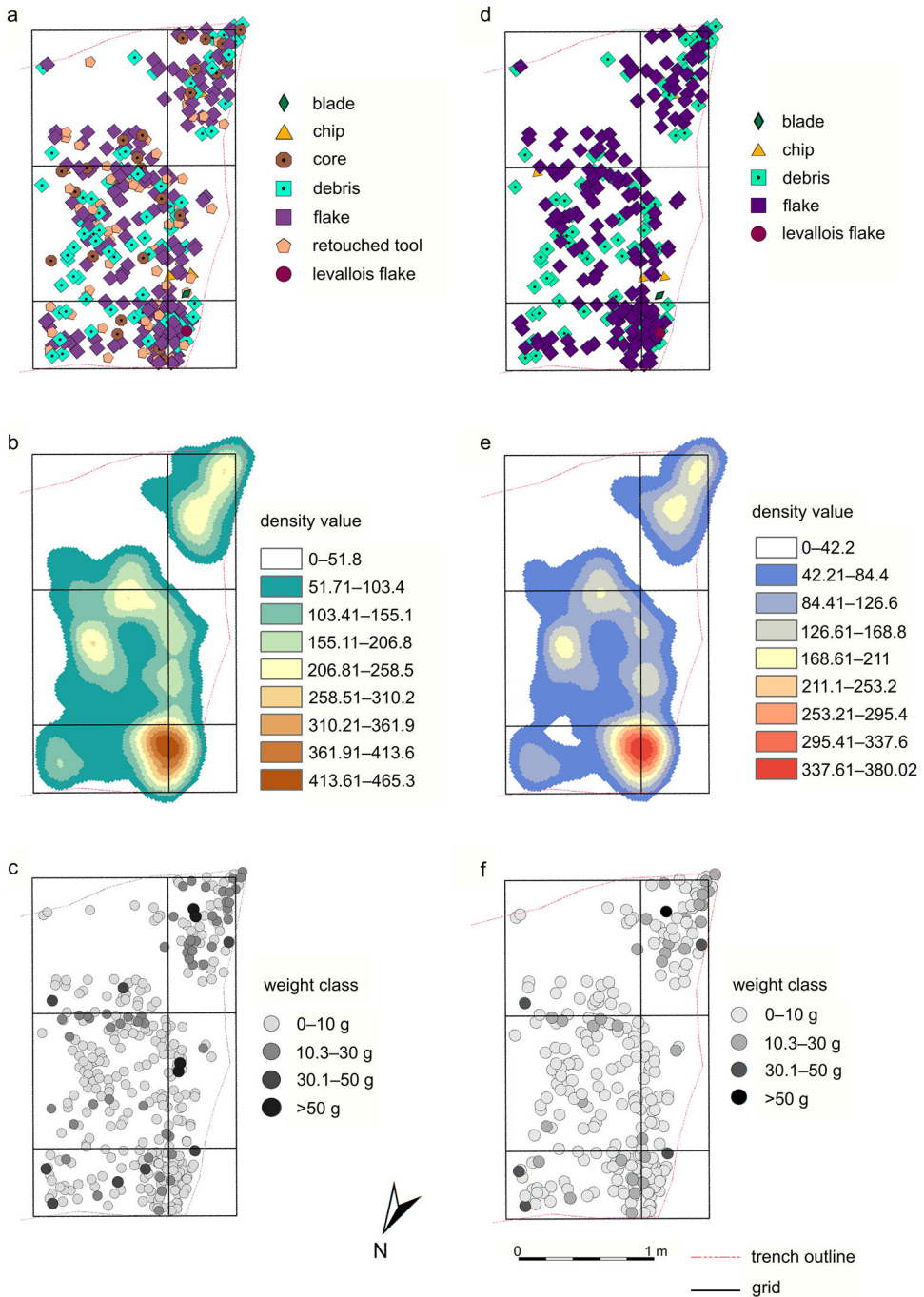


Figure 4. EDAR 135, upper level. Spatial distribution, density, and weight class distribution of artefact classes with (a, b, c) and without cores and tools (d, e, f); by E. Dreczko.

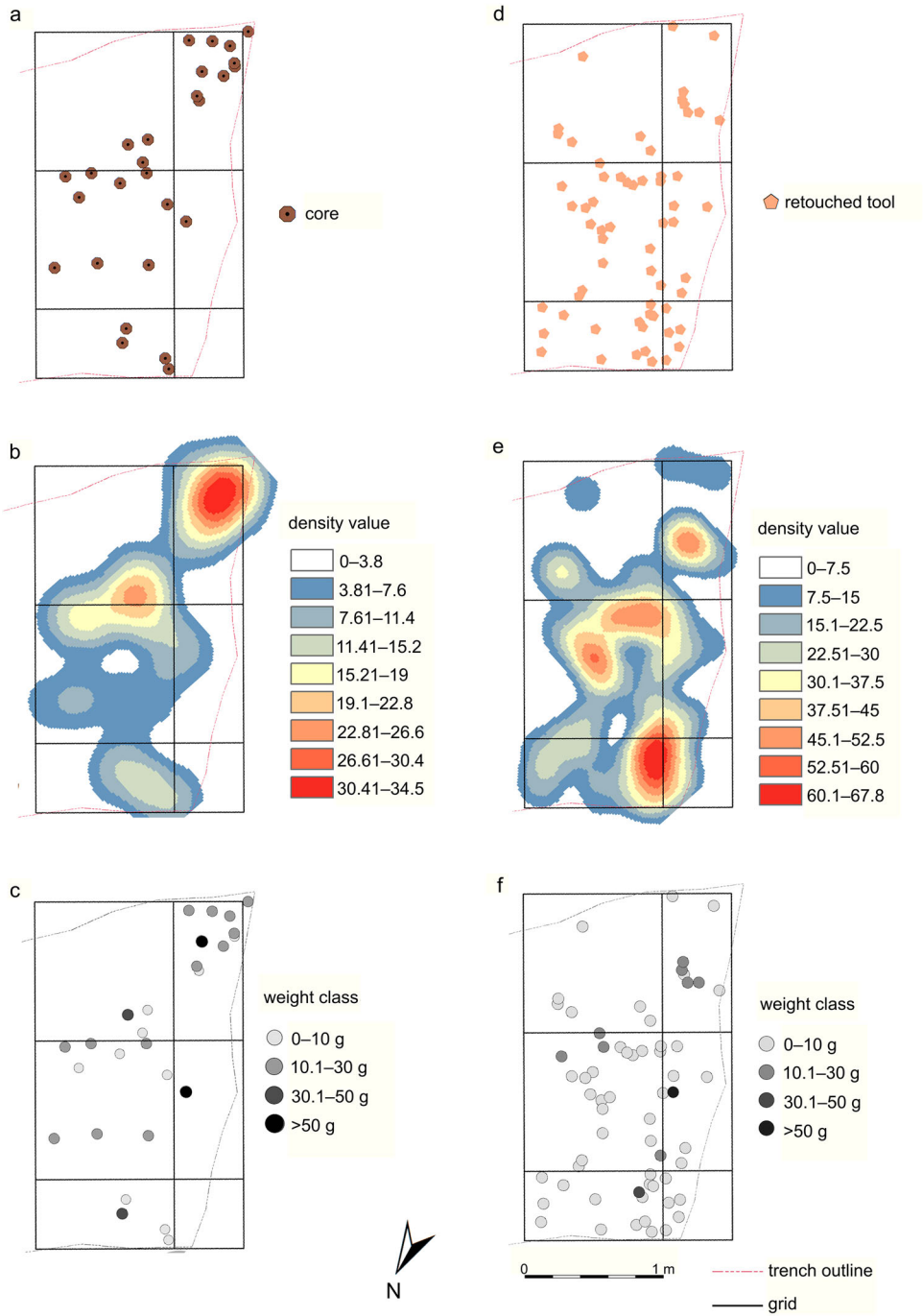


Figure 5. EDAR 135, upper level. Spatial distribution, density, and weight class distribution of cores (a, b, c) and retouched tools (d, e, f); by E. Dreczko.

Table 1. EDAR 135: OSL data summary and ages.

Sample	Radionuclide concentrations ¹			Sample depth (m)	Cosmic dose rate ² (Gy/ka)	Total dose rate ³ (Gy/ka)	Equivalent dose ⁴ (Gy)	Age ⁵ (ka)
	K (%)	U (ppm)	Th (ppm)					
EDAR-135-4	0.378 ± 0.017	0.49 ± 0.089	0.777 ± 0.039	1.6 ± 0.05	0.173 ± 0.017	0.684 ± 0.029	79.62 ± 8.47	116.449 ± 13.354
EDAR-135-S3-2017	0.412 ± 0.032	0.241 ± 0.024	1.182 ± 0.123	1.8 ± 0.05	0.169 ± 0.017	0.691 ± 0.033	86.57 ± 6.23	125.309 ± 10.794
EDAR-135-2	0.37 ± 0.017	0.477 ± 0.107	0.812 ± 0.043	2.6 ± 0.05	0.154 ± 0.015	0.656 ± 0.29	94.01 ± 12.01	144.657 ± 19.421
EDAR-135-1	0.303 ± 0.015	0.62 ± 0.196	1.117 ± 0.483	2.8 ± 0.05	0.151 ± 0.015	0.645 ± 0.044	127.74 ± 13.69	194.86 ± 25.079

Notes: 1. Radioisotope concentrations were measured using high resolution gamma spectrometry and converted to dose rates following Guérin *et al.* (2011).

2. Cosmic dose rates were calculated following Prescott and Hutton (1988) and using overburden densities of 1.8 g/cm³.

3. The total dose rates were corrected for grain sizes of 90-212 µm and an 8 ± 3% moisture content.

4. Equivalent dose rates were calculated using the Central Age Model (CAM; Galbraith *et al.* 1999).

5. The datum of the age calculation is 2019.

the site (latitude, longitude and altitude) and the present-day burial depth of each sample, assuming an overburden density of 1.8 g/cm^3 (Prescott and Hutton 1988). Dose rates and ages for each sample were calculated using the online Dose Rate and Age Calculator (DRAC; Durcan *et al.* 2015) and are presented in Table 1 and Figure 3d.

Lithic analysis

The attributes of the lithic inventory were entered into a MS Access database, along with information concerning the context of discovery, raw material and taphonomy. Chosen artefacts, mostly tools and cores, were photographed and drawn.

The assemblage was divided in two groups. First, all cores, flakes and tools were examined individually. Their weight (all artefacts) and length, width and thickness (intact or slightly damaged specimens) were then measured. Platform width and thickness were recorded for flakes and tools, whenever applicable. All three categories were further classified according to several relevant, published lists (e.g. Schild and Wendorf 1977) to facilitate inter-assemblage comparisons.

The second group was composed of debris (i.e. chunks or angular shatter) and chips (flakes with a diameter below 15 mm). They were grouped by category, square metre and raw material and then weighed *en masse*.

Samples of raw material were collected from the immediate vicinity of the site and used in a series of preliminary knapping experiments. Although designed mainly to assess the suitability of various form of quartz and rhyolite cobbles and blocks for Acheulean stone tool production methods, they provided us with valuable insights into the properties of these two raw materials and their behaviour during hard-hammer percussion technique.

Use wear

Quartz artefacts, although ubiquitous in the archaeological record, do not often become the subjects of use wear-analyses. Nevertheless, numerous papers have been published on the matter (e.g. Derndarsky and Ocklind, 2001; Clemente Conte *et al.* 2015; Pedergnana and Ollé, 2017). Early comprehensive studies by K. Knutsson (1988a, 1988b) and Sussman (1985) set the framework for further research. To this day, Knutsson's comparative tables are a great source of references (Derndarsky and Ocklind 2001: 1150–1152; Ollé *et al.* 2016: 155; Venditti *et al.* 2016: 1–2). Many subsequent experimental projects provided additional data on formation of use-wear (Lemorini *et al.* 2014; H. Knutsson *et al.* 2015; Liu and Chen 2016) and post-depositional traces (K. Knutsson and Lindé 1990; Venditti *et al.* 2016).

Quartz is a highly reflective, heterogeneous material. Both of these qualities pose a challenge during use wear analysis. Traces develop irregularly, more often on crystals than on the matrix (Clemente Conte and Gibaja Bao 2009: 94–95; Leipus 2014: 230–233; Clemente Conte *et al.* 2015: 64–65). Additionally, diagnostic traces such as striations, polish, or fractures may appear on different parts of the tool being analysed. Consequently, all edges and adjacent areas of the tool must be examined thoroughly to properly identify and interpret any potential traces.

Use-wear analysis was conducted in the laboratory of the Institute of Archaeology, University of Wrocław. A sample of 26 artefacts classified as typological tools with at least one intact, functional working edge was chosen and cleaned in an ultrasonic bath for 2–5 minutes. Macro-traces, such as edge rounding, tool surface condition and micro-chipping, were assessed in the first step. A NIKON Eclipse LV 100 with 200–500x magnification was then used for observing and documenting micro-traces (Taipale 2012: 94). Focus was enhanced by image stacking.

Results

Spatial distribution of artefacts

The artefacts were distributed uniformly over the excavated area, although in its mid-southern part a noticeable gap can be observed that divides them into two concentrations (Figure 3a, 4–5). All artefact categories and weight classes were mixed (Figure 4a–c).

The distribution of flakes, chips and debris reflects the overall artefact dispersal (Figure 4d–f). Generally, although the density is highest in the site's northwest corner, the heavier artefacts seem to be more prevalent in the southern concentration (Figure 4b–c, e–f) which is not only smaller, but also deposited a little deeper (Figure 3a).

The location, density and weight class dispersion of cores seems to be, at least partially, a result of their greater weight (Figure 5a–c). Like heavier débitage, their density is highest within the southern cluster. The opposite is true of retouched tools (Figure 5d–f), the dispersal of which reflects the general image, with a slightly lower density in the northwestern corner of the excavation.

Although the excavated area was too small to allow the observation of larger spatial patterns, it seems that the registered distribution of artefacts results from natural processes of erosion and deflation rather than direct human action. The roughly uniform placement of artefact categories, perhaps with some sorting by weight (heavier specimens in the southern cluster), as well as the conspicuous gap (eroded out and filled with sterile sediment), seems to support this interpretation. This conforms to both models of how the layer with MSA artefacts formed that are presented in the following section.

Luminescence dating

The equivalent dose values for individual samples are rather scattered (Figure 3d), but the distribution is not suggestive of incomplete bleaching of some mineral grains prior to deposition. Consequently, the Central Age Model (CAM) was used to calculate the equivalent dose for each sample. The CAM equivalent doses for samples EDAR-135-1, -2 and -4 are lower than those presented for the same samples in Masojć *et al.* (2019), resulting in younger calculated ages.

The MSA archaeology was found in gravel bracketed between layers dated to 116 ± 13 and 125 ± 11 kya. This layer was most likely the result of deflation of fine-grained sediment from the upper parts of Unit II B. It is exceedingly difficult to say whether the lithic artefacts were already there during this episode of erosion, which probably occurred during the dry and windy conditions at the very end of MIS 6. Alternatively, they

could have been washed out from sandy soils sometime between 125 and 116 kya, during a wet episode at the onset of MIS 5 that probably resulted in an increased sediment load in the Atbara, leading to the deposition of gravels. This period, globally recognised as the Last Interglacial, saw a wetting of the North African climate and the opening of the so-called green corridors across what is now the Sahara Desert (Drake *et al.* 2011) that may have promoted human dispersal through Northeast Africa (Pausata *et al.* 2020). Both kinds of processes seem to have left taphonomic traces on the artefacts found.

The lithic assemblage

Raw materials

The three raw material types used were, in descending order of importance, quartz, rhyolite and quartzitic sandstone. All three are available in the immediate vicinity of the site as pebbles (less than 6 cm), cobbles (between 6 and 25 cm) and blocks. Over 95% of the artefacts were made from quartz. In terms of weight, the picture is rather skewed by one particularly heavy quartzitic sandstone artefact. Nevertheless, when we compare the total weights of quartz and rhyolite, the ratio resembles the raw material count: 89 to 11 (Table 2).

The coexistence of these two raw materials, in different proportions, was noted on all the excavated EDAR sites, both Acheulian and MSA (Masojć *et al.* 2019, 2021a, 2021b; Michalec *et al.* 2021). Quartz, especially in the form of pebbles, seems to have been the most and popular raw material in the area (Figures 7, 8). Its quality is inferior to that of fine-grained rhyolite, but this might have been compensated for by its abundance. High availability and the convenient initial shape could have affected the technological choices and *chaînes opératoires* of knapping, which is perhaps reflected in some aspects of the analysed assemblage.

It is important to note that besides one tool, several flakes and pieces of debris, all of the identifiable rhyolite artefacts were made of the fine-grained variety of this material,

Table 2. EDAR 135: number and weight of artefact classes by raw material (Q quartzite; QS quartzitic sandstone; R rhyolite).

Raw material		Flakes	Blades	Tools		Cores	Chips	Debris	Total
				retouched	unretouched				
Q	N	204	1	67	1	37	747	100	1157
	%	16.85	0.08	5.53	0.08	3.06	61.68	8.26	95.54
	weight (g)	1251.7	8	496.2	7.5	993.3	650.9	570.4	3978
	%	22.45	0.14	8.9	0.13	17.82	11.67	10.23	71.35
QS	N	0	0	1	0	1	0	1	3
	%	0	0	0.08	0	0.08	0	0.08	0.25
	weight (g)	0	0	50.3	0	1046	0	4.5	1100.8
	%	0	0	0.9	0	18.76	0	0.08	19.74
R	N	24	1	2	0	1	16	7	51
	%	1.98	0.08	0.17	0	0.08	1.32	0.58	4.21
	weight (g)	239.2	28.1	76.4	0	19	19.4	114.3	496.4
	%	4.29	0.5	1.37	0	0.34	0.35	2.05	8.9
Total	N	228	2	70	1	39	763	108	1211
	%	18.83	0.17	5.78	0.08	3.22	63.01	8.92	100
	weight (g)	1490.9	36.1	622.9	7.5	2058.3	670.3	689.2	5575.2
	%	26.74	0.65	11.17	0.13	36.92	12.02	12.36	100

one that has outstanding knapping properties, not unlike those of good quality chert or flint.

Assemblage structure

Flakes, blades, debris and chips comprised slightly over 90% of the total assemblage. Chips were by far the most ubiquitous and almost two-thirds of the artefacts recovered from the upper level of EDAR 135 were classified as such. Tools and cores formed the remainder of the assemblage, with the former being more common than the latter (Table 2).

The weight of artefact categories offers a slightly different perspective from which to look at the assemblage. Cores now become the most significant due to the outstandingly high weight of the quartzitic sandstone specimen. Flakes are the next important category, comprising slightly more than one quarter of the whole, but when lumped together with chips and debris the total rises to 51.8%. The percentage of tools by weight is almost twice as high as by number (Table 2).

There are some differences between the two main raw materials. Comparing the artefact count of the categories, one notices significant discrepancies in flake to chip ratio. In the case of rhyolite, there were more of the former (47.1 to 31.7% of all rhyolite artefacts). In the case of quartz, on the other hand, this ratio was opposite and much more pronounced: 17.6 to 64.6% of all quartz artefacts. The predominance of small quartz débitage can be partially explained by the tendency of this raw material to shatter while being knapped (Pargeter and Peña 2017). Such a degree of discrepancy between quartz and rhyolite is not seen in category weight, although the importance of quartz chips can still be seen: 16.4% of all quartz artefacts, compared to just 3.9% in case of rhyolite. Finally, quartz has more cores and tools by number and, in the case of cores, also by weight.

Another difference between quartz and rhyolite can be seen in the ratio between flakes and tools. In the case of quartz, there was one tool for approximately every three flakes, while in that of rhyolite as many as 12.5. Such a degree of difference, unless it is accidental, may stem from raw material quality since flakes of fine-grained rhyolite have edges that are much more even and stable than those of quartz and can thus be more efficiently used without modification, leaving fewer artefacts with retouch and other obvious macroscopic use traces.

Artefact condition, size and weight

Surface condition and completeness were recorded for all cores, tools and flakes (N = 340, 29.4% of the assemblage). The summary of artefact size and weight is based on a sample of 231 complete specimens.

More than two thirds of the evaluated artefacts showed traces of either strong or moderate aeolian abrasion. Specimens recovered from the site profile were more affected with only 20% of them not being abraded (Figure 6a). Approximately 70% of the artefacts were found complete, with slightly more fragmentation among those found in the sieve (Figure 6b).

The artefacts were rather small in mean size, with only cores slightly exceeding 35 mm in mean length. Unsurprisingly, they are the largest (width and thickness) and heaviest category. Again, this is partially due to the presence of one comparatively large quartzitic

sandstone core. Without this specimen, mean and median core dimensions would be ~2 mm lower.

Rhyolite flakes tended to be somewhat heavier, longer, wider and slightly thicker than their quartz counterparts and tools; in fact, they have the highest mean and median length of all categories, including cores. Tools, 95.8% of which were made of quartz, are only very slightly larger, thicker, and heavier than quartz flakes (Table 3).

Only three artefacts — a rhyolite flake, a quartz tool and a quartz core — could be described as being at least twice as long as they are wide. Most of the others fall somewhere between that and a length to width proportion of 1:1. They cluster quite densely around 20–30 mm in length and 15–35 mm in width, with relatively few outliers (Figure 6c).

Cores

Besides the specimens classified as Levallois, cores from the upper level of EDAR 135 show no traces of preparation to any considerable degree (Table 4). Many were found fragmented and are therefore impossible to classify unambiguously.

Multiplatform cores (Figures 7e, 7h, 9b, 11a–d) were the most numerous identifiable group, but unidirectional cores (Figures 7c, 7g, 11e, 12a) were quite ubiquitous as well. These were followed in frequency by discoidal (Figures 7b, 7f, 9a, 12b–d) and Levallois forms, both preferential (Figures 8a, 12e, 13a) and recurrent (Figures 8b, 12f, 13c). Apart from them, there were only two bipolar (Figures 10c, 14d) one bidirectional (Figures 7d, 14e) and one 90-degree cores.

More than half of the cores were abandoned when their reduction was already in an advanced stage (Figures 8b, 9a, 9c, 10c, 11c–e, 12a, 12d–f, 13c); another quarter were reduced to a residual state (Figures 9b, 11a–b, 12b–c, 14d–e).

Evaluation of raw material form was impossible for almost 40% of the cores, either because of fragmentation or because they represent a very advanced reduction stage (Table 4). With such specimens excluded, it becomes apparent that almost 80% of the remaining cores were based on pebbles. This is true for cores of all types, not only those that seem to be best suited to roundish, flattened raw materials, i.e. discoidal and Levallois. Other initial forms were represented by one or two examples.

Finally, the number of flakes or tools in proportion to cores were calculated. For the former, the ratio was 5.9 flake per core, but for tools only 1.82. Thus overall, each core corresponded to 7.72 flakes. This is not especially high for the MSA (e.g. Groucutt *et al.* 2017: Table 12) and might result from the expedient, non-prepared nature of most of the cores.

Flakes

Although two flakes had lengths exceeding their width by at least twofold (Figures 6c, 10a) and were classified as blades, they were not treated a separate group. We decided against this in the face of the overwhelming dominance of blanks under the $L = 2W$ line (Figure 6c) and the lack of evidence for a discrete blade technology. It seems that producing elongated flakes was not a priority for the knappers responsible for the assemblage we analysed. Eleven flakes, including a *débordant*, were classified as core-trimming elements.

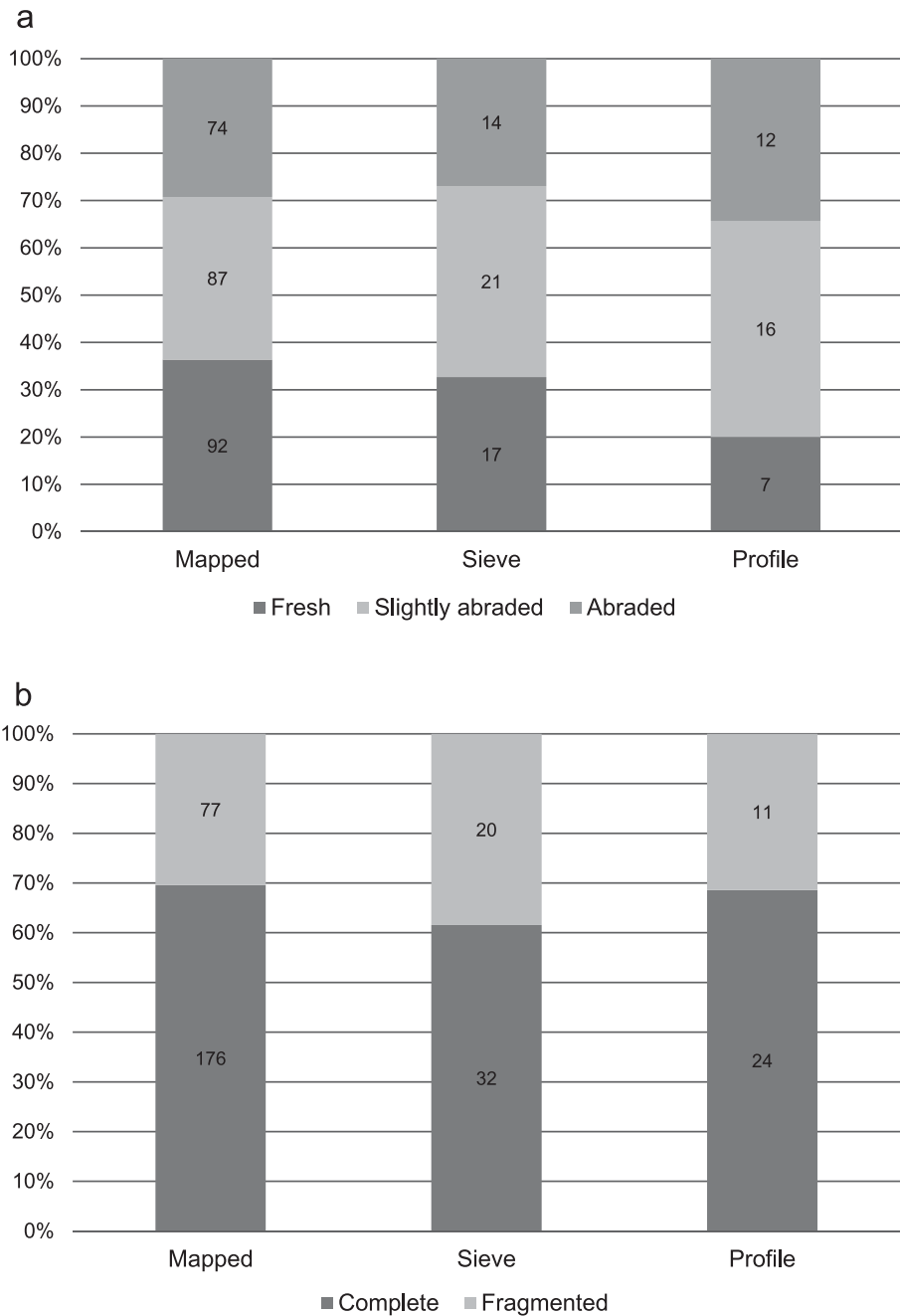


Figure 6. EDAR 135, upper level. Artefact properties: (a) surface condition; (b) completeness; (c) length/width scatter plot: 1 quartz flakes; 2 rhyolite flakes; 3 quartz tools; 4 rhyolite tools; 5 quartzitic sandstone tool; 6 quartz cores; 7 rhyolite cores; 8 quartzitic sandstone core. For surface condition and completeness N = 340. For the length/width scatter plot N = 231.

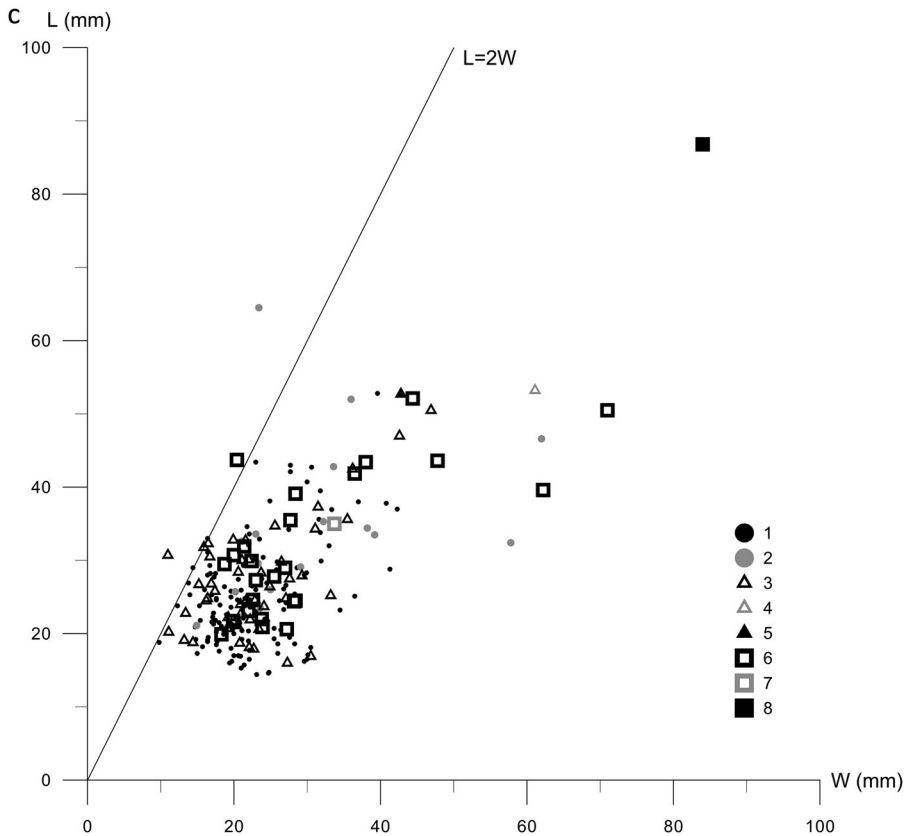


Figure 6. Continued.

Most flakes had less than 50% of cortex on their dorsal sides (Table 5). Flakes fully covered with previous removal scars comprise approximately half of the subset, while ones with more than 50% of natural surface only 21%.

There were slightly more flakes with multidirectional scars than those with unidirectional ones. This is especially true of quartz, as in the case of rhyolite the ratio was close to 1:1 (Table 5). Almost one third of the multidirectional flakes had parallel scars. Some bidirectional flakes, mainly made of quartz, were found as well. Again, these characteristics match the frequencies of the main core types.

The two most popular platform types were plain and cortical; 75% of flakes with preserved platforms had one or other of these, especially the former. Linear and punctiform platforms were also quite common, albeit only among quartz flakes. Again, this might be the result of a tendency for that raw material to shatter when struck. More elaborate platform types (dihedral, faceted) evidencing some degree of preparation prior to removal were rather uncommon.

Tools

A definite preference for non-cortical blanks can be seen. When specimens with undetermined amount of cortex are excluded for clarity, those fully covered with scars

Table 3. EDAR 135: sizes and weight of chosen artefact classes. For length, width, and thickness N = 238, for platform width and thickness N = 165 and for weight N = 338.

Attribute		Flakes Q	Flakes R	Tools	Cores	All
Length	Minimum	14.4	21.1	16	19.9	14.4
	Maximum	52.8	64.5	53.2	86.8	86.8
	Mean	24.86	35.17	27.13	35.05	30.55
	Median	23.6	33.05	25.5	30.07	27.79
Width	Minimum	9.8	14.9	11	18.3	9.8
	Maximum	42.3	62	61.1	84	84
	Mean	22.7	31.41	23.15	32.96	27.56
	Median	21.35	27.05	21.65	27.2	24.35
Thickness	Minimum	4.6	4.3	4.5	6.4	4.3
	Maximum	28.8	15.8	22.1	100.6	100.6
	Mean	10.47	9.46	10.9	22.81	13.41
	Median	8.5	9.25	9.15	17	9.2
Platform width	Minimum	4.5	7.6	6.4	n/a	4.5
	Maximum	38	55.4	33		55.4
	Mean	15.75	22.06	15.04		17.62
	Median	15.1	22	15.35		15.35
Platform thickness	Minimum	3	4.3	2.3	n/a	2.3
	Maximum	20.7	15.7	9.8		20.7
	Mean	8.36	9.03	7.47		8.29
	Median	8	8.8	6.7		8
Weight (g)	Minimum	1.5	1.1	1	4.4	1.3
	Maximum	1.5	1.1	1	4.4	1.3
	Mean	59.2	56.7	73	1046	66.1
	Median	6.98	11.14	7.84	53.86	9.49

make up 65% and flakes with less than 50% cortex 90% of the subset. Multidirectional flakes were usually chosen over unidirectional ones. Plain platforms were the most common type; flakes with a cortical platform were chosen less often. Besides that, the presence of faceted platforms is more marked, but these still are isolated cases; two of them are Levallois blanks (Figure 15a–b; Table 6).

Eight types of tools were distinguished. Expedient, multidirectional or unidirectional retouched flakes were the most frequent (Figures 10b, 14a–b, 15f–i). Endscrapers (Figure 16) were the second most numerous tool type. Notches were next (Figure 17c–h), followed closely by perforators, of both flake (Figure 15c–d) and core (Figure 15e) kinds, as well as sidescrapers (Figures 7a, 10d, 13b, 18a–e). Some of these were made on comparatively large flakes. That cannot be said, however, about denticulates (Figure 17a–b). Three forms were described as combined tools and can be described as forms somewhere on a continuum between retouched flakes, denticulates and notches, with additional burin blows (Figure 18f–g). The tool list is closed by two Levallois forms: a point (Figure 15a) and a retouched flake (Figure 15b).

Use wear

Macro-traces suggesting possible use, including various degrees of edge rounding and patterns of chipping, were detected on 15 artefacts. Their detailed description, along with that of micro-traces is presented in Table 7.

Based on polish location, type of chipping and linear features (Liu and Chen 2016: 508–509; Ollé *et al.* 2016: 157–158), direction of tool movement was identified on five artefacts, namely three endscrapers (Figures 16c, 16e, 19a), a sidescraper (Figures 18c,

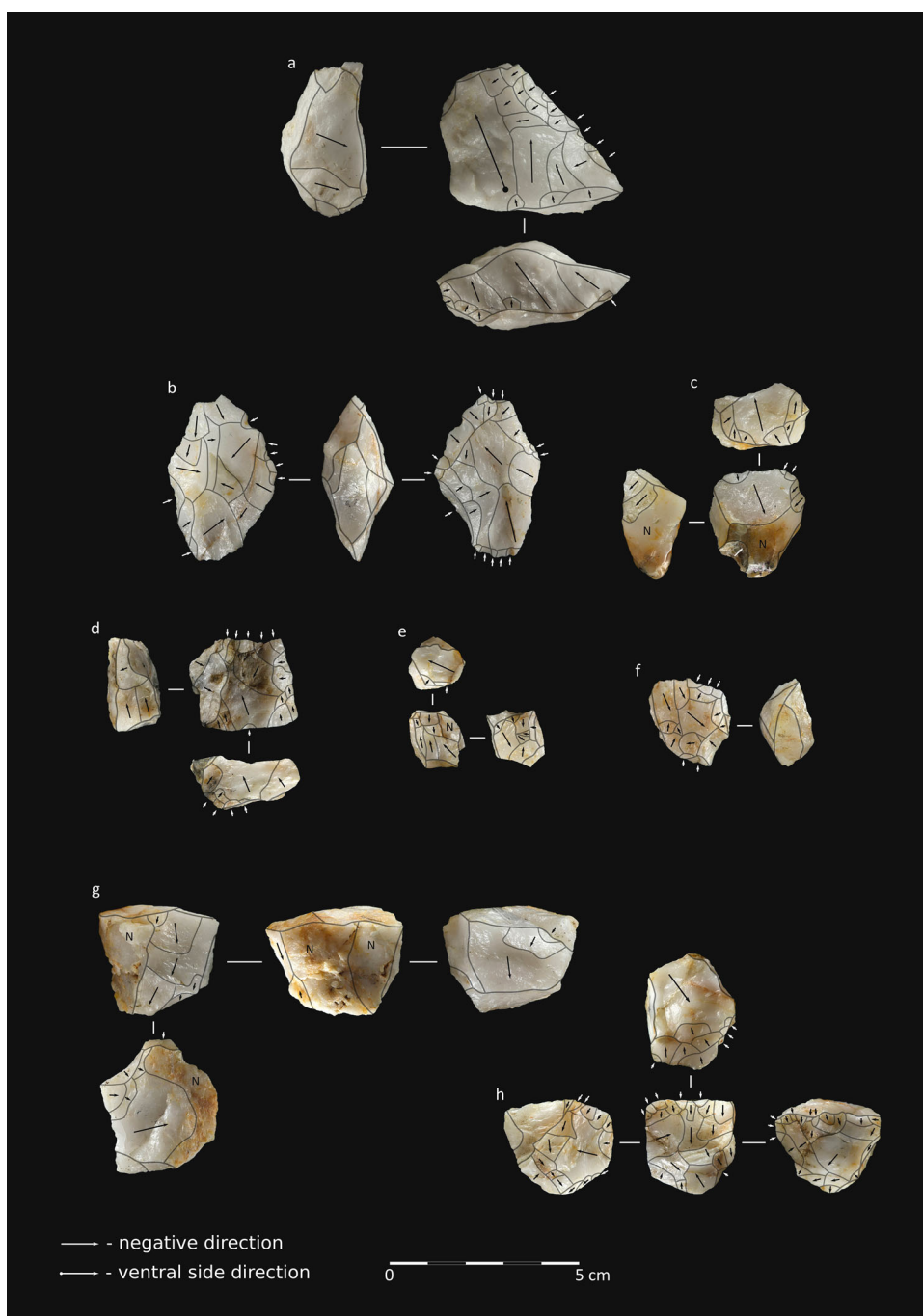


Figure 7. EDAR 135, upper level artefacts: (a) sidescraper (Figure 13: b); (b) discoidal core (Figure 12: d); (c) unidirectional core (Figure 12: a); (d) bidirectional core (Figure 14: e); (e) multiplatform core (Figure 11: c); (f) discoidal core (Figure 12: c); (g) unidirectional core (Figure 11: e); (h) multiplatform core (Figure 11: d). Photographs by M. Jórdeczka.

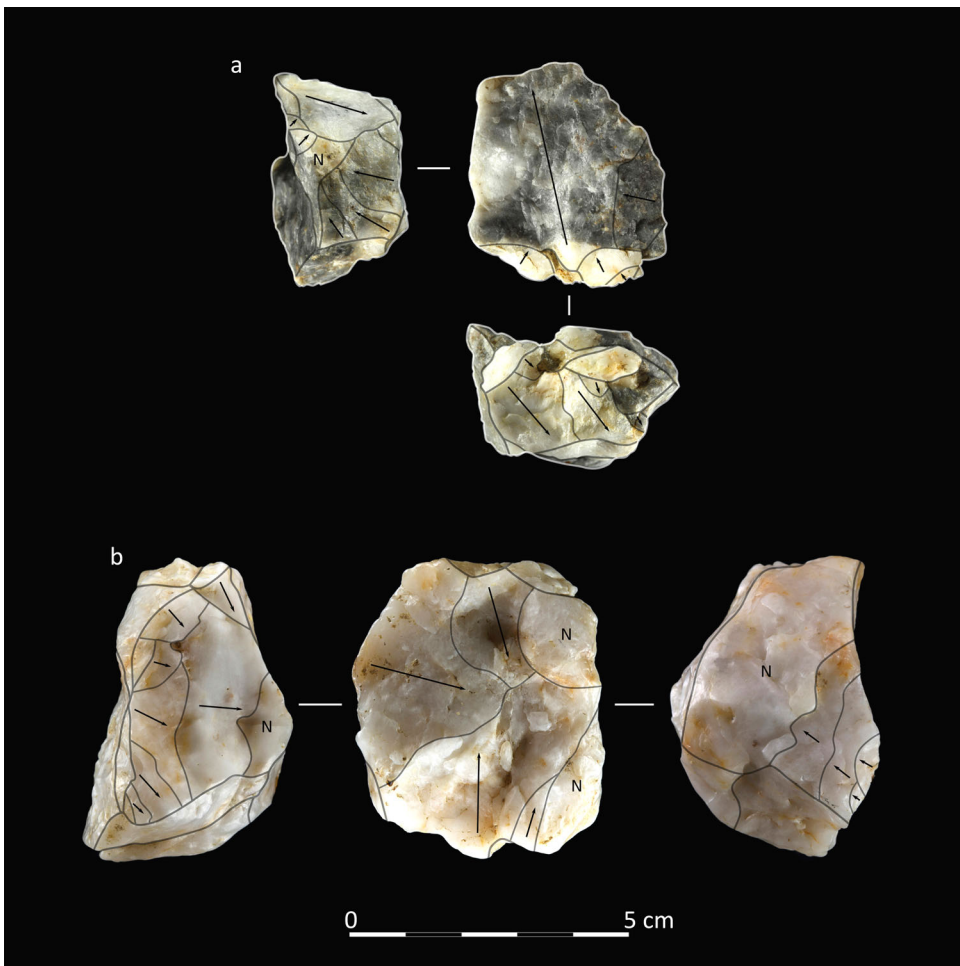


Figure 8. EDAR 135, upper level Levallois cores: a (Figure 13: a) and b (Figure 13: c). Photographs by M. Jórdeczka.

19b) and the retouched Levallois flake (Figure 15b). In all cases small, overlapping chips and perpendicular striations of varied depth and regularity were visible on the edges used for scraping. Two of the tools were possibly used in more than one manner, for both cutting and scraping (Figure 19). All the analysed artefacts revealed a preference for only one working edge. No traces of hafting were detected.

Identification of worked material was possible for only a few artefacts. In the case of two tools — the retouched Levallois flake (Figure 15b) and a sidescraper (Figures 18c, 19b) — rough and matt polish together with striations of varying depth and width were identified and interpreted as resulting from hide scraping. Another three artefacts — two perforators (Figure 15c) and an endscraper (Figure 16c) — had linear traces perpendicular to the edge, but no distinct polish. This suggests brief contact with meat and hide, possibly during butchering (Lazuén *et al.* 2011; Stemp *et al.* 2013). One endscraper revealed a very bright, smooth polish with domed topography. The traces were located

Table 4. EDAR 135: core types, reduction stage and initial raw material form.

		N	%
Type	Bidirectional	1	2.56
	Bipolar	2	5.13
	Levallois ¹	4	10.26
	Discoidal	5	12.82
	90-degree	1	2.56
	Multiplatform	10	25.64
	Unidirectional	6	15.38
	Unidentified/fragment ²	10	25.64
Reduction stage	Advanced	21	53.85
	Residual	10	25.64
	Unknown	8	20.51
Raw material form	Cobble	1	2.56
	Concretion	2	5.13
	Nodule	2	5.13
	Pebble	19	48.72
	Unknown	15	38.46
Total		39	100

Notes: 1. of which three were made in quartz and one in rhyolite

2. of which nine were made in quartz and one in rhyolite

mostly on and near the well-rounded edge and are interpreted as a result of bone working (Figure 19a/2).

Eleven artefacts revealed post-depositional alterations that made interpretation of their function either exceedingly difficult or completely impossible. They showed several characteristics distinguishing them from other types of wear. Tool edges and ridges were irregularly chipped and sometimes heavily rounded. Surfaces were marked by numerous impact pits forming differently sized concentrations. Linear features of varying width and depth were distributed randomly, sometimes criss-crossing. The degree of abrasion spanned mostly from light and local to medium and covering most of the surface. Examples of very heavy, covering abrasion making the entire surface appear matt to the naked eye were exceedingly rare.

The traces detected on EDAR 135 upper-level tools, although rare due to post-depositional damage, suggest activities oriented mostly towards processing of hide and bone. It is possible that some of the tools were also applied to softer materials, for example meat (butchering?) or for shorter periods of time, resulting in the creation of weaker and more generic traces (Rots *et al.* 2011; Igreja and Porraz 2013; Porraz *et al.* 2015).

Although quite small, the analysed sample reflects general use-wear trends observed in other MSA assemblages from Africa where evidence of work on faunal resources has been recorded. Artefacts from Diepkloof Rock Shelter in the Western Cape Province of South Africa, which are dated by TL to 106 ± 10 kya and by OSL to 109 ± 10 kya (although note that the chronology for this site is contentious (e.g. Tribolo *et al.* 2013; Jacobs and Roberts 2017) show traces of the processing of wood and animal materials by cutting and scraping (Igreja and Porraz 2013). Traces of butchering have also been found at Site 8-B-11 on Sai Island, Sudan, where they were accompanied by several artefacts bearing impact wear, implying a possible function as hunting weapons. Most of the Sai tools were used hand-held, whereas the projectiles were hafted (Rots *et al.* 2011). Finally, we note that wood and hide working, together with butchery, are activities detected at White Paintings Rock Shelter site, Botswana. This younger (94.3 ± 9.4 kya) site also provided numerous examples of points used as spear tips (Donahue *et al.* 2004).

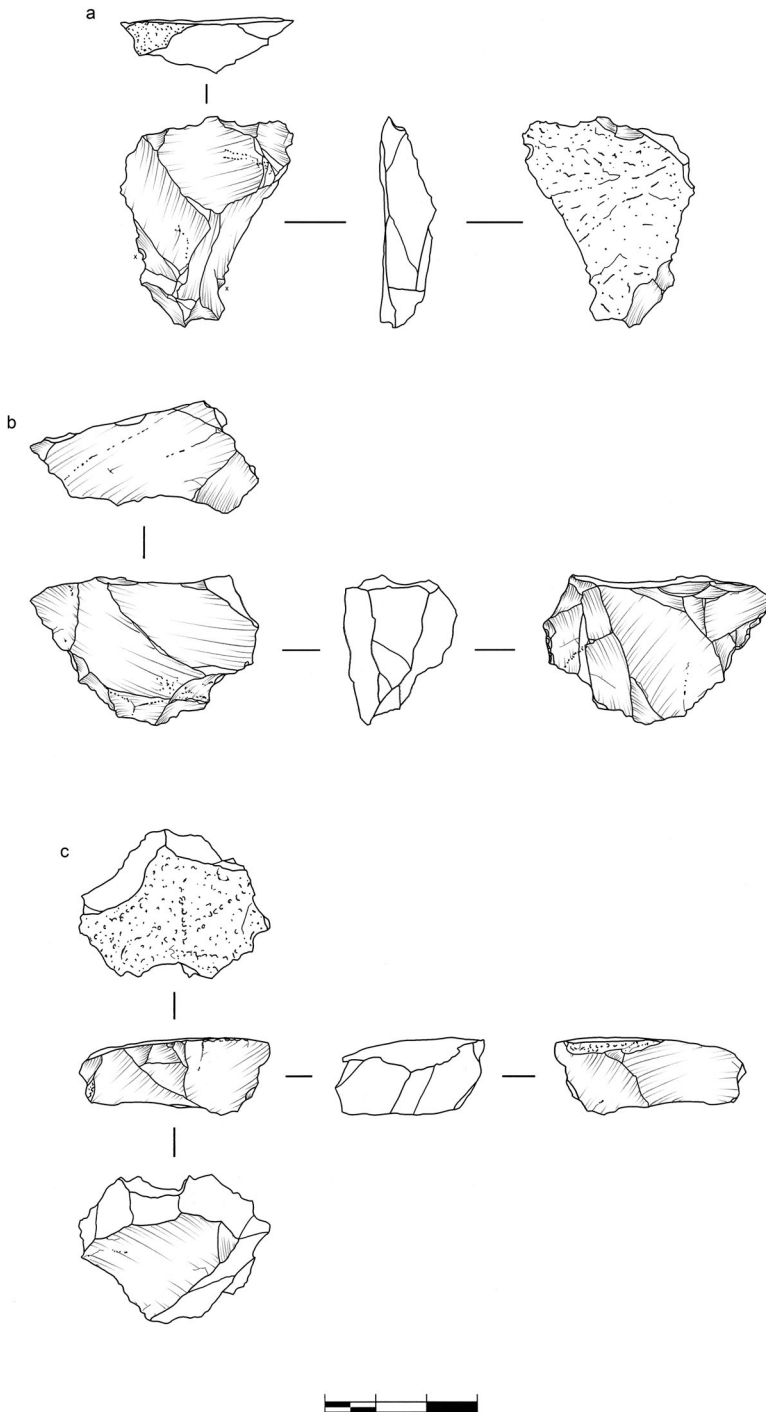


Figure 9. EDAR 135, upper level. Artefacts collected before the excavations from the site's surface and profile: (a) discoidal core; (b–c) multiplatform cores. All in quartz. Drawings by M. Ehlert.

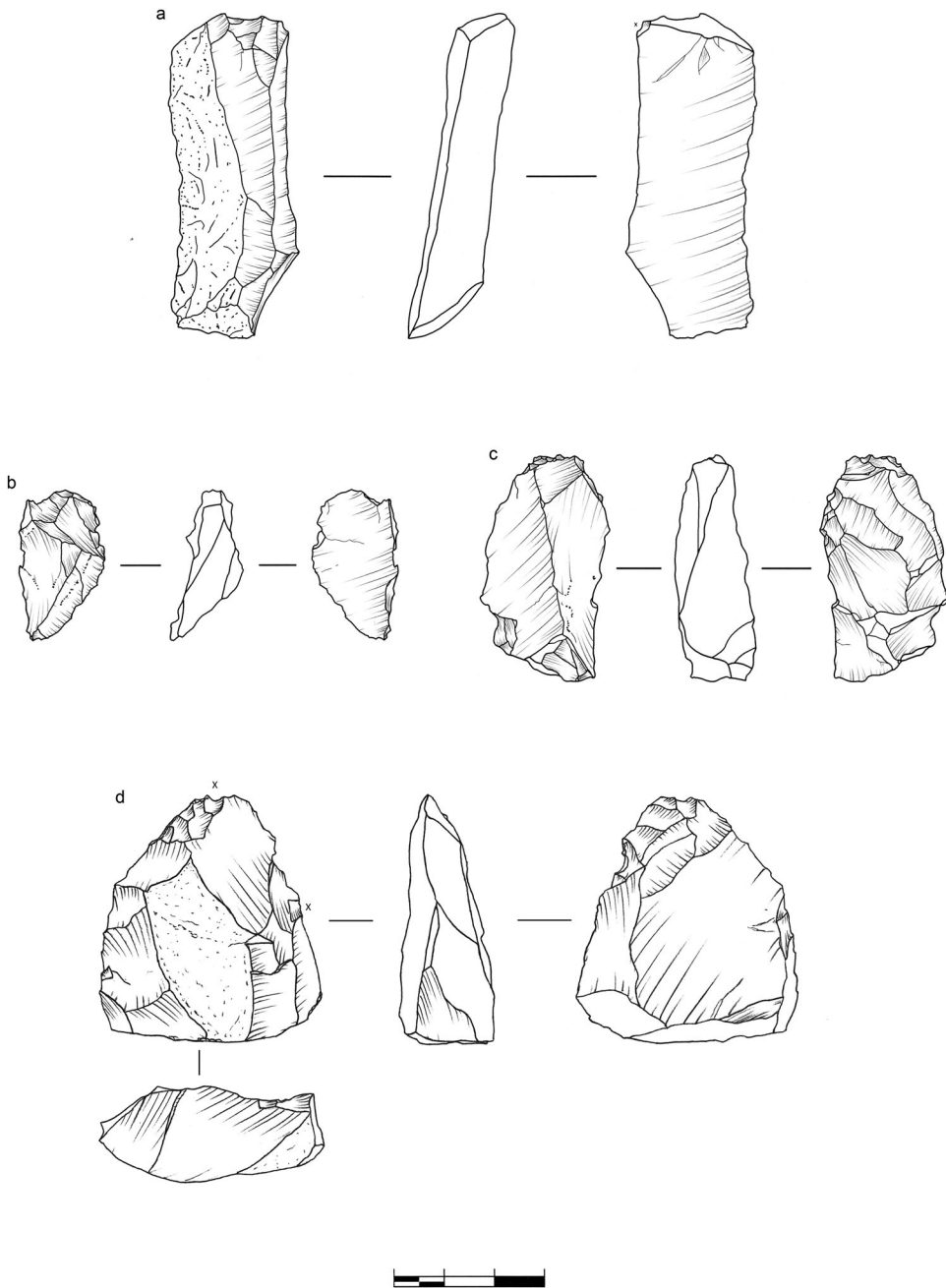


Figure 10. EDAR 135, upper level. Artefacts collected before the excavations from the site's surface and profile: (a) blade; (b) retouched flake; (c) bipolar core; (d) sidescraper; Raw material: (a) fine-grained rhyolite, (b–d) quartz. Drawings by M. Ehlert.

Artefact taphonomy provides clues about site formation processes. Published experiments show that the damage found on the analysed sample could have been caused by several factors, including the friction between sediment and artefact surface, rolling,

Table 5. EDAR 135: flake attributes by raw material.

		Q		R		Total	
		N	%	N	%	N	%
Type	Blade	1	0.43	1	0.43	2	0.87
	Flake	195	84.78	22	9.57	217	94.35
	CTE	9	3.91	2	0.87	11	4.78
Cortex	0%	78	33.91	9	3.91	87	37.83
	≤25%	37	16.09	6	2.61	43	18.7
	25–50%	5	2.17	2	0.87	7	3.04
	≥50%	37	16.09	1	0.43	38	16.52
	Undetermined	48	20.87	7	3.04	55	23.91
Directions	Unidirectional	63	27.39	11	4.78	74	32.17
	Bidirectional	21	9.13	1	0.43	22	9.57
	Multidirectional	75	32.61	10	4.35	85	36.96
	Undetermined	46	20	3	1.3	49	21.3
Platform type	Cortical	41	17.83	1	0.43	42	18.26
	Dihedral	8	3.48	2	0.87	10	4.35
	Faceted	4	1.74	1	0.43	5	2.17
	Linear	17	7.39	0	0	17	7.39
	Plain	90	39.13	16	6.96	106	46.09
	Punctiform	19	8.26	0	0	19	8.26
	Undetermined	26	11.3	5	2.17	31	13.48
Raw material total		205	89.13	25	10.87	230	100

sand particle impact or water activity (Venditti *et al.* 2016). Aeolian abrasion creates numerous impact pits, flat fractures, and cracks (K. Knutsson and Lindé 1990). In the case of water abrasion, the degree of wear depends on artefact stability. Surfaces and edges of freely rolling artefacts become well-polished and rounded. Being embedded or buried in sediment makes such damage more local. Rolling in coarse-grained gravel would have exacerbated chipping (Petraglia and Potts 1994; Venditti *et al.* 2016).

Thus, some traces on the EDAR 135 artefacts, such as impact pits, irregular striations and crushes, could have been caused by aeolian activity. Other features, such as edge rounding and chipping, covering abrasion, irregular patches of bright polish and criss-crossing striations, may be attributed to transport in water.

The assemblage: summary

The analysed assemblage can be characterised as being rather utilitarian and opportunistic, at least from the technological point of view. It is dominated by quartz chips by count and cores by weight (Table 2). Tools were quite abundant, too, and the flake-tool ratio for the whole assemblage was approximately 3.2.

The blanks came mostly from non-predetermined, multiplatform or unidirectional cores. This is corroborated by both core type frequency and flake dorsal side attributes (Tables 4 and 5). The cores were reduced intensely, with the overwhelming majority of them found in an advanced or residual state. Thus, mainly multi/unidirectional flakes with no or little cortex were the key product of blank production (Table 6). They were rather thick, usually below 30 mm in diameter and had length/width ratios of between 1:1 and 2:1. Such blanks were then transformed into tools. In most cases, this encompassed applying generic retouch to parts of their edges; sometimes the retouch can be described as notch or denticulate. Endscrapers were the most numerous formal tool type (Table 6).

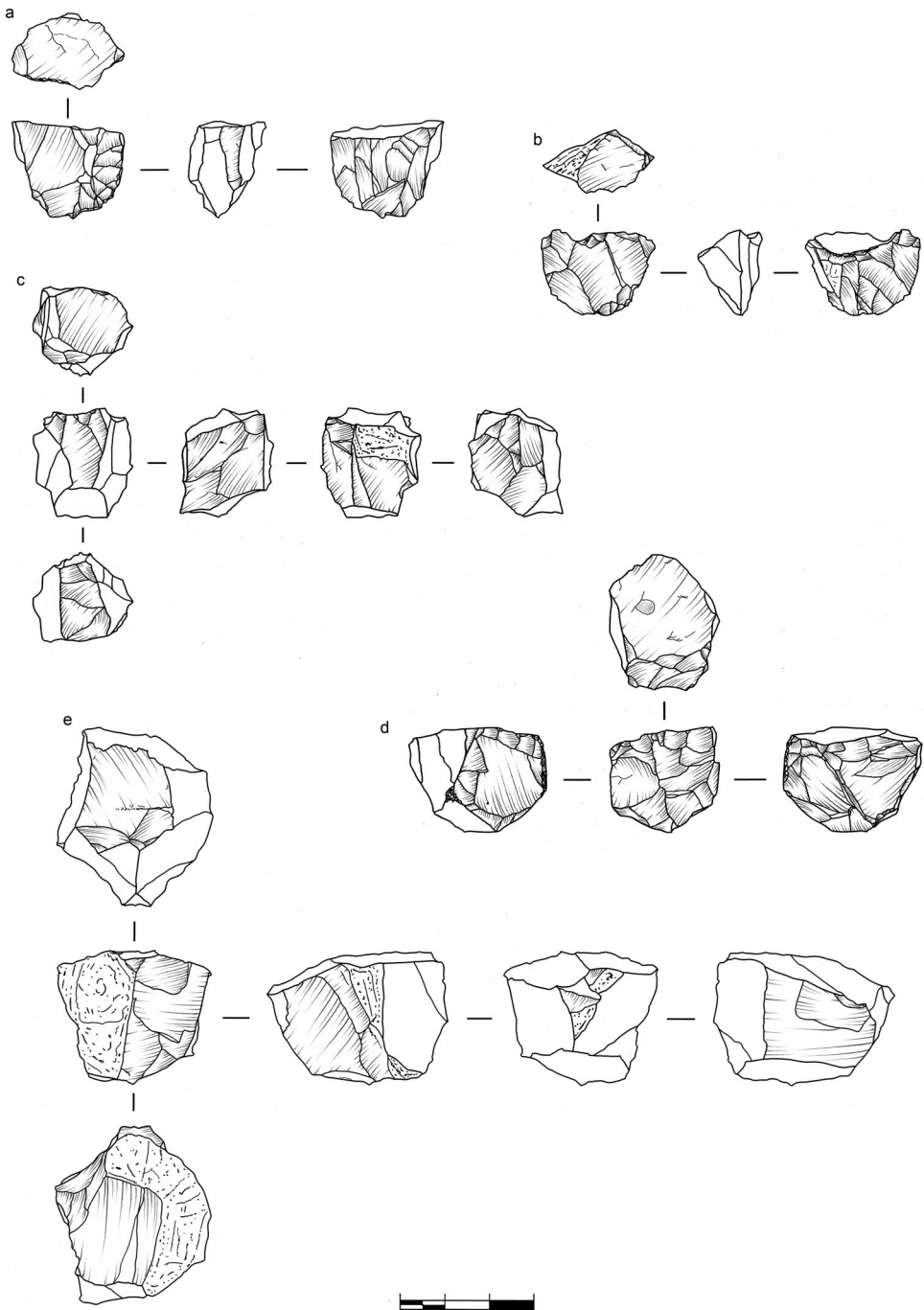


Figure 11. EDAR 135, upper level cores: (a–d) multiplatform; (e) unidirectional. All in quartz. Drawings by M. Ehlert.

The rather marginal use of predetermined techniques is perhaps the most striking feature of the upper level assemblage at EDAR 135. It is evidenced only by four Levallois cores, two tools and several core-trimming flakes. Although initially hinted at by several

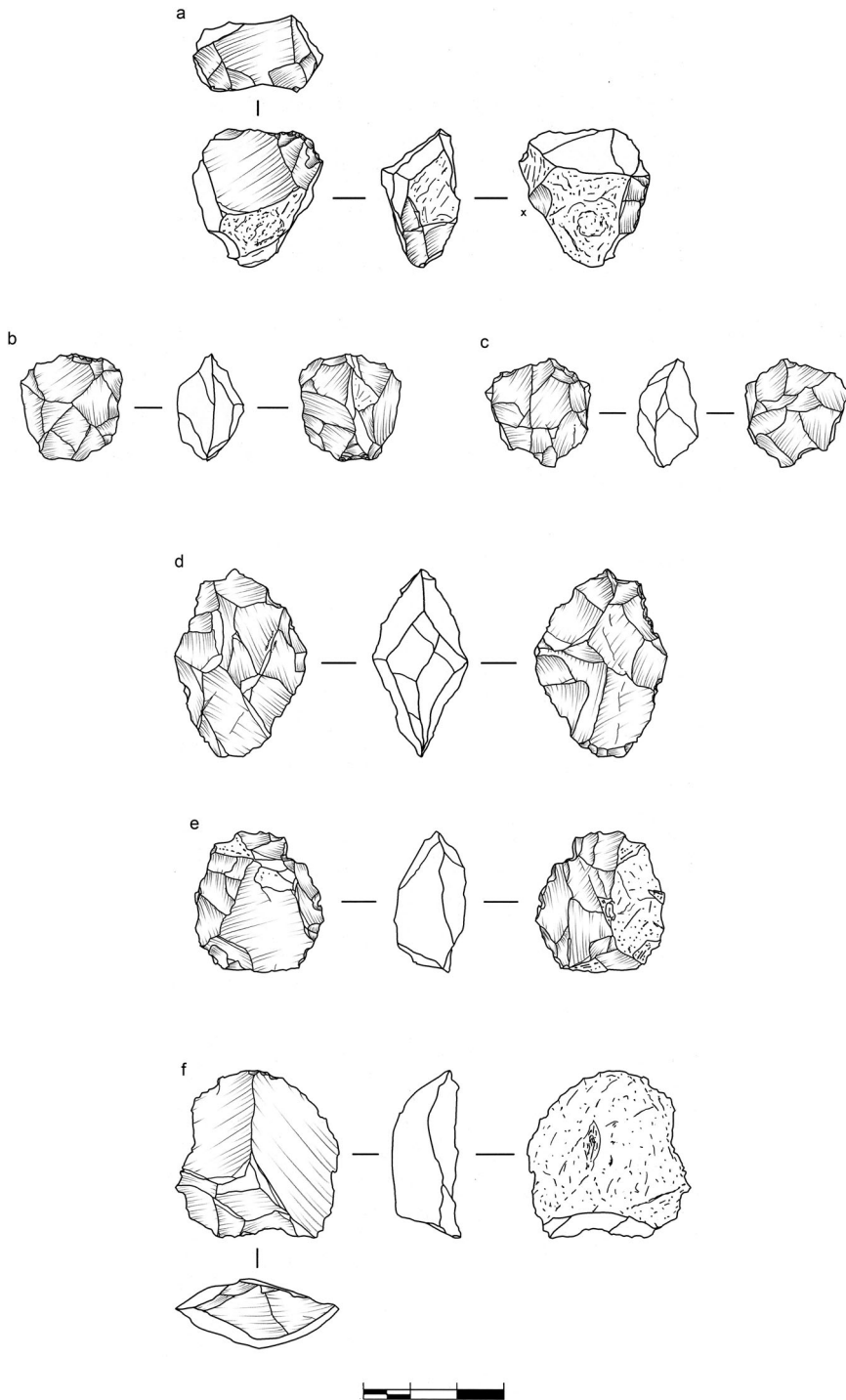


Figure 12. EDAR 135, upper level cores: (a) unidirectional; (b–d) discoidal; (e–f) Levallois. Raw material: (a–e) quartz, (f) coarse-grained rhyolite. Drawings by M. Ehlert.

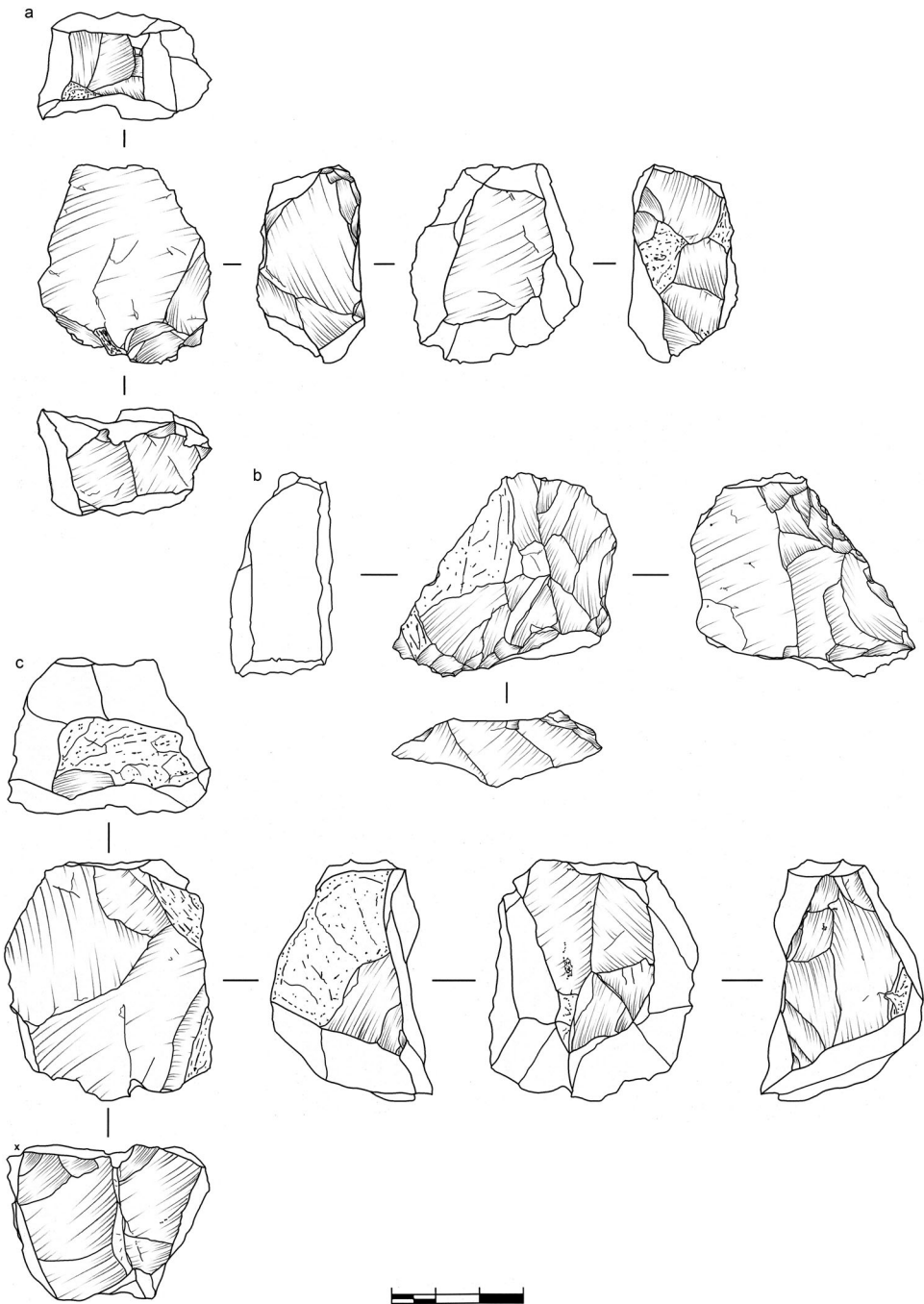


Figure 13. EDAR 135, upper level quartz artefacts: (a) Levallois core; (b) sidescraper; (c) Levallois core. Drawings by M. Ehlert.

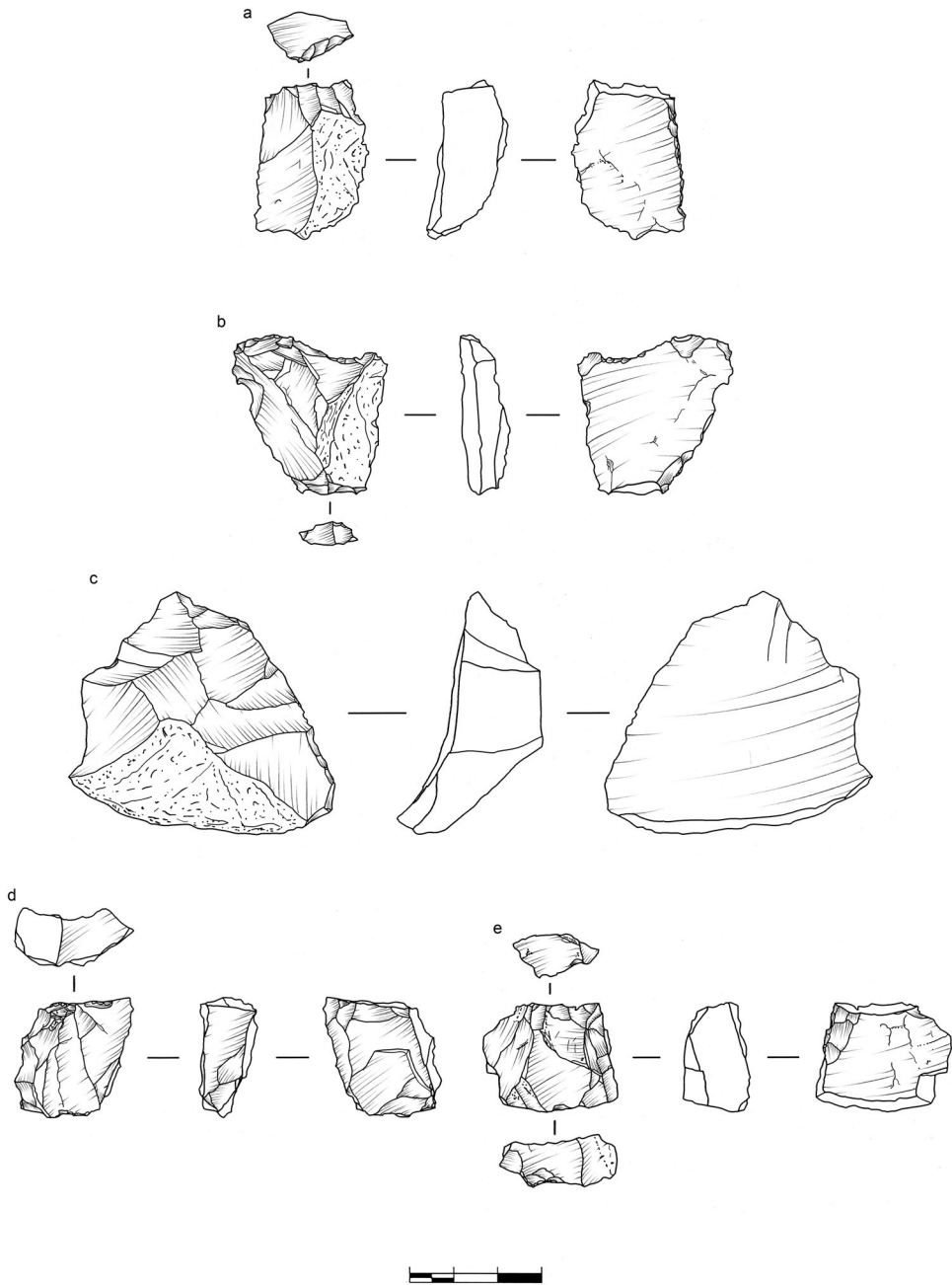


Figure 14. EDAR 135, upper level artefacts: a–c) retouched flakes; d) residual bipolar core; e) residual bidirectional core. Raw material: (a–b, d–e) quartz, (c) fine-grained rhyolite. Drawings by M. Ehlert.

artefacts from the mine wall at the site, closer examination revealed no evidence of use of the Nubian Levallois technique (Masojć *et al.* 2019: 147).

It seems unlikely that such a situation is the result of factors related to raw material quality and availability (*sensu* Andrefsky 1994). The assemblage from the adjacent,

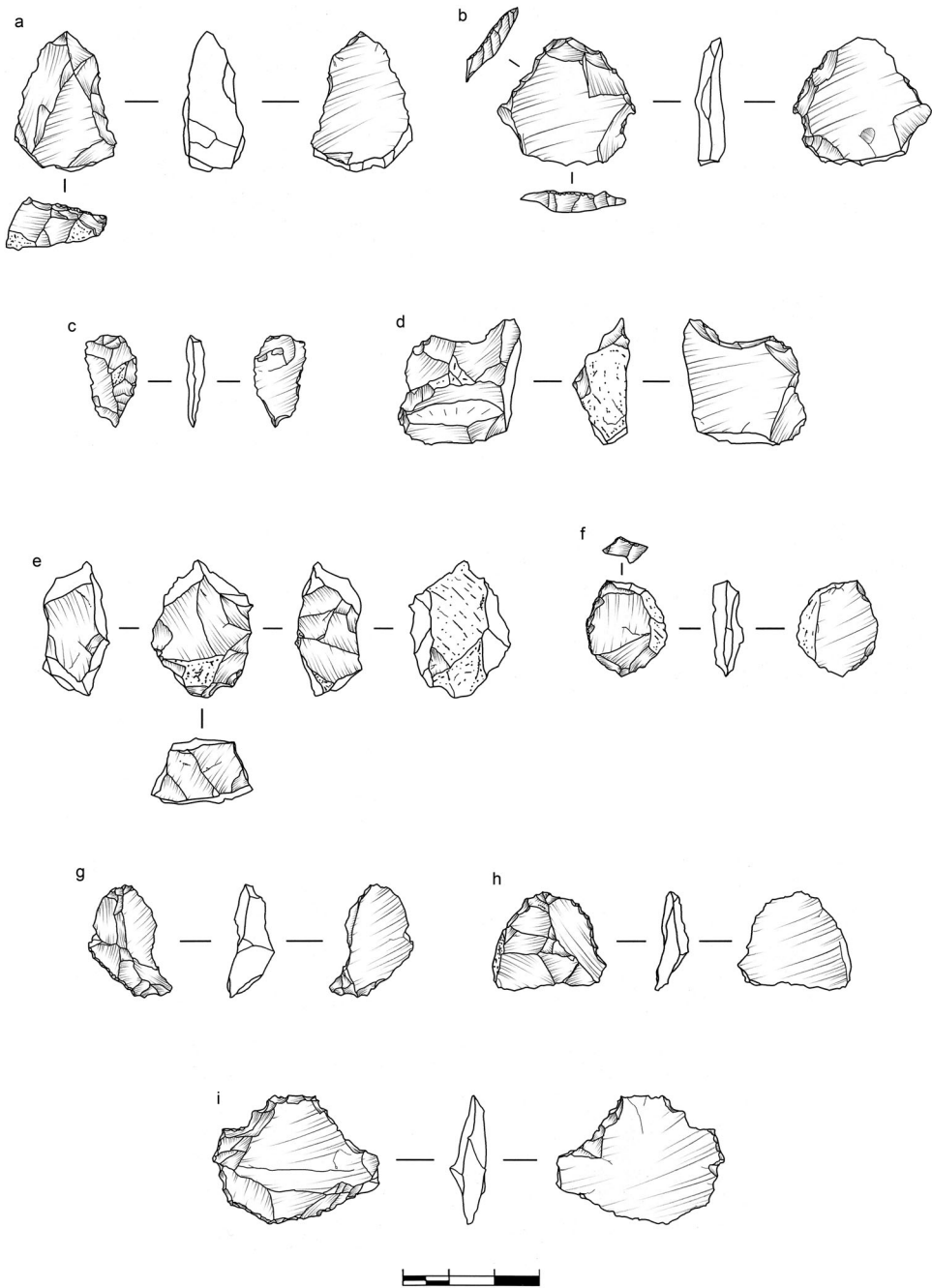


Figure 15. EDAR 135, upper level quartz tools: (a) Levallois point; (b) retouched Levallois flake; (c–e) perforators; (f–i) retouched flakes. Drawings by M. Ehlert.

although younger MSA site of EDAR 155 was based on the same stone sources and has a higher incidence of Levallois tools and cores. In another nearby site, EDAR 134, rhyolite was the predominant raw material. All the remaining assemblages, whether younger or

Table 6. EDAR 135: types and blank properties of tools.

		N	%
Type	Combined tools	3	4.23
	Denticulates	4	5.63
	Endscrapers	13	18.31
	Notches	8	11.27
	Perforators	7	9.86
	Retouched flakes	27	38.03
	Sidescrapers	7	9.86
	Levallois	1	1.41
	Undetermined	1	1.41
	Cortex	None	38
≤25%		9	12.68
25–50%		5	7.04
≥50%		6	8.45
Undetermined		13	18.31
Dorsal scar directions	Unidirectional	13	18.31
	Bidirectional	6	8.45
	Multidirectional	40	56.34
	N	12	16.9
Platform type	Cortical	7	9.86
	Dihedral	2	2.82
	Faceted	6	8.45
	Linear	5	7.04
	Plain	31	43.66
	Punctiform	10	14.08
	Undetermined	10	14.08
Total		71	100

older than that from EDAR 135's upper level, were dominated by quartz (Masojć *et al.* 2019: 146–147, 2021b).

If we exclude raw material limitations, we are therefore led to conclude that the technological choices evident must have been functionally motivated, i.e. by the needs to which the manufactured tools corresponded. Micro-traces of use were to a large degree obliterated by factors standing behind the formation of the artefact-bearing layer. What could be detected, coupled with the environmental context in which the tools were utilised, seems to hint at a functionally driven production. Micro-traces appear to suggest that these small tools were used *ad hoc*, during animal butchery. These preliminary and tentative observations may imply that the repertoire of reduction sequences and artefact forms was wide and did not only depend on socio-cultural factors. The question that inevitably follows from this is whether this situation should be treated as unique or whether it has analogies elsewhere in the MSA of Northeast Africa and beyond?

Discussion: EDAR 135 in the Middle Stone Age of Northeast Africa

An accurate comparison of the upper level assemblage at EDAR 135 with contemporaneous, published ones from Sudan, Nubia and the rest of Northeast Africa is not an easy task to accomplish (Scerri and Spinapolice 2019; Usai 2019; Garcea 2020; Leplongeon 2021, 2022; Masojć 2021). The dearth of similarly well dated sites and the technological characteristics of the analysed assemblage make placing it within any of the taxonomic units identified in the area in MIS 5 (the Nubian Complex, the Lupemban and the Aterian) an exceedingly difficult task.

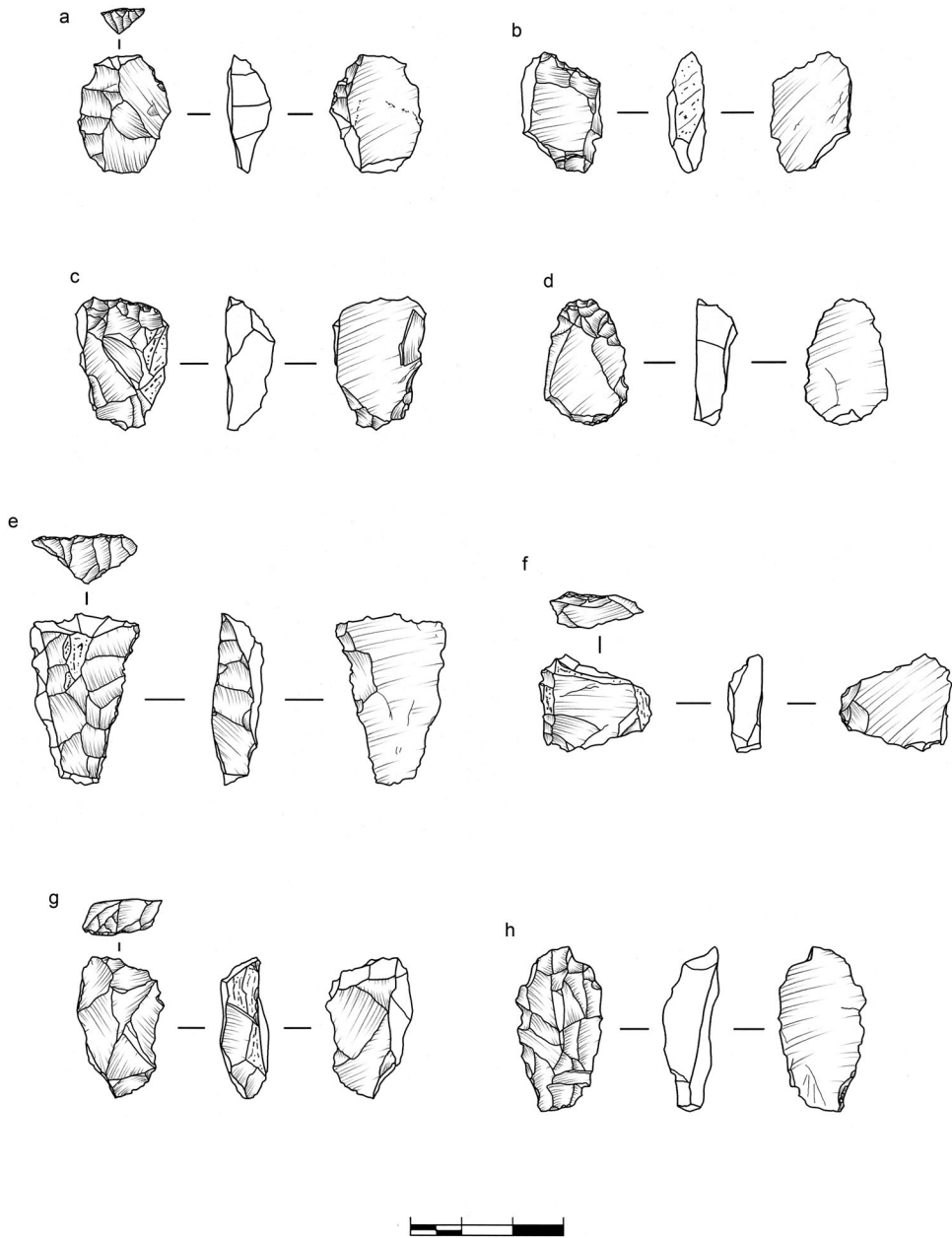


Figure 16. EDAR 135, upper level quartz endscrapers. Drawings by M. Ehlert.

One analogy, perhaps the closest, comes from a complex of MSA localities found near Kharga Oasis in the Western Desert of Egypt. One of them, KH/MT-02 contained an artefact-bearing silt layer between two tufa sheets dated by uranium-series methods to 103 kya (above) and 128 kya (below) (Smith *et al.* 2007: 695). The assemblage was composed mostly of débitage and cores, which were described as oval, discoidal and ‘classical Levallois’, although two triangular specimens, interpreted as Nubian II cores are

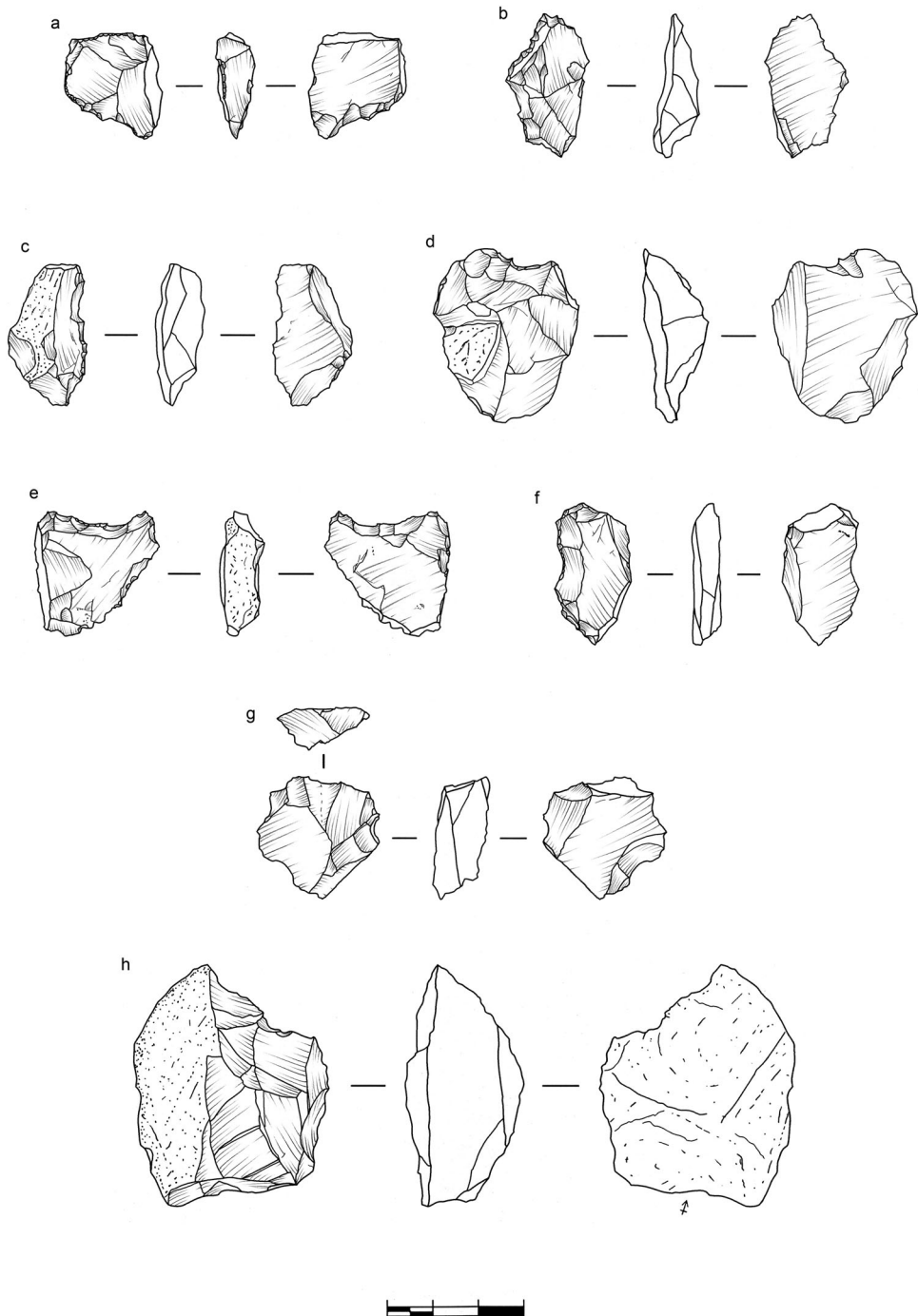


Figure 17. EDAR 135, upper level tools: (a–b) denticulates; (c–h) notches. Raw material: (a–g) quartz, (h) coarse-grained rhyolite. Drawings by M. Ehlert.

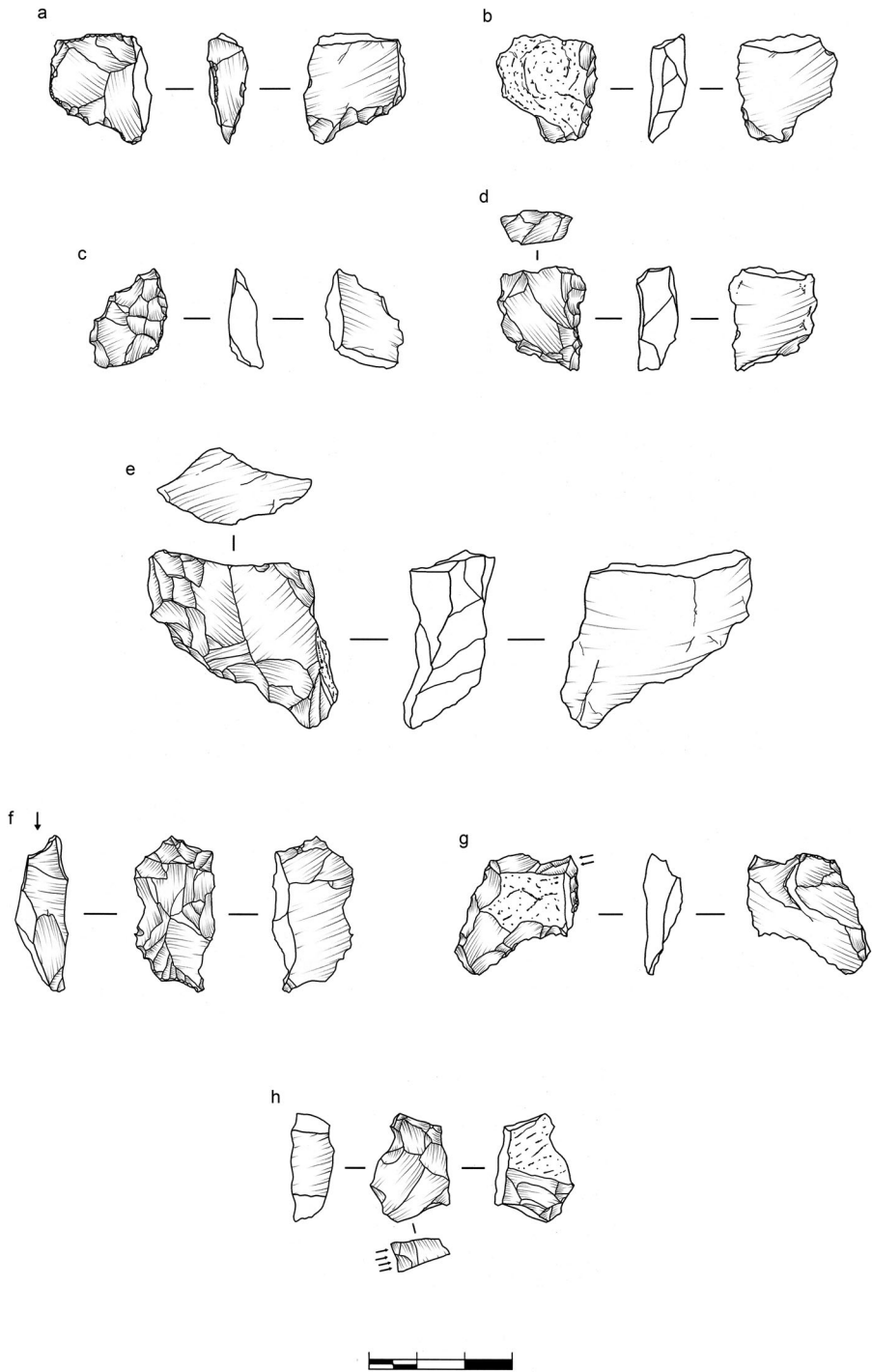


Figure 18. EDAR 135, upper level quartz tools: (a–e) sidescrapers; (f–h) combined tools. Drawings by M. Ehlert.

Table 7. EDAR 135: description and interpretation of detected macro and micro traces; PDT – post-depositional traces. All artefacts made of quartz.

Figure	Tool type	Macro-traces	Micro-traces	Activity	Material
n/a	Perforator	Small, shallow chips; edge appears fresh	Edge matt, with overlapping shallow crushing; deep, rounded impact pits; several grooves perpendicular to the edge	n/a	PDT and soft material
16d	Endscraper	Irregular chipping of the edges	Shallow impact pits; irregular crisscrossing striations	n/a	PDT
16a	Endscraper	Numerous, small chips; the middle of the artefact is matt	Crushing of the edge; scattered bright spots	n/a	PDT
16c	Endscraper	Chips of varying size, no edge rounding	Linear traces perpendicular to the scraping edge; numerous, small chips	Scraping	Soft
16h	Endscraper	Damage to the scraping edge, numerous smaller chips	Crushing and rounding of protruding parts; large and concentrated impact pits	n/a	PDT
16e, 19a	Endscraper	Small, overlapping micro scars on the scraping edge	Well-rounded edge, domed, smooth and shiny polish reaching scar bottoms; thin striations perpendicular to the edge	Scraping	Bone
n/a	Endscraper	Matt surface, numerous, scattered chips, one edge more rounded and polished	Irregular, scattered traces; numerous impact pits and crisscrossing striations	Possibly scraping	PDT
16g	Endscraper	Slight, scattered edge rounding	Few irregular patches of bright, strong polish	n/a	PDT
17c	Notch	Rounded edge, matt surface	Irregular scratches, patches of polish; bright, well-polished edge	n/a	PDT
15i	Retouched flake	Slight edge rounding, numerous small chips with step endings	Shiny polish on tool edge; irregular, crisscrossing striations	n/a	PDT
18f	Combined	Irregular, scattered chipping	Numerous impact pits, irregular polish	n/a	PDT
14b	Retouched flake	Crushed edges with numerous, scattered chipping; most of the surface matt even to the naked eye	Rounding of all edges	n/a	n/a
15c	Perforator	Irregular chipping of one edge	Rounding of all edges, scattered PDT traces and later breakage	n/a	Soft
18c, 19b	Sidescraper	Small, overlapping chips; edge rounding	Continuous breakage of crystals on tools edge; rough and matt polish; small striations perpendicular to the edge	Scraping or cutting	Hide
15b	Retouched Levallois flake	Small, scattered chips	Wide grooves perpendicular to the edge; rough polish on the edge; crushed and partly smoothed ridges	Cutting and scraping	Butchery and hide

mentioned as well (Smith *et al.* 2007: 695–696). Because of their minor proportion in the assemblage, these Nubian Complex components were treated as the results of local innovation or inter-population contact (Smith *et al.* 2007: 699).

The complexly stratified site of Taramsa in Upper Egypt provides another analogy. Lithic artefacts found in the oldest group of contexts named Activity Phase I, which is dated to between approximately 117 and 160 kya, have been described as coming from

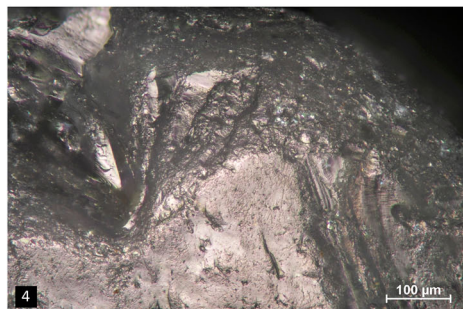
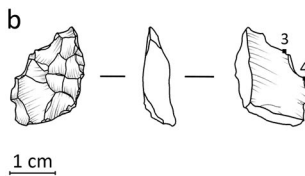
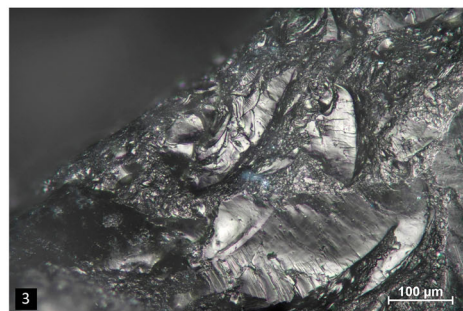
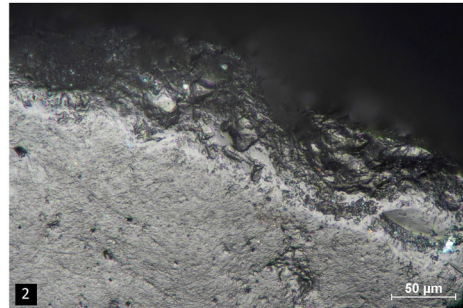
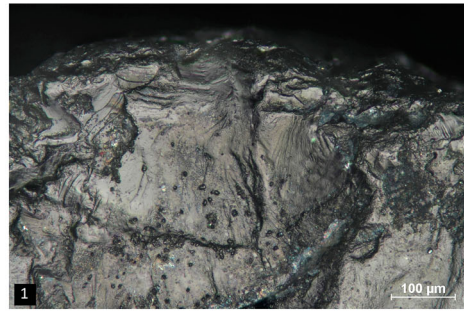
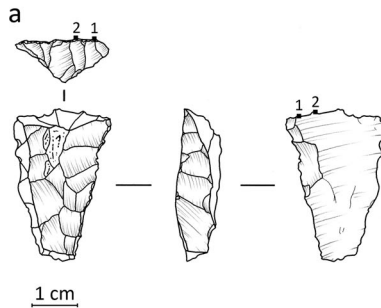


Figure 19. EDAR 135, upper level examples of use wear: (a) post-depositional concentrations of impact pits and ridge crushing that are: (1) superimposed on traces interpreted as results of work in bone and 2) showing a rounded edge with smooth and bright polish of uneven morphology overlapping onto crescent-shaped, few striations parallel to the edge; (b) traces interpreted as produced by hide scraping that exhibit: 3) a significant edge rounding and heavy abrasion, patches of rough, matt polish and 4) a similar polish, plus numerous thin striations perpendicular to the edge. Note that some of the fresher-looking scars here could be from post-depositional damage. Photographs by M. Cendrowska.

a production system dominated by the discoid method, with only marginal occurrence of a Levallois technique. The whole phase is classified as Lupemban; the later date is supposed to mark the onset of the early Nubian Complex (Van Peer *et al.* 2003: 225–227). It seems to correspond well to the situation in the upper level at EDAR 135, although there are differences, with blades and foliates being named as the main flaking products.

Other assemblages yielding similar ages as to those found in the upper level at EDAR 135 are quite different technologically and all exhibit a much higher importance of Levallois methods, especially of the Nubian kind. MSA artefacts from Site 8-B-11 on Sai Island, Sudan, are a good example. Found in layers above an OSL date of 150 ± 10 kya, they are described as having been made using classic Levallois, Nubian and discoid reduction strategies. They were also accompanied by thin bifacial foliates and described as belonging to a Nubian Complex with Lupemban affinities (Van Peer *et al.* 2003: 189). The lithic assemblage from Station One in northern Sudan shared these characteristics; its similarities to the upper level at EDAR 135 include the dominance of quartz despite the availability of other raw materials and the structure of non-Levallois cores and unifacial tools (Rose 2004).

Further comparable MSA assemblages such as Affad 23 (Osypiński *et al.* 2016) or BP177 in the Bayuda Desert of Sudan (Masojć *et al.* 2017; Masojć 2018) are either technologically quite different or not precisely dated. Site E-88-1 in Bir Sahara East, southern Egypt, is roughly contemporaneous, but its lithic industry was dominated by Levallois reduction (Close and Wendorf 1993). Some forms of retouched tools from the inselberg of Maghendoli, Sudan, especially burins and perforators (called gravers by the author), resemble those from the upper level at EDAR 135. This site, which was repeatedly used as a raw material source, is not well dated, but appears to be MSA in age. Additionally, its assemblage contains numerous stemmed tools, which are completely absent from all the EDAR sites (Carlson 2015: 120, 125–128).

In summary, assemblages that are approximately contemporaneous with that from the upper level at EDAR 135 have variously been classified as belonging to the Lupemban, the early Nubian Complex or the Aterian. Although the definitions of these taxonomic units seem to be quite well established, their exact ages change as new data are published. For example, the beginning of the Nubian Complex has been dated to anywhere between 240 to 120 kya, while its geographical distribution has widened from Nubia itself to the whole of Northeast, and then eastern, Africa together with the Arabian Peninsula and even the Levant (Groucutt 2020).

The presence of the Lupemban in Sudan is placed in MIS 6 and is known from two localities, Sai Island and Khor Abu Anga (Van Peer *et al.* 2003; Carlson 2015; Taylor 2016). The most characteristic feature of the Lupemban industries is a mixture of different lithic reduction strategies, including bifaces, prepared cores, blades and backed blades; bifacial lanceolate points as well as core axes and picks are common (Taylor 2016: 276). The Aterian, seen by some researchers as a desert adaptation, formed away from the larger hydrological systems and is distinguished by its stemmed tools; its early stage dates to MIS 6–5b. Despite differences in core reduction patterns, researchers have noted some similarities in blank production between Aterian and the Nubian Complex, perhaps stemming from a common, Lupemban origin (Scerri 2013; Scerri and Spinapolice 2019: Table 2). MSA sites containing such forms are spread over vast areas of northern Africa, including Sudan (Carlson 2015; Scerri and Spinapolice 2019: Figure 1).

In addition, the assemblage from EDAR 135 shares some similarities with much younger collections that have been published as Khormusan, the most important feature of which is the absence of Nubian Levallois. On the other hand, the EDAR 135 assemblage shows no trace of bladelets, which are seen as a defining feature of the Khormusan (Marks 1968; Goder-Goldberger 2013).

As stated at the beginning of this section, there do not seem to be any direct analogies for the assemblage from the upper level at EDAR 135 among the published literature. This assemblage, which was gathered from a small area and is fragmentary, lacks forms that would allow it to be placed unambiguously in any of the above-mentioned complexes. The typical Lupemban (foliate bifaces), Nubian Complex (Nubian Levallois) and Aterian (stemmed tools) components are absent, in contrast to the situation with the few well-dated, published assemblages. Sites dated based on technological and typological properties of the lithics help only marginally.

Perhaps the EDAR 135 assemblage should therefore be viewed as yet another example of the variability of the lithic industries of Northeast and East Africa (Tryon and Faith 2013; Groucutt *et al.* 2015). Recent studies have shown that this variability is not necessarily dependent on geographical and environmental variation (Blinkhorn and Grove 2018). However, it is unfortunately not yet possible to determine unambiguously the cause of that variation, although it could perhaps reflect variability between the groups inhabiting the Nile Valley and societies subsisting in the habitats beyond it, as suggested by Van Peer (1998). Such a difference could have been accentuated in periods of relative humidity in the region, such as MIS 5d (Drake *et al.* 2013: 56, Figure 3; but see Van Peer 2016 for an opposite view of conditions in MIS 5d).

There are chronological analogies to the upper level assemblage from EDAR 135 among Middle Palaeolithic sites in the Arabian Peninsula (Petraglia *et al.* 2011; Groucutt and Petraglia 2012; Blinkhorn *et al.* 2013). These localities were probably inhabited by *Homo sapiens* groups that originated in Northeast Africa (Armitage *et al.* 2011). The Al-Wusta site in the Nefud Desert of Saudi Arabia, where an intermediate *Homo sapiens* phalanx was recently found, is, for example, dated to ~90 kya (Groucutt *et al.* 2018). Middle Palaeolithic sites in that area dating to MIS 5 are often thought to be located near palaeolakes and their lithic débitage is dominated by a centripetal Levallois technology (Breeze *et al.* 2017).

Many questions remain unanswered and there are still controversies and inconsistencies to investigate in the Northeast African Middle Stone Age (Groucutt 2020; Leplongeon 2022). However, well-dated sites such as the EDAR series can provide valuable new data. Eventually, this will enhance our understanding of variation in lithic assemblages and of the cultural processes that took place at the onset of the expansion of anatomically modern human populations across Africa and into adjacent parts of Eurasia.

Endnote

1. The three published EDAR OSL dates, corresponding to the first, second and fourth samples from the top in Figure 3a (Masojć *et al.* 2019: Figure 4, Table 1) have recently been recalculated following a standardised methodology at Royal Holloway, University of London as being younger than previously thought.

Acknowledgements

This work was supported by the National Science Centre, Poland, under Grant no. NCN2015/19/B/HS3/03562 and the Excellence Initiative — Research University (IDUB) programme of the University of Wrocław. The project was based at the University of Wrocław and supported by the Korean Institute of Geoscience and Mineral Resources (GP2017-013), Gyeongsang National University and Al Neelain University, Khartoum, Sudan. Researchers and students from these organisations were of course not the only people participating in the fieldwork. It would not be possible to have carried out the project without the permission of the National Corporation for Antiques and the Museum in Khartoum and the dedicated work of our many Sudanese friends and colleagues.

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