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POTTERY SAMPLES RECOVERED FROM ABU ERTEILA (SUDAN) – CORRELATION OF MACROSCOPICALLY IDENTIFIED FABRICS WITH LABORATORY-DEFINED RAW MATERIAL GROUPS

Abstract

This article reports on the use of laboratory analysis to examine whether pottery recovered from excavations at Abu Erteila includes wares made at the same workshops as pottery found at other Meroitic sites in the region. It also examines whether wares deemed typical of the Abu Erteila ceramic assemblage were made of the same raw materials as pottery at neighbouring sites or clay used at other workshops. Particular attention was paid to assessing whether samples with fabrics which macroscopically resemble the Musawwarat fabrics were indeed made at workshops in Musawwarat or whether this macroscopic similarity is deceptive.

Key words

Meroitic ceramics, MGR-analysis, provenance studies

INTRODUCTION

It is common knowledge that archaeological pottery constitutes a valuable source of information, serving as a chronological indicator and providing evidence for the existence of trade, technological developments and changes in socioeconomic structures. In order to have a statistically significant database for testing hypotheses, all or nearly all pottery sherds should be classified in terms of provenance and technology. Unfortunately, most of the significant information contained within ceramic sherds can only be revealed by precise laboratory analyses (this information having been encoded during the technological process, when the raw materials were transformed into the finished product). The perfect scenario would be to carry out a suite of laboratory analyses on each potsherd recovered from excavation. However, because of both time and money constraints, in cases where ceramics constitute bulk finds this type of analysis is not carried out on every sherd[1]. In reality, it is only macroscopic analysis that is carried out on all ceramic fragments found at archaeological sites. Ideally, laboratory analysis should be carried out after the first season of excavation. This allows for an assessment of whether the results of laboratory analysis of a given ceramic assemblage can be correlated with macroscopic analysis results, and if so to what degree. This type of study can be used as the basis for formulating a catalogue of macroscopic diagnostic parameters that can be used when compiling macroscopic descriptions to enable the classification of strictly defined fabric types. In order to minimalize the number of erroneously classified sherds, these fabric types should equate as closely as possible to the groupings determined by the results of laboratory analysis. It must be remembered that different macroscopically identified fabrics sometimes prove to have the same chemical, mineralogical and petrographic composition, which means that they must have been made using the same ceramic body. This shows that macroscopically visible differences between individual fabrics are attributable to technological processes (e.g. firing temperature, firing atmosphere, firing time, or methods used to prepare the ceramic body). However, this type of situation is not problematic: the process of linking fabrics in one provenance group can be done without having to re-examine any samples. Problems are presented by the opposite situation, when, after analysing several samples

[1] This level of analysis is not possible even using the currently fashionable technique of portable energy dispersive X-ray fluorescence (p-ED-XRF). Although this technique is undoubtedly useful in classifying bulk finds, it is nonetheless of limited use in provenance studies.

representing the same fabric, it transpires that each sample has a different chemical, mineralogical and petrographic composition. It is in these circumstances that all pottery fragments must be reassessed in order to present an accurate picture of the proportion of sherds representing individual types of ceramic bodies. At sites where only locally made pottery occurs, incorrect classification (e.g. identifying two local workshops instead of five) will not lead to the far-reaching errors in socioeconomic interpretations that can result from erroneous classification of imported pottery.

This article is the first in a series on the correct identification of so-called Musawwarat fabric. Laboratory analyses were carried out by Małgorzata Daszkiewicz and Gerwulf Schneider as part of the Musawwarat research project undertaken at the Freie Universitat Berlin by the TOPOI 2 Cluster of Excellence, Research area A – Spatial Environment; A-6 Economic Space. This project aims to examine whether ceramics identified as locally made wares from Musawwarat es Sufra[2] were exported and to determine which production centres pottery imports came from. To this end the management of the archaeological mission at Abu Erteila was asked to provide samples of pottery typically found at the Abu Erteila site, as well as sherds whose fabric is macroscopically similar in appearance to that of locally produced pottery from Musawwarat es Sufra. The map in figure 1 shows sites dated to the Meroitic period (and post-Meroitic period) located in the immediate vicinity of Musawwarat es Sufra from which pottery was analysed as part of various earlier projects (Awlib, Hamada, Meroe, El Hassa, Muweis) and sites (Wad Ban Naga, Abu Erteila) from which pottery was analysed as part of the project run by the TOPOI 2 Cluster of Excellence.

THE STUDY MATERIAL

In this article the authors present the results of analysis carried out on 20 potsherds recovered from excavations carried out by the Italian-Russian Archaeological Mission at Abu Erteila, Sudan[3]. These sherds represent various

[2] M. Daszkiewicz, C Näser, New data from the ceramic workshop in courtyard 224 of the Great Enclosure in Musawwarat es-Sufra, MittSAG 24, 2013, pp. 15-22; M. Daszkiewicz, M. Wetendorf, A new series of laboratory analyses of coarse wares from „pottery courtyard" 224 of the Great Enclosure in Musawwarat es-Sufra (Sudan), MittSAG 24, 2014, pp. 99-104.

[3] The Abu Erteila project is the result of an international agreement between the IsIAO (Istituto Italiano per l'Africa e l'Oriente), currently IsMEO (Associazione Internazionale di Studi sul Mediterraneo e l'Oriente), and the IOS RAS (Institute for Oriental Studies – Russian Academy

macroscopically defined clay fabrics. The clay fabrics of 17 samples (table 1, samples AD 494-499 and AD 501-507) are typical of the Abu Erteila ceramic assemblage and were probably made using a local source of pottery clay from Wadi el-Hawad. It is possible that this ware was produced by a local pottery workshop which has not yet been discovered. These samples conform to the usual morphological types of the Meroitic period (some are of post-Meroitic date): wheel-made bowls, cups, small plates/lids, stands for a censer, large tubular and globular jars. They were found in the upper surface layer of the site, in the fill deposits of rooms within the temple and administrative complex of Kom I and Kom II at Abu Erteila. Three sherds (table 2, samples AD 491-493) were made of classical kaolinitic clay fabrics of the Meroe region; these fine wheel-made bowls and cups were probably transported to Abu Erteila, probably from the capital. The clay fabric of one sample (table 1, the sample AD 500) is rare for the Abu Erteila site: at the moment we have no more than 10 fragments of this ware. It appears to be made of alluvial clay. Sample AD 500 (a hand-made bowl with mat impressions) may have been transported to Abu Erteila from a neighbouring settlement near the Nile.

The clay fabrics of three samples (table 2, samples AD 508-510) are absolutely atypical of the ceramic corpus of Abu Erteila. Moreover, the shapes of jar (?) AD 509 and bowl AD 510 are also unusual for Abu Erteila. All three are probably of non-local origin. They were recovered from the upper surface layer of the site, from the fill of rooms in the administrative complex of Kom I; sample AD 510 was found beneath the building's destruction level and was attributable to the last stages of occupation at the complex in the late Meroitic period.

ANALYSIS RESULTS

The first laboratory procedure carried out was MGR-analysis. Images of all of the analysed samples before and after refiring are shown in figures 2 and 3. The thermal behaviour of each sample refired at three temperatures (1100°C, 1150°C and 1200°C) is taken into account when defining groups.

of Sciences). Fieldwork is carried out in keeping with the excavation licence granted by the NCAM (National Corporation for Antiquities and Museums of Sudan). For more about the excavation of this site see, for example: E. Fantusati, E. Kormysheva, Quinta e sesta campagna di scavo ad Abu Erteila: rapporto preliminare, [in:] M. Baldi, E. Fantusati (ed.), Atti della Quarta Giornata di Studi nubiani. A Tribute to the Nubian Civilization, Rome 2014, pp. 1-48.

This is used as the basis for identifying groups of greatest similarity, known as MGR-groups. Definitive classification is based on thermal behaviour at 1200°C. Each MGR-group comprises samples that exhibit the same thermal behaviour, i.e. samples which display the same appearance, colour and shade after refiring at 1200°C. This indicates that they were made using the same plastic raw material (clay). All ceramic samples attributed to the same MGR-group[4] were made of the same clay, or of the same ceramic body to which the same type and quantity of intentional temper was added[5].

The results of MGR-analysis (examining the colour of samples after re-firing) conclusively demonstrate that 6 of the ceramic fragments were made using various clays with a low iron content, while 14 sherds were made of various iron-rich clays.

The following types of matrix were identified based on the appearance of samples when refired at 1200°C:

– sintered matrix type (SN) = the sherd is well-compacted, it may or may not become smaller in size in comparison to the original sample, whilst its edges remain sharp;

– over-fired matrix type (ovF) = the sample changes in shape, bloating, however, does not occur, nor does the surface of the sample become over-melted;

– slightly over-melted matrix type (sovM) = the surface of the sample becomes slightly over-melted and its edges slightly rounded;

– over-melted matrix type (ovM) = the surface of the sample becomes over-melted and its edges slightly rounded.

Figure 4 shows samples after refiring at 1200°C divided into MGR-groups. A total of 18 MGR-groups were identified (only two MGR-groups are represented by more than one sample). Grouping was carried out in accordance with a uniform system used for classifying archaeological pottery from

[4] The term „group" is used even when that group features only a solitary sample. It is unlikely that just one vessel would have been made from a particular ceramic body, therefore it is assumed that the analysed sample represents a group of vessels made from the same material. It is for this reason that the term „group" is used even in relation to groups which are represented solely by a single sample.

[5] Ceramic vessels made from the same clay to which the potter did not add any non-plastic ingredients will have the same chemical composition and will belong to the same MGR-group. In contrast, vessels made of the same clay which was intentionally tempered with various non-plastic ingredients will belong to the same MGR-group but their chemical composition will be different (see e.g.: M. Daszkiewicz, Ancient pottery in the laboratory – principles of archaeoceramological investigations of provenance and technology, Novensia 25, 2014, pp. 177-199).

Sudan[6]. This system relies on the four-stage attribution of a given ceramic sample to an MGR group, a reference group, a production region and a clay type. The MGR-groups are numbered consecutively within this system. Each newly analysed pottery fragment is compared to the earlier analysed fragments and if it is not attributed to an existing group a new MGR-group is created and ascribed the next number in the sequence. Based on similarities in chemical composition (table 2), MGR-groups are linked to make reference groups. In keeping with the established conventions of classification, reference groups are identified by alphanumerical codes (table 3).

In the case of pottery recovered from Abu Erteila comparison with the SDB[7] revealed that 13 ceramic sherds of the present sample series represent raw material groups which do not occur at other sites. The sherds in question belong to MGR-groups 140-145, 147-149, 151-54 (table 3).

MGR-groups 140 and 141 encompass three samples made of raw materials very slightly coloured by iron compounds (Fe_2O_3 content ranges from 2.19% to 2.92% – see table 2). They were classified macroscopically by S. Malykh as sherds made in classical kaolinitic clay fabrics of the Meroe region. They represent raw materials attributed to group Y (in the SDB), which are characterised by SiO_2 levels of *c.* 70-74% and an Al_2O_3 content of *c.* 20-22%. A new reference group – Y4 – of kaolinitic raw materials[8] of unknown provenance had to be established for the sherds found at Abu Erteila because of their chemical composition (table 2) and their thermal behaviour.

MGR-group 142 consists of a ceramic fragment (AD 494) made from a darker firing kaolinitic clay than raw material Y; it represents clay type YB in the SDB. This sample is ascribed to reference group YB3, and in view of its chemical composition it was attributed to a group of unknown provenance, despite the fact that after macroscopic examination it was classified as a sherd typical of the Abu Erteila ceramic corpus.

A further two samples made of raw materials with a higher content of Fe_2O_3 colouring the ceramic matrix (4.56% and 5.70% respectively) represent

[6] A detailed description of the principles of this classification system can be found in an article on pottery from Meroe and Hamadab (M. Daszkiewicz, G. Schneider, Keramik aus Meroë und Hamadab. Bericht über die ersten Ergebnisse zur Klassifizierung durch Nachbrennen (MGR-Analyse) und chemische Analyse (WD-XRF), AA 2011/2, 2012, pp. 247-265.

[7] SDB = database for Sudanese ancient pottery. This database of analyses compiled by M. Daszkiewicz (analyses carried out by M. Daszkiewicz, G. Schneider and E. Bobryk) currently encompasses 1235 ceramic fragments recovered from various sites dating from the Mesolithic to the Christian period (see literature).

[8] Very silty kaolinitic clay.

pottery which is absolutely atypical of forms found in Abu Erteila. One of these vessels was made of clay classified as type JA, reference group JA1. Clay type JA made its first appearance in the SDB following the analysis of samples from Abu Erteila. JA is a similar clay type to J, but differs from J in having lower levels of potassium and rubidium. In the second sherd made using clay type YG (sample AD 509, reference group YG4) the iron content (Fe_2O_3 = 5.70%) is largely attributable to the presence of ferruginous aggregates in the non-plastic part of the ceramic body. The provenance of these vessels remains unidentified as there are no known analogies.

A further ten sherds represent samples typical of the ceramic corpus of Abu Erteila (MGR-groups 145-153). They were made using two clay types: H and S. The matrix of these samples is heavily coloured by iron compounds, and several of the samples feature aggregates of iron-poor kaolinitic clay, which affects the Al_2O_3 content (table 2). Only two reference groups – S1.1 and S2 – were confirmed at sites other than Abu Erteila. One sample belonging to each of these groups was discovered at Awlib[9]. Given that these two sites lie on opposite banks of the Wadi el-Hawad (figure 1) one would expect to find a greater number of sherds made of the same clays. Despite the lack of any obvious evidence for local production at Abu Erteila (e.g. kiln wasters), it seems highly probable that sherds belonging to reference groups H2, H3, S1.1, S1.2, S1.3 and S2 represent wares produced at local pottery workshops in Abu Erteila.

One sample (AD 504) exhibited unusual thermal behaviour (figure 4, MGR-group 154), suggesting a significant alteration effect, which also has an impact on changes in chemical composition. This sample was not ascribed to any reference group.

One sherd macroscopically classified to a group of local wares (AD 505) was made of a raw material typical of clays deposited at the point where the wadi enters the Nile valley. It represents a mixed clay type: A/W. A sherd made from the same raw material (attributable to the same MGR-group)[10] was also found at Wad Ben Naga. Its provenance is unknown.

One of the atypical sherds for Abu Erteila (AD 508) was made using type O clay (reference group O2). The same raw material was used to make sherds

[9] M. Daszkiewicz, E. Bobryk, G. Schneider, Archaeoceramological study of pottery fabrics from Awlib, Sudan, Gdansk Archaeological Museum African Reports 3, 2005, pp. 67-78.

[10] Unpublished results of analysis on pottery recovered from Wad Ben Naga. Samples were submitted for analysis courtesy of site director P. Onderka. Analysis was carried out as part of the MUSAWWARAT project run by TOPOI FU Berlin.

discovered in Hamadab, Muweis and Musawwarat[11]. The chemical composition and thermal behaviour of this pottery suggest that it was not made in workshops at either Musawwarat, Hamadab or Muweis. This group of sherds is characterised by a high potassium content (K_2O = 5.69%) and low levels of titanium (TiO_2 = 0.92%), vanadium (V = 64 ppm) and chrome (Cr = 57 ppm) – see table 2.

One of the analysed sherds found at Abu Erteila (sample AD 500) belongs to MGR-group 2.03 and reference group A2. The same raw material was used to make ceramics recovered from Meroe and Musawwarat and from a pottery kiln in Hamadab[12]. It is for this reason the pottery attributed to this reference group is deemed to have been made at workshops in Hamadab.

The results of laboratory analysis indicate that none of the sherds recovered from Abu Erteila which were selected for analysis were made of raw materials representing the reference groups defined for pottery from Musawwarat (Mus 1-4)[13]. However, this is not quite so clearly evident from a macroscopic examination of the sherd fabrics. Figure 5 shows the original cross-sections (i.e. before the samples were refired) of all analysed sherds from Abu Erteila divided into MGR-groups. Figure 6 shows two sherds of pottery from Musawwarat and two sherds from Abu Erteila at 10x magnification. At macroscopic level, one of the fragments is similar in appearance (AD 509) and the other (AD 496) is virtually identical to a typical Musawwarat fabric (two large, single grains are visible in samples from Musawwarat). Refiring proved conclusively that the two sherds were made of different raw materials which had nothing in common with the raw material used for making pottery at Musawwarat (figure 7). The only common trait between pottery from Musawwarat and sample AD 496 is that they are both tempered with kaolinitic clay aggregates. Sample AD 496, which at macroscopic level is the same as the Musawwarat fabric, differs distinctly in its chemical composition. Its thermal behaviour is also very different from that of pottery made at Musawwarat (table 2).

This example demonstrates the need for caution when drawing conclusions about the economic space of particular pottery workshops based solely on macroscopic examination of fabrics.

[11] Reference group O2 equates to group GV of the earlier classification system (M. Daszkiewicz, G. Schneider, Chemical and mineralogical-petrographic composition of fabrics from Musawwarat es-Sufra, Sudan, MittSAG 12, 2001, pp. 80-91.

[12] M. Daszkiewicz, G. Schneider, Keramik aus Meroë und Hamadab, AA 2011/2, 2012, pp. 247-265.

[13] M. Daszkiewicz, C. Näser, New data from the ceramic workshop in courtyard 224, pp. 15-22; M. Daszkiewicz, M. Wetendorf, A new series of laboratory analyses, pp. 99-104.

Figures 8-10 show the forms represented by the analysed sherds divided into MGR-groups. Figure 8 shows sherds made from raw materials with a low iron content (regional wares or imports from beyond the region), while figure 9 shows wares considered most likely to be from local workshops in Abu Erteila. Figure 10 shows sherds that have been noted at other sites in the vicinity (Wad Ben Naga, Musawwarat, Hamada, Meroe, Muweis), which were made regionally (e.g. at Hamada) or imported from beyond the region (such as the group featuring a high potassium content).

CONCLUSIONS

Laboratory analysis revealed the presence at Abu Erteila of pottery made from raw materials not previously noted at any other sites. Some of these wares were doubtless made at regional workshops (probably within the Meroe region). A group of 10 samples typical of the ceramic corpus of Abu Erteila were most probably produced by local workshops using two different types of clay: clay type H and S. In addition, the analysed pottery from Abu Erteila included vessels made at a workshop in Hamadab as well as wares also noted at other local sites – these wares represent regionally traded/exchanged goods as well as imports from beyond the region.

Laboratory analysis did not confirm the presence of local Musawwarat wares at Abu Erteila, despite the macroscopic similarity in fabrics.

ACKNOWLEDGEMENTS

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APPENDIX

DESCRIPTION OF METHODS USED

MGR-ANALYSIS

Four thin slices were cut from each sample in a plane at right angles to the vessel's main axis. One of these sections was left as an indicator of the sample's original appearance, whilst the remaining three were fired in an electric laboratory chamber furnace, each one at a different temperature. Firing was carried out at the following temperatures: 1100°C, 1150°C and 1200°C in air, static, with a heating rate of 200°C/h and a soaking time of 1h at the peak temperature. They were cooled with the kiln to 500ºC and subsequently cooled in air on removal from the kiln. The fragments were then glued on to paper.

CHEMICAL ANALYSIS

Chemical analysis by wavelength-dispersive X-ray fluorescence was used to determine the content of major elements, including phosphorus, and to give a rough estimation of sulphur and chlorine. Total iron was calculated as Fe_2O_3. Samples were prepared by pulverising fragments weighing *c.* 2 g (sample size was determined by the number and size of non-plastic components), having first removed their surfaces and cleaned the remaining fragments with distilled water in an ultrasonic device. The resulting powders were ignited at 900°C (heating rate 200°C/h, soaking time 1h), melted with a lithium-borate mixture (Merck Spectromelt A12) and cast into small discs for measurement. This data is, therefore, valid for ignited samples but, with the ignition losses given, may be recalculated to a dry basis. For easier comparison the major elements are normalised to a constant sum of 100%. Major elements are calculated as oxides.

The precision for major elements is below 1%; for trace elements this rises to a maximum of 20% depending on the concentrations. Accuracy was tested by analysing international reference samples and by exchange of samples with other laboratories. For major elements (except sodium) the maximal deviation mostly is below 5% for sodium and trace elements (except La, Ce, Nb, Pb, Th) below 10%.

Preparation of samples for analysis was carried out by ARCHEA M. Daszkiewicz, measurement using a PANnalytical AXIOS XRF-spectrometer and the calibration of Arbeitsgruppe Archaeometrie by G. Schneider and A. Schleicher in GFZ Potsdam[14].

Małgorzata Daszkiewicz, Swietlana Malykh

PRÓBKI CERAMIKI Z WYKOPALISK W ABU ERTEILA (SUDAN) – KORELACJA MAKROSKOPOWO ZIDENTYFIKOWANYCH TWORZYW CERAMICZNYCH Z LABORATORYJNIE OKREŚLONYMI GRUPAMI SUROWCOWYMI

Streszczenie

Obecny artykuł jest pierwszym z planowanej serii artykułów dotyczących prawidłowej identyfikacji tzw. musawwarat fabric. Analizy laboratoryjne zostały wykonane w ramach projektu Musawwarat realizowanego na Freie Universitat Berlin w Cluster of Excellence TOPOI 2, Research area A – Spacial Environment; A-6 Economic Space. Celem tego projektu było sprawdzenie czy wyroby ceramiczne uznane za wyroby lokalne w Musawwarat es Sufra były przedmiotem eksportu oraz sprawdzenie z jakich ośrodków pochodziła ceramika importowana. W związku z tym zwrócono się z prośbą do kierownictwa misji w Abu Erteila o przekazanie do analiz fragmentów ceramiki typowych dla stanowiska Abu Erteila oraz czerepów, których tworzywo wygląda makroskopowo podobnie do ceramiki lokalnej w Musawwarat es Sufra. W niniejszym artykule autorki przedstawiają wyniki analiz dla 20 fragmentów ceramiki naczyniowej pochodzącej z wykopalisk prowadzonych przez Italian-Russian Archaeological Mission na stanowisku Abu Erteila w Sudanie. Fragmenty te reprezentują różne makroskopowo zdefiniowane rodzaje tworzywa, zarówno typowego jak i nietypowego dla tego stanowiska. Dla wszystkich próbek została wykonana skrócona analiza MGR oraz analiza chemiczna techniką WD-XRF. Wyniki analiz (grupowanie) zostało wykonane z zastosowaniem systemu opracowanego przez M. Daszkiewicz na potrzeby SDB (SDB = database for Sudanese ancient pottery, the database of analysis, baza ta obejmuje obecnie analizy 1235 fragmentów ceramiki pochodzących z różnych stanowisk datowanych od Mezolitu po Chrześcijaństwo). Analizy laboratoryjne wykazały obecności w Abu Erteila wyrobów wyko-

[14] Helmholtz-Zentrum Potsdam, Deutsches Geo-ForschungsZentrum GFZ, Sektion 4.2, Anorganische und Isotopengeochemie.

nanych z surowców nieznanych do tej pory z innych stanowisk. Część z tych wyrobów niewątpliwie pochodzi z warsztatów regionalnych (prawdopodobnie z okolic Meroe). Grupa 10 próbek typowych dla korpusu ceramiki z Abu Erteila została wykonana najprawdopodobniej w lokalnych warsztatach z dwóch różnych typów gliny, gliny typ H oraz S. Ponadto w Abu Erteila znalezione zostały wyroby ceramiczne z warsztatu w Hamadab oraz znane również na innych okolicznych stanowiskach wyroby będące przedmiotem wymiany/handlu regionalnego jak i będące importami spoza regionu. Analizy laboratoryjne nie potwierdziły obecności w Abu Erteila wyrobów lokalnych z Musawwarat pomimo makroskopowych podobieństw tworzywa.

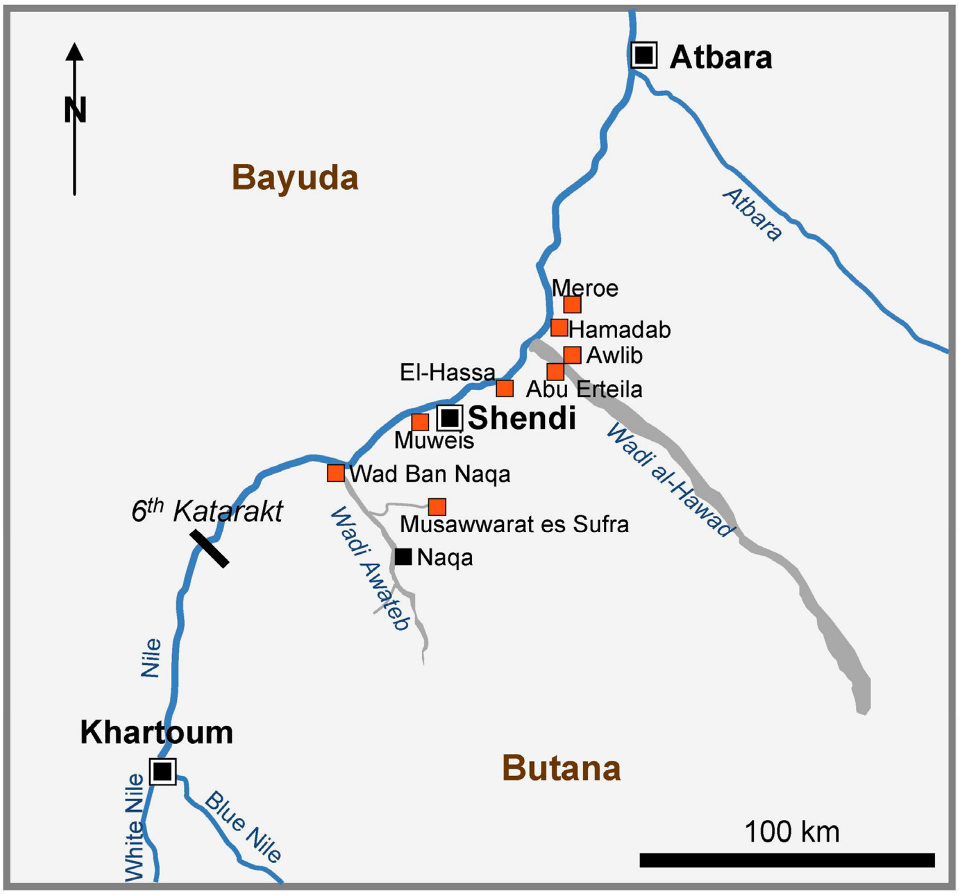

Fig. 1. Location of Abu Erteila and other principal Meroitic sites in the Western Butana region. Red squares = sites from which ceramic sherds have been analysed by M. Daszkiewicz, G. Schneider, E. Bobryk (map created by E. Bobryk)

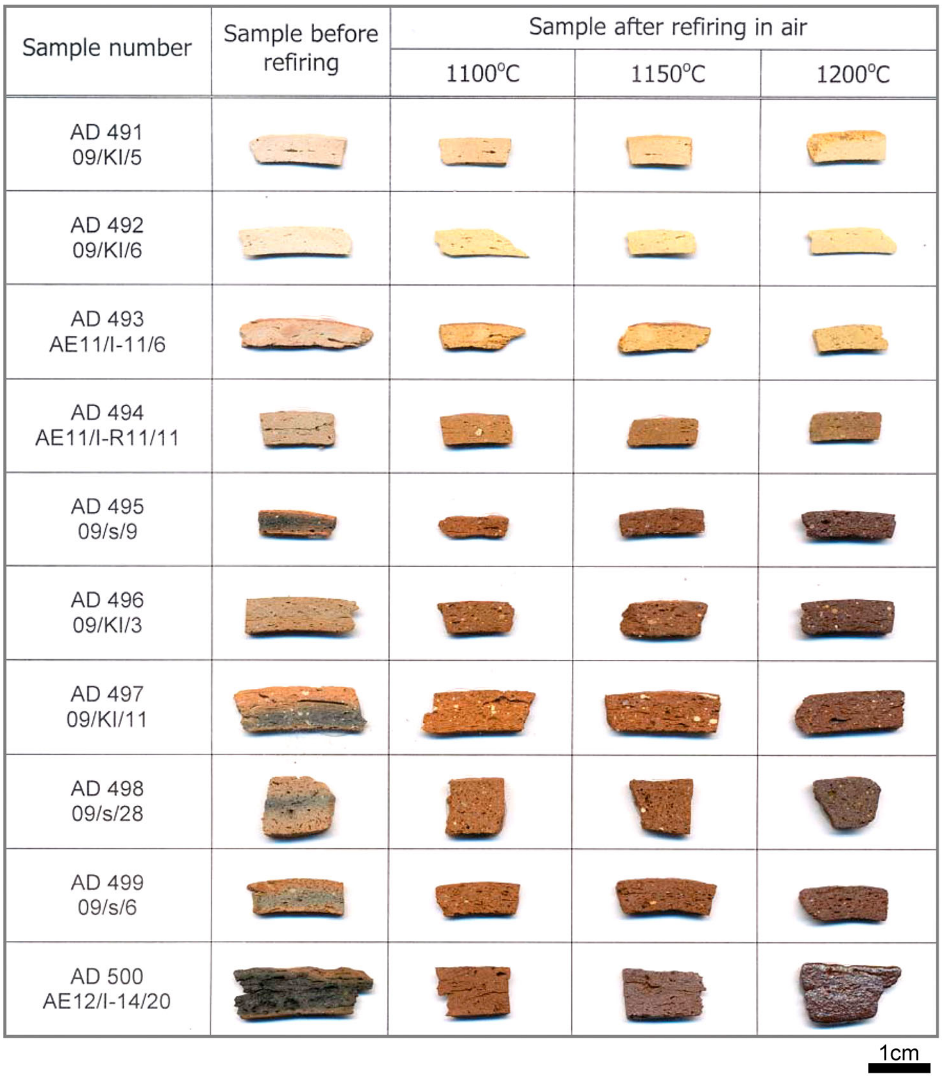

Fig. 2. Original MGR-chart. Samples before and after refiring (scan by H. Baranowska)

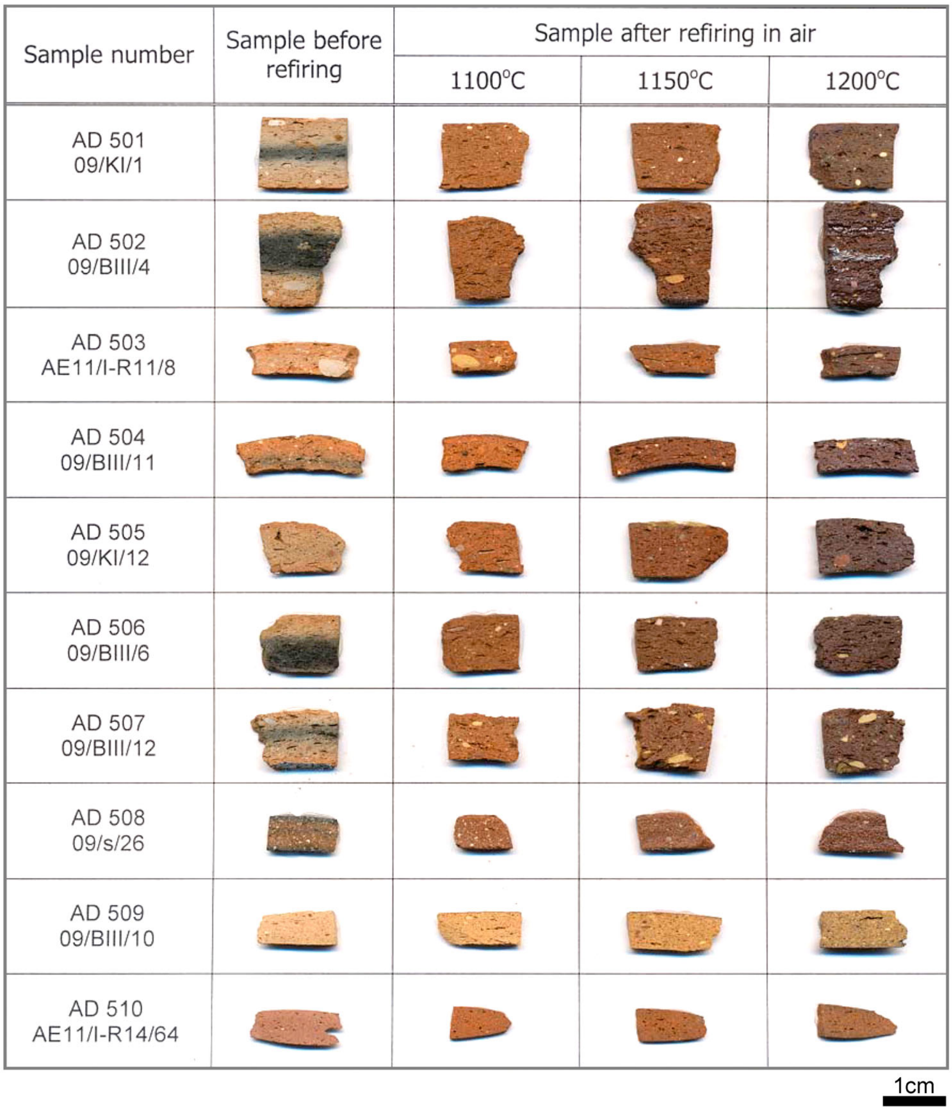

Fig. 3. Original MGR-chart. Samples before and after refiring (scan by H. Baranowska)

Fig. 4. Samples after refiring at 1200°C grouped according to their attribution to MGR-groups (photos: M. Baranowski)

Fig. 5. Appearance of original samples; samples grouped according to their attribution to MGR-groups (photos: M. Baranowski)

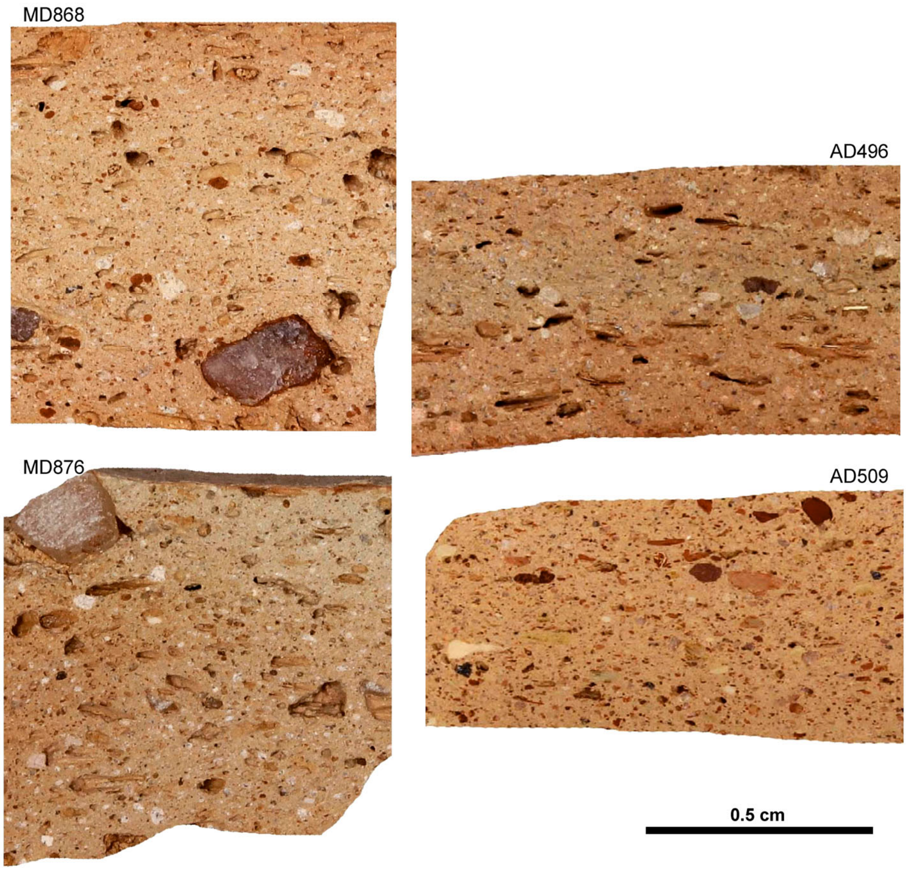

Fig. 6. Two sherds found at Musawwarat es Sufra representing Musawwarat fabric (MGR-groups 102 and 102.02, reference group Mus 2) and two sherds found at Abu Erteila; sample AD496 represents a fabric local to Abu Erteila; sample AD509 represents a regional ware (photos: M. Baranowski)

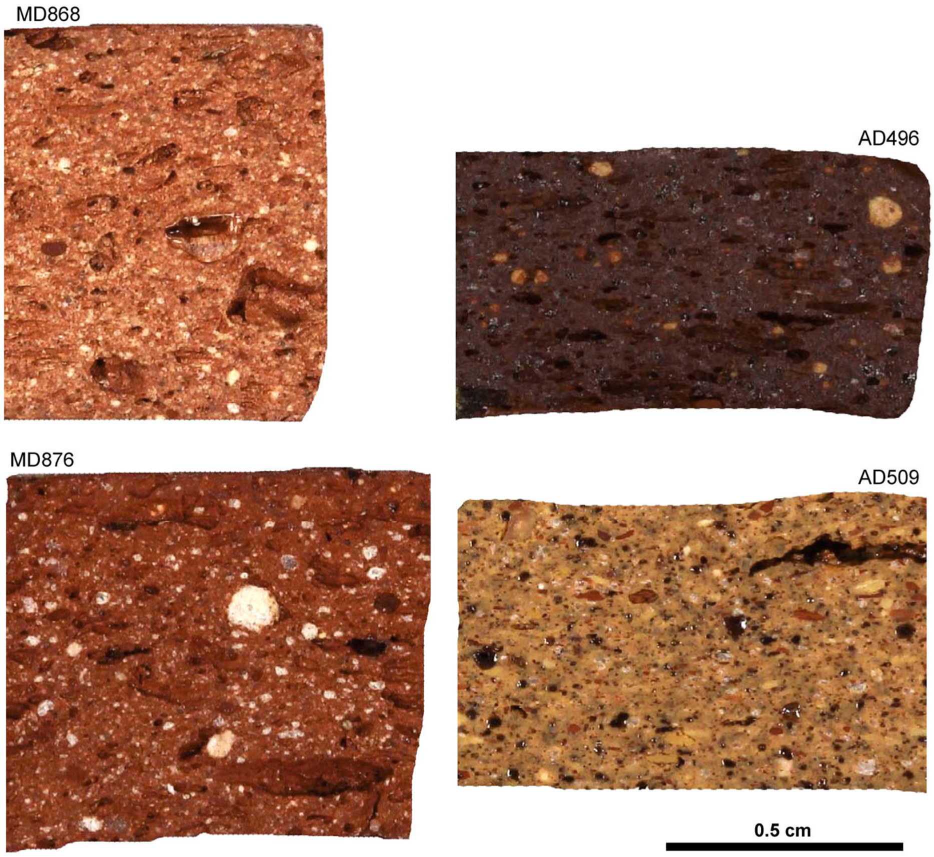

Fig. 7. The same samples as shown in figure 6 after refiring at 1200ºC. Samples found at Abu Erteila were made from distinctly different raw materials than samples found at Musawwarat es Sufra (photos: M. Baranowski)

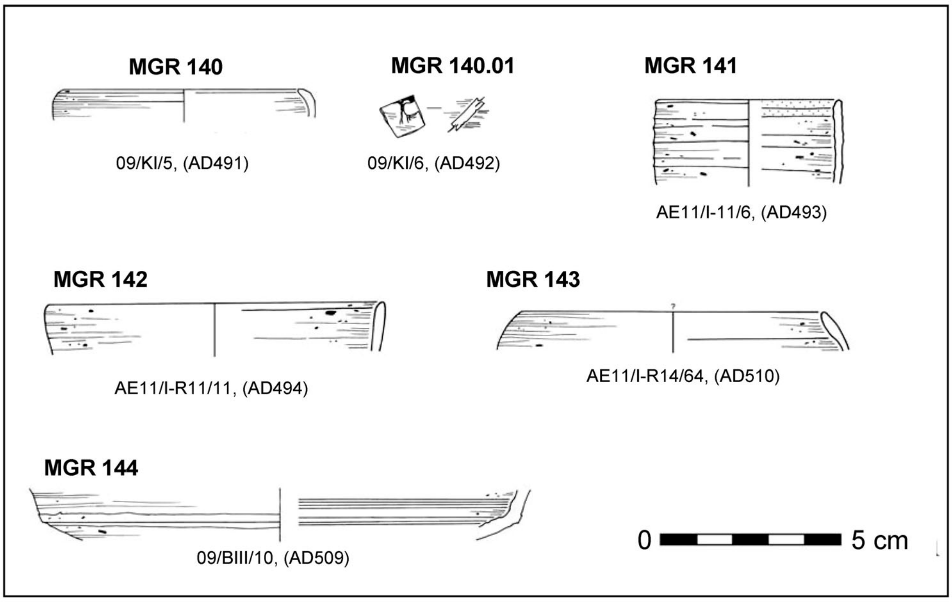

Fig. 8. Pottery found at Abu Erteila. Wares made of various kaolinitic clays (drawings: S. Malykh)

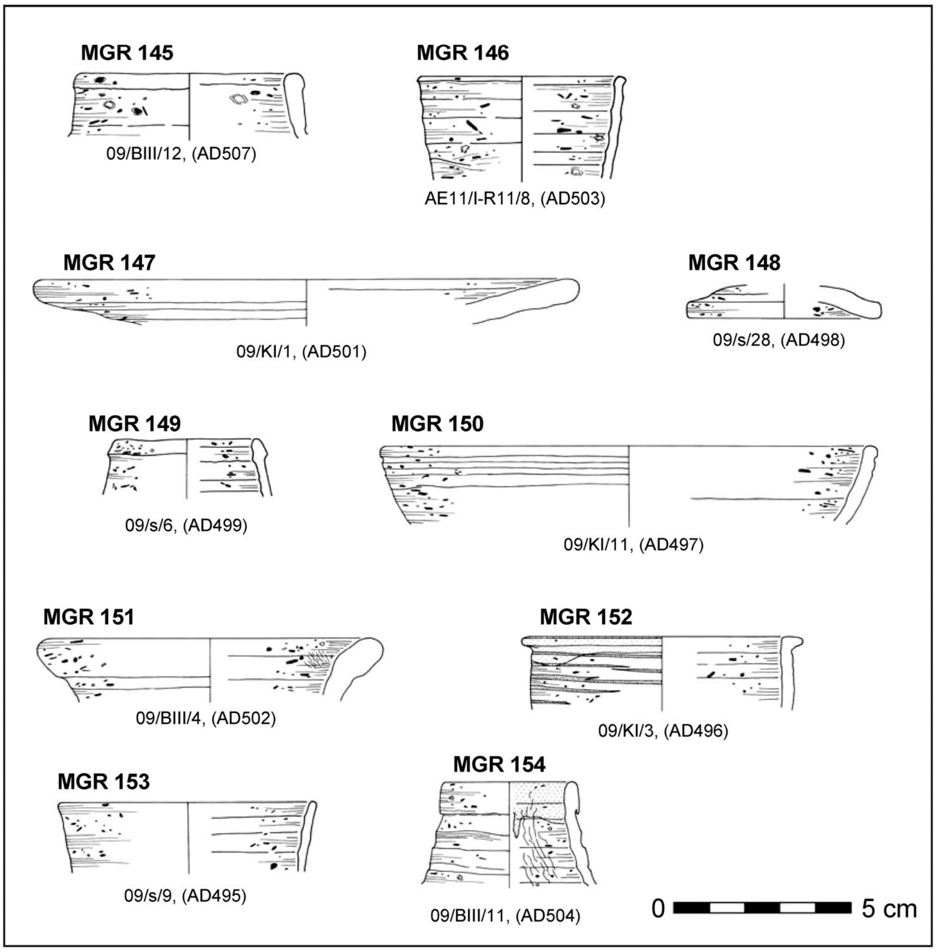

Fig. 9. Pottery representing typical wares of the Abu Erteila ceramic corpus; these were most probably made at local, on-site pottery workshops (drawings: S. Malykh)

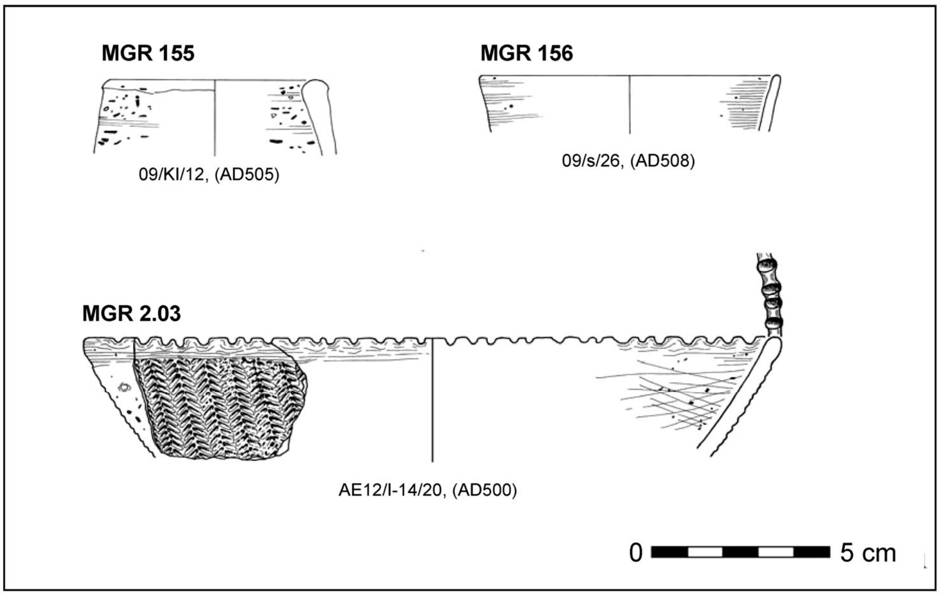

Fig. 10. Pottery found at Abu Erteila: regional/imported wares (drawings: S. Malykh)

Tab. 1a. S. Malykh's descriptions of the analysed sherds

Sample number	Description (by S. Malykh)
Samples typical of the ceramic corpus of Abu Erteila	
AD 494 AE11/I-R11/11	Rim of wheel-made bowl, probably late Meroitic Period. Fine wadi clay fabric, grey, red-polished engobe inside and outside. Archaeological context: Kom I, fill of Room 11, upper layer
AD 495 09/s/9	Rim of wheel-made bowl, Meroitic Period(?) Fine wadi(?) clay fabric, light red-brown, without engobe. Archaeological context: upper surface of the site (mixed upper layer).
AD 496 09/KI/3	Rim of wheel-made bowl, late Meroitic Period. Fine wadi clay fabric, grey-beige, red engobe inside and partly outside, line-polished inside and outside. Archaeological context: Kom I, upper surface (mixed upper layer).
AD 497 09/KI/11	Rim of wheel-made bowl, late Meroitic Period. Medium-fine wadi clay fabric, pale red-brown, red engobe outside. Archaeological context: Kom I, upper surface (mixed upper layer).
AD 498 09/s/28	Rim of wheel-made small plate / lid, Meroitic Period. Medium-fine wadi clay fabric, grey-beige, red engobe. Archaeological context: upper surface of the site (mixed upper layer).
AD 499 09/s/6	Rim of wheel-made globular jar, late Meroitic Period. Medium-fine wadi clay fabric, grey-beige, red-brown engobe. Archaeological context: upper surface of the site (mixed upper layer).
AD 501 09/KI/1	Rim of wheel-made stand / plate, Meroitic Period. Medium-coarse wadi clay fabric, grey-beige, red polished engobe. Archaeological context: Kom I, upper surface (mixed upper layer).
AD 502 09/BIII/4	Rim of wheel-made stand for a censer, Meroitic Period. Medium-coarse wadi clay fabric, grey-beige, red engobe inside and partly outside. Archaeological context: Kom I, sondage (test pit) BIII, middle layer.
AD 503 AE11/I-R11/8	Rim of wheel-made cup, probably late Meroitic Period. Medium-coarse wadi clay fabric, grey-beige, red engobe. Archaeological context: Kom I, fill of Room 11, upper layer.
AD 504 09/BIII/11	Rim of wheel-made jar, late Meroitic Period / post-Meroitic Period. Medium-fine wadi clay fabric, grey-beige-orange, brown engobe inside and partly outside. Archaeological context: Kom I, sondage BIII, middle layer.
AD 505 09/KI/12	Rim of wheel-made large tubular jar, late Meroitic Period. Medium-fine wadi clay fabric, grey-beige, red engobe outside. Archaeological context: Kom I, upper surface (mixed upper layer).
AD 506 09/BIII/6	Lower part of body of wheel-made large tubular jar, late Meroitic Period. Medium-fine wadi clay fabric, grey-beige, red engobe outside. Archaeological context: Kom I, sondage BIII, middle layer. *(Undrawn)*
AD 507 09/BIII/12	Rim of wheel-made large tubular jar, late Meroitic Period. Medium-coarse wadi clay fabric, grey-beige, red engobe outside. Archaeological context: Kom I, sondage BIII, middle layer.

Source: Authors' own work

Tab. 1b. S. Malykh's descriptions of the analysed sherds

Sample number	Description (by S. Malykh)
Samples made of classical kaolinitic clay fabrics of the Meroe Region; these fine wheel-made bowls and cups were probably transported to Abu Erteila from the capital	
AD 491 09/KI/5	Rim of wheel-made bowl, Meroitic Period. Fine kaolinitic clay fabric, milky-white, without engobe (slip). Archaeological context: Kom I, upper surface (mixed upper layer).
AD 492 09/KI/6	Wall of wheel-made bowl with red-painted decoration inside, Meroitic Period. Fine kaolinitic clay fabric, milky-white, without engobe. Archaeological context: Kom I, upper surface (mixed upper layer).
AD 493 AE11/I-11/6	Rim of wheel-made cup, probably late Meroitic Period. Medium-fine kaolinitic clay fabric, grey-beige, red engobe inside and outside, polished outside and partly inside. Archaeological context: Kom I, fill of Room 10, upper layer.
The sample not common at Abu Erteila site: at the moment we have no more than 10 fragments of such ware	
AD 500 AE12/I-14/20	Rim of hand-made bowl with mat prints outside, late Meroitic Period / post-Meroitic Period. Medium-fine alluvial(?) clay fabric, dark red-brown (2.5YR3/3), partly polished inside. Archaeological context: Kom I, square I-14, middle layer.
Samples absolutely atypical for the ceramic corpus of Abu Erteila	
AD 508 09/s/26	Rim of hand-made bowl, Meroitic Period / post-Meroitic Period. Medium-fine wadi(?) clay fabric, dark brown, polished inside and outside. Archaeological context: upper surface of the site (mixed upper layer).
AD 509 09/BIII/10	Rim of wheel-made jar(?), Meroitic Period(?). Medium-fine wadi(?) / kaolinitic(?) / mixed(?) clay fabric, beige, brown engobe outside. Archaeological context: Kom I, sondage BIII, middle layer.
AD 510 AE11/I-R14/64	Rim of wheel-made bowl, Meroitic Period. Fine kaolinitic(?) clay fabric, grey-pink (7.5R7/3), red engobe. Archaeological context: Kom I, fill of Room 14, under burnt deposit.

Source: Authors' own work

Tab. 2. Results of chemical analysis by WD-XRF. Analysis of samples ignited at 900°C and melted

MGR	Lab.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	V	Cr	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba	(La	Ce)	l.o.i.	TOTAL
group	No.	per cent by weight										ppm													%	%
	various clays low in iron, regional/imports																									
140	AD491	73.51	1.61	20.10	2.36	0.018	0.24	1.18	0.33	0.45	0.20	85	156	27	48	20	9	139	23	308	25	649			3.45	99.88
140.01	AD492	72.65	1.58	21.29	2.19	0.010	0.18	1.11	0.39	0.44	0.16	106	161	34	19	33	14	166	41	421	26	356	41	110	2.79	100.13
141	AD493	71.19	1.58	21.16	2.92	0.016	0.30	1.35	0.58	0.76	0.14	139	172	48	39	40	17	141	51	416	23	370	51	82	4.36	99.95
142	AD494	70.25	1.57	19.99	3.41	0.029	0.64	1.92	1.34	0.72	0.15	138	159	34	18	34	18	170	35	406	27	212	23	70	6.04	100.63
143	AD510	70.71	1.50	19.72	4.56	0.038	0.34	1.59	0.85	0.51	0.18	155	168	36	21	41	13	132	21	401	25	180			7.19	99.41
144	AD509	62.63	1.90	25.29	5.70	0.065	1.05	1.18	0.50	1.52	0.16	172	153	46	30	42	54	213	44	263	32	292	66	103	1.04	98.19
	local at Abu Erteila																									
145	AD507	62.84	1.74	21.00	6.92	0.061	1.43	3.16	1.45	1.16	0.24	153	136	52	41	93	36	314	38	421	31	454	47	108	5.76	99.80
145	AD506	62.59	1.79	20.57	6.63	0.095	1.62	3.31	1.85	1.26	0.29	158	146	61	125	72	37	295	39	413	32	427	53	96	6.43	99.89
146	AD503	62.29	1.82	22.11	7.21	0.101	1.44	2.50	1.19	1.10	0.25	156	142	58	114	95	34	220	44	397	31	375	61	105	3.83	99.37
147	AD501	64.29	1.90	21.48	5.94	0.095	1.54	2.36	0.89	1.23	0.28	139	147	55	26	81	32	283	46	362	34	824	56	100	3.40	99.52
148	AD498	64.17	1.80	20.78	6.61	0.094	1.36	2.93	0.91	1.08	0.27	141	149	62	35	75	23	388	56	402	36	1208	47	142	4.93	99.24
149	AD499	64.83	1.69	18.82	7.35	0.101	1.52	3.16	0.81	1.38	0.33	150	167	74	50	90	31	401	47	337	28	1049	47	92	4.37	99.56
150	AD497	69.97	1.47	17.31	6.09	0.088	1.33	2.01	0.55	0.81	0.36	140	147	52	38	62	26	162	37	351	26	366	42	53	1.66	100.00
151	AD502	66.63	1.48	17.26	6.53	0.090	1.59	3.37	1.17	1.25	0.62	151	159	68	48	79	31	265	40	347	26	591	39	77	4.45	99.69
152	AD496	68.04	1.55	17.15	7.06	0.124	1.36	2.42	1.03	1.07	0.20	124	136	61	34	68	28	232	46	363	25	745	31	57	3.02	99.45
153	AD495	67.58	1.60	15.89	8.02	0.120	1.79	2.52	0.94	1.24	0.30	156	151	65	44	81	36	234	48	340	25	539	50	47	2.16	99.59
	?																									
154	AD504	62.73	1.45	18.94	10.12	0.098	1.66	2.77	1.08	0.85	0.31	163	132	75	50	77	26	232	33	247	22	581	22	54	2.17	99.78
	various clays, regional/imports																									
155	AD505	66.59	1.43	16.67	8.57	0.097	1.45	3.00	0.84	1.12	0.24	139	114	52	44	61	24	294	56	263	20	629	48	100	3.36	100.40
156	AD508	63.01	0.92	20.20	6.07	0.063	0.91	1.89	1.13	5.69	0.12	64	57	44	10	64	149	251	61	584	31	689	90	182	3.72	99.54
2.03	AD500	60.75	1.91	17.03	10.74	0.181	2.53	3.50	1.40	1.63	0.32	198	168	84	53	105	51	294	43	303	32	561	40	70	1.43	100.15
	local at Musawwarat, reference group Mus 4 (Näser, Daszkiewicz 2013)																									
102.02	MD868	67.28	1.48	22.81	4.99	0.060	0.82	1.18	0.19	1.01	0.17	142	155	48	31	46	29	109	53	271	18	261	45	104	1.77	100.36
102	MD876	68.20	1.43	21.49	5.42	0.070	0.85	1.07	0.15	1.13	0.19	140	151	54	23	52	30	102	45	279	18	258	59	88	1.48	100.61

Source: Preparation by M. Daszkiewicz ARCHEA, measurements by G. Schenider and A. Schleicher GFZ Potsdam

Tab. 3. Provenance grouping. The numbering of MGR-groups and reference groups is consistent with that used in the SDB

Sample No.	Lab. No.	MGR group	Reference group	Other sites	Production place
09/KI/5	AD 491	140	Y4	no	?
09/KI/6	AD 492	140.01	Y4	no	?
AE11/I-11/6	AD 493	141	Y4	no	?
AE11/I-R11/11	AD 494	142	YB3	no	?
AE11/I-R14/64	AD 510	143	JA1	no	?
09/BIII/10	AD 509	144	YG4	no	?
09/BIII/6	AD 506	145	H2	no	Abu Erteila?
09/BIII/12	AD 507	145	H2	no	Abu Erteila?
AE11/I-R11/8	AD 503	146	S1.1	Awlib	Abu Erteila?
09/KI/11	AD 501	147	S1.2	no	Abu Erteila?
09/s/28	AD 498	148	H2	no	Abu Erteila?
09/s/6	AD 499	149	S1.3	no	Abu Erteila?
09/KI/11	AD 497	150	S2	Awlib	Abu Erteila?
09/BIII/4	AD 502	151	H3	no	Abu Erteila?
09/KI/3	AD 496	152	H2	no	Abu Erteila?
09/s/9	AD 495	153	H2	no	Abu Erteila?
09/BIII/11	AD 504	154	?	no	?
09/KI/12	AD 505	155	A/W1	Wad Ban Naga	?
09/s/26	AD 508	156	O2	Hamadab, Muweis, Musawwarat	?
AE12/I-14/20	AD 500	2.03	A2	Hamadab, Meroe, Musawwarat	Hamadab

Source: Authors' own work; no = no analogy was found for the given sample from Abu Erteila among all of the samples in the SDB (the SDB encompasses 1235 samples from various sites in Sudan)

Bibliography

Bobryk E., Daszkiewicz M., Raw material classification of Mesolithic to Early Islamic pottery from the Karima-Abu Hamad region (Sudan), H. Paner (ed.), Gdansk Archaeological Museum African Reports 2, 2003, pp. 77-80.

Bobryk E., Daszkiewicz M., Schneider G., Continuity and change in pottery making from the Mesolithic to Christian period in the Fourth Cataract region (Sudan), H. Paner (ed.), Gdansk Archaeological Museum African Reports 2, 2003, pp. 81-89.

Bobryk E., Daszkiewicz M., Schneider G., Archaeoceramological study of pottery fabrics from Awlib, Sudan, Gdansk Archaeological Museum African Reports 3, 2005, pp. 67-78.

Bobryk E., Daszkiewicz M., Schneider G., Laboratory analysis of materials recovered from sites HP45 and HP47, Gdansk Archaeological Museum African Reports 5, 2007, pp. 103-121.

Bobryk E., Daszkiewicz M., El-Tayeb M., Kolosowska E., Schneider G., Composition and technology of pottery from Neolithic to Christian periods from Jebel el-Ghaddar and from the Karima-Abu Hamed region, Sudan, Archéologie du Nil Moyen 9, 2002, pp. 65-87.

Daszkiewicz M., Ancient pottery in the laboratory – principles of archaeoceramological investigations of provenance and technology, Novensia 25, 2014, pp. 177-199.

Daszkiewicz M., Refiring, [in:] A. Hunt (ed.), The Oxford Handbook of Archaeological Ceramics Analysis, in press.

Daszkiewicz M., Schneider G., Chemical and mineralogical-petrographic composition of fabrics from Musawwarat es-Sufra, Sudan, MittSAG 12, 2001, pp. 80-91.

Daszkiewicz M., Schneider G., Keramik aus Meroë und Hamadab. Bericht über die ersten Ergebnisse zur Klassifizierung durch Nachbrennen (MGR-Analyse) und chemische Analyse (WD-XRF), AA 2011/2, 2012, pp. 247-265.

Daszkiewicz M., Wetendorf M., A new series of laboratory analyses of coarse wares from „pottery courtyard" 224 of the Great Enclosure in Musawwarat es-Sufra (Sudan), MittSAG 24, 2014, pp. 99-104.

Daszkiewicz M., Näser C., New data from the ceramic workshop in courtyard 224 of the Great Enclosure in Musawwarat es-Sufra, MittSAG 24, 2013, pp. 15-22.