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NEW DATA FROM THE CERAMIC WORKSHOP IN COURTYARD 224 OF THE GREAT ENCLOSURE IN MUSAWWARAT ES SUFRA

In 1997, parts of a substantial ceramic deposit identified as the dump from a potter's workshop were excavated in courtyard 224 of the Great Enclosure.¹ They were investigated in trench 224.12, comprising an area of 5 x 5 m in the northeastern corner of the courtyard. This trench enlarged an architectural sondage, 224.9, of an earlier season, 1995/96, which had alerted attention to the deposit and resulted in the 1997 investigations.² The same deposit allegedly also showed in sondage 224.8 abutting the central part of the courtyard's northern wall, also excavated in 1995/96.³ Contrary to the assumption of Steffen Wenig (in Edwards 1999, 4-6), the deposit could not be detected in trenches 2241 and 2242 in the southeastern part of courtyard 224, which had first been excavated by Fritz Hintze (1967/68, 289: plan IV, 1968, plan IV) in his sixth field season in 1965/66 and were reinvestigated and enlarged into trench 224.10 by Hans-Ulrich Onasch (2001, 52-53, Abb. 1) in 1999. Data from these minor locations remain to be integrated with the main excavation of trench 224.12.

From the 1997 excavations of trench 224.12 some 24,200 sherds were recorded and subjected to a first analysis by David Edwards.⁴ Edwards also produced a preliminary fabric series, which partly relies on earlier work undertaken by Anne Seiler on the finds from the 1995/96 sondages 224.8 and 224.9 (Seiler 1998) and the pottery corpus from the Small Enclosure (Seiler 1999). While Edwards adopts Seiler's fabric groups A (Nile silt), B (mixed clay) and C (kaolin), he also introduces fabric group H, which according to him represents pottery "manufactured from locally-dug wadi silts" (Edwards 1999, 18, 27). Generally, Edwards (1999, 16) notes the "unusual nature of the assemblage as a whole, which includes a relatively limited number of different wares or

fabric types, while being quantitatively dominated by a single (local) range of products".

The ceramics from courtyard 224 have now become the focus of a project under the auspices of the Berlin Cluster of Excellence TOPOI, whose aim it is to take up the unfinished analyses of the materials excavated in 1995/96 and 1997, continue investigations on the site and shed further light on pottery production and consumption in Musawwarat.⁵ One first step in this endeavour was a reconnaissance of the finds of the 1997 field season in the storerooms of the Musawwarat mission in July 2013. In the course of this work, a first limited number of samples was selected (Claudia Näser), exported to Berlin and later to Warsaw, and subsequently analysed (Malgorzata Daszkiewicz).⁶ In all, 44 samples were taken. They comprised 39 samples from sherd material from trench 224.12 and one melted ball (sample 2013.224.32) from the same location, as well as four comparative samples from other contexts.

Abridged MGR analysis and chemical analysis by WD-XRF was conducted on all 44 samples. Physical ceramic properties (open porosity, water absorption and apparent density) were measured for 25 selected samples. The first of the analytical procedures to be carried out was abridged MGR analysis. In defining different MGR groups, the thermal behaviour of each sample when refired at three temperatures (1100 °C, 1150 °C and 1200 °C) is taken into consideration. Definitive classification is based on thermal

1 Wenig and Wolf 1998c, 29-33; Edwards 1998, 1999.

2 Wenig and Wolf 1998a, 29, map 6, 1998b, 44; Seiler 1998, giving a wrong position („Südwestecke“) for the sondage. Cf. Edwards 1999, 67: fig. 4.

3 Wenig and Wolf 1998a, 29, map 6, 1998c, 29.

4 Wenig and Wolf 1998c, 30; Edwards 1998, 1999.

5 For the project in question, „Meroitische Feinkeramik: Produktion, Distribution, Nutzung“, see <http://www.topoi.org/project/a-6-5/>. The financial and logistic support of TOPOI towards conducting this project and undertaking the analysis presented in this paper is gratefully acknowledged.

6 The authors would like to express their gratitude towards the National Corporation for Antiquities and Museums of Sudan, in particular towards Dr. Abdelrahman Ali and el-Hassan Ahmed Mohammed, for granting an export permission and assisting in the necessary logistic procedures at short notice.



| Musawwarat sample ID | ZN | Lab. No. | Fabric by Edwards | Ware | Physical ceramic properties | | | MGR-analysis | | MGR group (SDB) |
|-------------------------|----------------|-------------|-------------------------|------------------------------|-----------------------------|-------------|----------------------------|-----------------------------|-----------------------|-----------------------|
| | | | | | Po [%] | N [%] | dv [g/cm ³] | thermal behaviour at 1200°C | | |
| | | | | | | Matrix type | Matrix colour | | | |
| 2013.224.4 | none | MD862 | none | fineware | 27.65 | 15.23 | 1.82 | SN | dark beige-greenish | 95 |
| 2013.224.28 | 916 | MD886 | none | fineware | 31.57 | 18.36 | 1.72 | SN | beige-greenish | 95 |
| 2013.224.30 | 324B | MD888 | none | fineware | 29.50 | 16.92 | 1.74 | SN | beige-greenish | 95 |
| 2013.224.33 | 905 / 911 | MD891 | none | fineware | 35.53 | 21.27 | 1.67 | ovF | grayish-greenish | 96 |
| 2013.224.40 | 938 | MD898 | none | fineware | 33.26 | 19.62 | 1.70 | ovF | grayish-greenish | 96 |
| 2013.224.35 | none | MD893 | none | fineware | 30.33 | 17.50 | 1.73 | ovF | pale grayish-greenish | 96.01 |
| 2013.224.23 | 322B | MD881 | none | fineware | 34.46 | 19.86 | 1.74 | SN | beige | 97 |
| 2013.224.25 | 861 | MD883 | none | fineware | 33.41 | 19.48 | 1.72 | SN | beige | 97 |
| 2013.224.27 | 903 | MD885 | none | fineware | 32.59 | 18.80 | 1.73 | SN | beige | 97 |
| 2013.224.2 | 879 | MD860 | none | fineware | 27.13 | 15.43 | 1.76 | SN | dark beige | 98 |
| 2013.224.3 | 300 | MD861 | none | fineware | 31.13 | 18.04 | 1.73 | SN | dark beige | 98 |
| 2013.224.22 | 324 | MD880 | none | fineware | 30.08 | 17.01 | 1.77 | SN | pale brownish-beige | 99 |
| 2013.224.24 | 853 | MD882 | none | fineware | 30.87 | 17.39 | 1.78 | SN | pale brownish-beige | 99 |
| 2013.224.26 | 876 | MD884 | none | fineware | 30.97 | 17.77 | 1.74 | SN | pale brownish-beige | 99 |
| 2013.224.29 | 918 | MD887 | none | fineware | 31.30 | 17.62 | 1.78 | SN | pale brownish-beige | 99 |
| 2013.224.1 | 837 | MD859 | none | fineware (red slipped bowls) | 34.22 | 20.75 | 1.65 | SN | grayish-beige | 100 |
| 2013.224.13 | 794 | MD871 | none | fineware (red slipped bowls) | 35.67 | 21.72 | 1.64 | SN | grayish-beige | 100 |
| 2013.224.31 | 836 | MD889 | none | coarse ware (jar) | - | - | - | SN | brownish-beige | 101 |
| 2013.224.5 | 792 | MD863 | none | coarse ware | 39.33 | 24.68 | 1.59 | SN | reddish-brownish | 102 |
| 2013.224.7 | 788 | MD865 | H3 | coarse ware | - | - | - | SN | reddish-brownish | 102 |
| 2013.224.14 | 782 | MD872 | H1 | coarse ware | - | - | - | SN | reddish-brownish | 102 |
| 2013.224.15 | 726 | MD873 | B1 | coarse ware | 38.34 | 24.49 | 1.57 | SN | reddish-brownish | 102 |
| 2013.224.16 | 735 | MD874 | B1 | coarse ware | 41.09 | 27.08 | 1.52 | SN | reddish-brownish | 102 |
| 2013.224.17 | 737 | MD875 | B1 | coarse ware | 39.00 | 24.89 | 1.57 | SN | reddish-brownish | 102 |
| 2013.224.18 | 719 | MD876 | none | coarse ware | 41.75 | 27.04 | 1.54 | SN | reddish-brownish | 102 |
| 2013.224.20 | 820 | MD878 | H1? | coarse ware | 30.72 | 17.17 | 1.79 | SN | reddish-brownish | 102 |
| 2013.224.38 | 777 | MD896 | none | coarse ware | - | - | - | SN | reddish-brownish | 102 |
| 2013.224.8 | 772 | MD866 | B1 | coarse ware | - | - | - | SN | darker than 102 | 102.01 |
| 2013.224.9 | 773 | MD867 | B1 | coarse ware | - | - | - | SN | darker than 102 | 102.01 |
| 2013.224.19 | 718 | MD877 | H1 | coarse ware | 35.75 | 21.31 | 1.68 | SN | darker than 102 | 102.01 |
| 2013.224.21 | 712, joins 616 | MD879 | H3? | coarse ware | 39.36 | 24.99 | 1.57 | SN | darker than 102 | 102.01 |
| 2013.224.34 | 716 | MD892 | H3? | coarse ware | - | - | - | SN | darker than 102 | 102.01 |
| 2013.224.39 | 785 | MD897 | none | coarse ware | - | - | - | SN | darker than 102 | 102.01 |
| 2013.224.6 | 789 | MD864 | H3 | coarse ware | - | - | - | SN | paler than 102 | 102.02 |
| 2013.224.10 | 774 | MD868 | H3 | coarse ware | - | - | - | SN | paler than 102 | 102.02 |
| 2013.224.12 | 344, joins 771 | MD870 | B1 | coarse ware | 43.03 | 28.47 | 1.51 | SN | paler than 102 | 102.02 |
| 2013.224.36 | none | MD894 | none | fineware | 25.70 | 13.60 | 1.89 | SN | red-brownish | 103 |
| 2013.224.37 | 821 | MD895 | none | fineware (carinated bowl) | 26.45 | 14.73 | 1.80 | SN | gray-brown | 104 |
| 2013.224.11 | 778 | MD869 | none | coarse ware (offering stand) | - | - | - | SN | gray-brown | 104 |

Table 1: Musawwarat. List of analysed samples. Concordance of sample numbers, 'Zeichnummer' for identification in the Musawwarat recording system (Wenig in Edwards 1999, 1), fabric according to Edwards 1999 and laboratory number (identification number in the Daszkiewicz-Schneider database). Values of physical ceramic properties: P = open porosity, N = water absorption, dv = apparent density, - = analysis was not done.

behaviour at 1200 °C.⁷ When samples exhibit the same appearance, colour and shade after refiring at 1200 °C this indicates that they were made from the same plastic raw material. All pottery samples belonging to the same MGR group⁸ were made of the same clay or of the same ceramic body in those instances where intentional temper was not added. When MGR analysis and chemical analysis have been completed, each of the analysed samples is

added to a database of pottery from Sudan (SDB⁹). Thus, pottery from Musawwarat has been grouped in keeping with a uniform system used for classifying archaeological pottery from Sudan.¹⁰ This system relies on the four-stage attribution of a given ceramic sample to an MGR group/reference group/production region/clay type. In the following, first results

⁷ This description is a standardised one which is used for describing all analysed ceramic fragments.

⁸ The term 'group' is used even when the group in question is represented by one single sample only. It is unlikely that only a solitary vessel was made from one ceramic body, therefore it is assumed that the sample submitted for analysis represents a group of vessels made from the same material.

⁹ Malgorzata Daszkiewicz has been analysing archaeological pottery from Sudan since 1991; since 1997 all chemical analyses have been undertaken in cooperation with Gerwulf Schneider. The database currently encompasses 1150 ceramic fragments.

¹⁰ The principles of this classification system are described in an article on pottery from Meroe and Hamadab (Daszkiewicz and Schneider 2012).



of the analysis of the 39 pottery samples from trench 224.12 are discussed (tab. 1).

RESULTS OF THE ANALYSIS

MGR analysis revealed that 36 pottery samples are characterised by a sintered matrix type;¹¹ these samples included all coarse ware sherds and 16 fragments of fineware pottery. Only three fragments of fineware have an over-fired matrix type¹² (tab. 1). Ten MGR groups were distinguished taking into consideration thermal behaviour, i.e. the colour of the matrix and the matrix type (colour fig. 4). Fineware is the only type of pottery belonging to MGR groups 95–100 and 103, whilst MGR groups 101–102 are represented solely by coarse ware (numbering of MGR groups corresponds to SDB numbers). MGR group 104 is represented by only two sherds, one of which is a fineware (carinated bowl), while the other is a coarse ware (offering stand). Fineware with an over-fired matrix type was made from a ceramic body which fired greyish-greenish at 1200 °C. All fineware pottery with a sintered matrix type was made using ceramic bodies which fired various shades of beige at 1200 °C (beige, beige-greenish, dark beige, pale brownish-beige, greyish-beige). Pottery belonging to MGR groups 97–99 was made from very similar ceramic bodies, slight colour variations stemming from differences in the way the raw materials were mixed together (one pale-firing raw material and one coloured by iron compounds). Only one fragment of coarse ware (jar, MGR group 101) was made from a ceramic body which fired brownish-beige at 1200 °C. The remaining 18 coarse ware sherds take on shades of reddish-brown (MGR group 102). The fineware sherd representing MGR group 103 (MD894) was made using a ceramic body with a temper which is almost invisible macroscopically. Coarse ware pottery fragments representing MGR groups 101 and 102 were made from the same plastic raw material as sample MD894 with the addition of a coarse temper. MD876 has clearly visible clay lumps that exhibit the same thermal behaviour as the matrix of sample MD894 (colour fig. 4).

Measurements of physical ceramic properties (open porosity, water absorption and apparent density) showed that all fineware sherds are character-

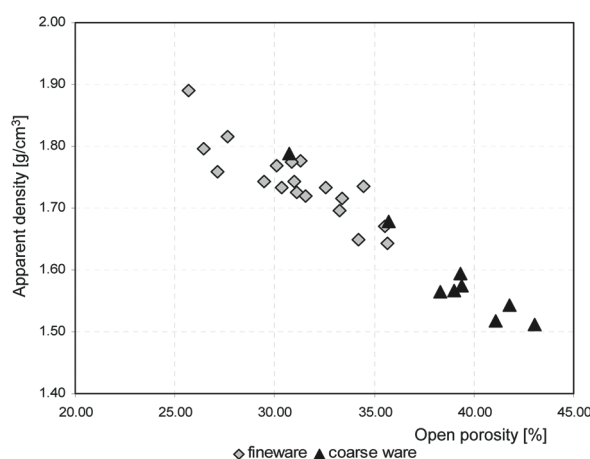


Fig. 1: Musawwarat. Open porosity versus apparent density.

ised by high open porosity values (26.45–35.67 %), even though distinct differences are observable in the way that fineware and coarse ware pottery was made (table 1, fig. 1). Coarse ware sherds have much higher open porosity values (up to 43 % in the case of a beer jar). Only two coarse ware sherds (2013.224.19, 20) have physical ceramic properties with the same range of values as fineware pottery. A fineware bowl (sample MD894 – fragment almost devoid of macroscopically visible temper) was found to have the best parameters – an open porosity 25.7 %.

The results obtained from the analysis of the sherds' chemical composition allowed the identification of eight chemical groups. Multivariate cluster analysis¹³ results are presented in the form of a dendrogram (fig. 2). The results of chemical analysis by WD-XRF, which formed the basis for the grouping analysis outlined above, are presented in table 2; the sequence of samples in this table corresponds to the groups revised using MGR analysis and shown in the dendrogram (multivariate cluster analysis is based on the content of elements within a given sample regardless of what phase they occur in).¹⁴ High levels of Al_2O_3 point to the presence of kaolinite in the ceramic body. The content of iron compounds has a major effect on the colour

13 Brookhaven Data Handling Programs: Euclidean Distance, Average Linkage, logged date, elements used: Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, V, Cr, Ni, Zn, Rb, Y, Sr, Zr, Ce, La.

14 Chemical analysis allows to establish the quantity of major and trace elements in the body, although the phases in which individual elements occur cannot be ascertained; giving the major elements as oxides is standard procedure in geochemistry when presenting the results of chemical analysis (CaO content identified by chemical analysis may be attributable to, for example, inclusions of calcite or dolomite or anorthite, or may occur exclusively in clay fraction in the matrix).

11 Sintered (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.

12 Over-fired (ovF) = the sample changes in shape, bloating, however, does not occur nor does the surface of the sample become over-melted.

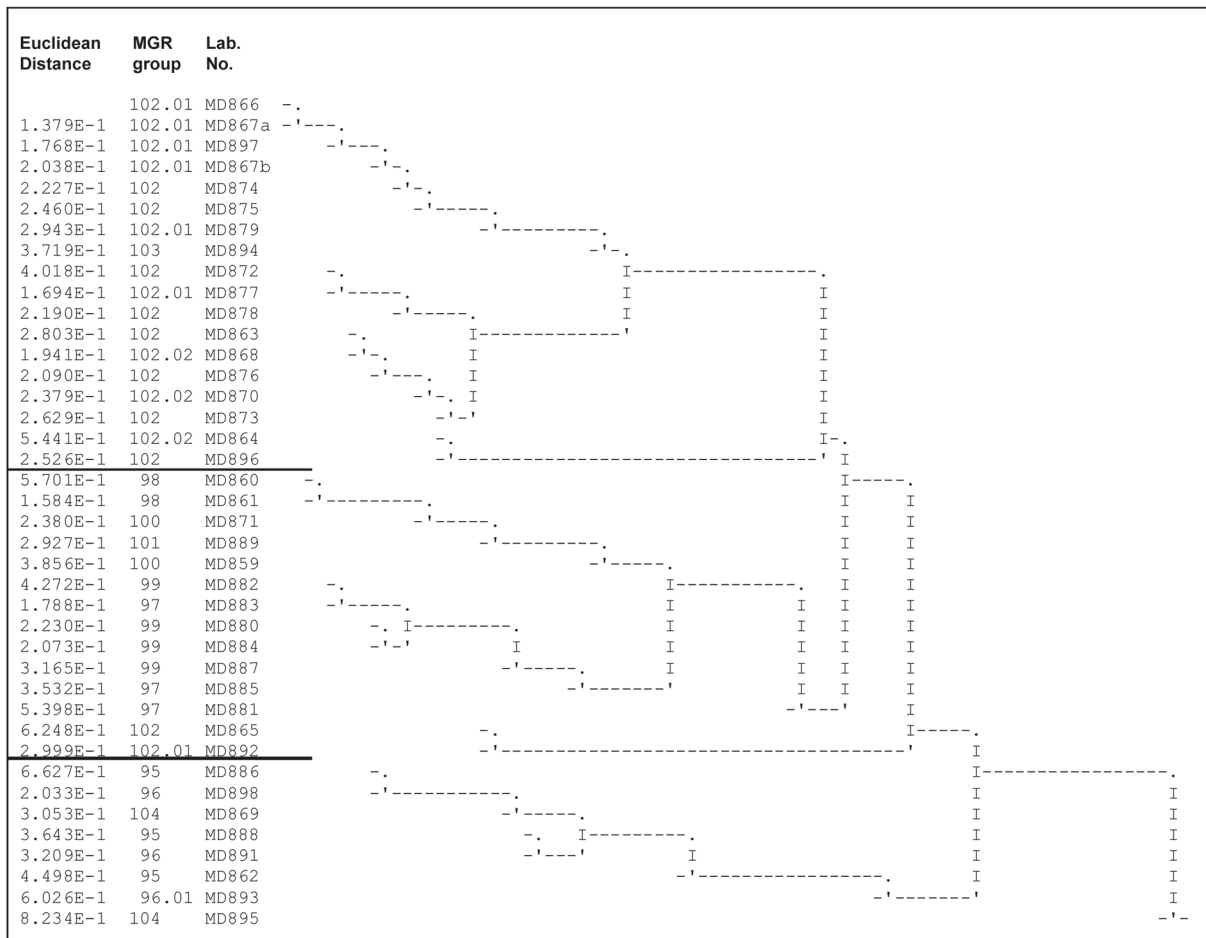


Fig. 2: Musawwarat. Dendrogram of cluster analysis using Euclidean Distance and aggregative clustering of distance using average linkage with the following elements: Si, Ti, Al, Fe, Mg, Na, Ca, K, V, Cr, Ni, Rb, Sr, Y, Zr, Ce and La, data logged (Brookhaven Data Handling Programs, kindly provided by E. Sayre).

of ceramics. Both in the dendrogram (fig. 2) and the two-component diagram showing Na₂O content versus SiO₂ content (fig. 3), samples made from ceramic bodies representing MGR groups 95, 96 and 104 are clearly differentiated. But the geochemi-

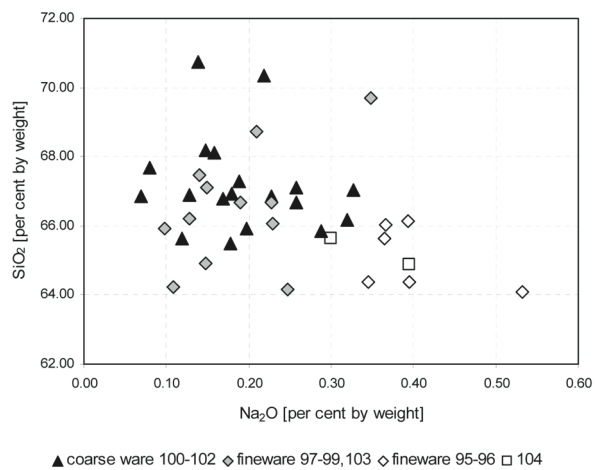


Fig. 3: Musawwarat. Content of sodium (as Na₂O in per cent by weight) versus silicon (as SiO₂ in per cent by weight).

cal parameters determined in the chemical analysis indicate that all analysed samples were made of raw materials sourced from the same geological region. Comparison with the SDB revealed that all samples of the present series represent a raw material group which does not occur at other sites. This group also includes ceramic sherds from Musawwarat analysed in previous studies (Gerullat 2001; Daszkiewicz and Schneider 2001: chemical group GI; dito unpublished samples submitted for analysis by Claudia Näser and Ulrike Nowotnick). A collation of all MGR groups (and subgroups) is presented in table 3, detailing the count of individual groups with division into reference groups. In keeping with the established conventions of classification, reference groups are identified by alphanumeric codes. In this instance, because the provenance is known, the reference groups have been named Mus 1–4 (abbreviation derived from Musawwarat). Three reference groups are associated exclusively with fineware (Mus 1–3). Reference group Mus 4 is represented by a raw material which was mainly used for making coarse



| MGR group | Lab. No. | SiO ₂ | TiO ₂ | Al ₂ O ₃ | Fe ₂ O ₃ | MnO | MgO | CaO | Na ₂ O | K ₂ O | P ₂ O ₅ | V ppm | Cr | Ni (Cu) | Zn | Rb | Sr | Y | Zr (Nb) | Ba | (La | Ce | Pb | Th) | I.o.i. % | TOTAL % | | |
|--|----------|------------------|------------------|--------------------------------|--------------------------------|-------|------|------|-------------------|------------------|-------------------------------|-------|-----|---------|----|----|----|-----|---------|-----|-----|-----|----|-----|----------|---------|------|--------|
| beige-greenish fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 95 | MD862 | 66.02 | 1.42 | 23.94 | 5.23 | 0.058 | 0.63 | 1.38 | 0.37 | 0.68 | 0.27 | 116 | 157 | 88 | 32 | 60 | 20 | 181 | 43 | 242 | 16 | 226 | 30 | 51 | 11 | 11 | 5.87 | 100.48 |
| 95 | MD886 | 65.64 | 1.39 | 24.97 | 4.90 | 0.045 | 0.54 | 1.05 | 0.37 | 1.00 | 0.09 | 140 | 153 | 50 | 34 | 44 | 24 | 132 | 48 | 232 | 17 | 363 | 21 | 73 | 12 | 14 | 3.82 | 100.80 |
| 95 | MD888 | 66.15 | 1.47 | 24.47 | 4.69 | 0.046 | 0.57 | 1.13 | 0.39 | 0.98 | 0.09 | 146 | 148 | 50 | 31 | 44 | 23 | 150 | 53 | 242 | 18 | 300 | 48 | 77 | 14 | 16 | 4.05 | 101.12 |
| grayish-greenish fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 96 | MD891 | 64.39 | 1.42 | 26.21 | 4.52 | 0.040 | 0.47 | 1.39 | 0.35 | 1.11 | 0.10 | 143 | 159 | 53 | 35 | 47 | 20 | 156 | 43 | 221 | 18 | 166 | 33 | 50 | 12 | 14 | 3.61 | 100.88 |
| 96 | MD898 | 64.37 | 1.43 | 26.50 | 4.56 | 0.041 | 0.48 | 1.17 | 0.39 | 0.95 | 0.10 | 140 | 157 | 54 | 30 | 47 | 21 | 117 | 43 | 223 | 20 | 169 | 19 | 53 | 9 | 15 | 3.25 | 100.25 |
| 96.01 | MD893 | 64.08 | 1.36 | 28.01 | 3.63 | 0.021 | 0.37 | 1.05 | 0.53 | 0.89 | 0.06 | 141 | 157 | 52 | 41 | 42 | 15 | 159 | 52 | 195 | 16 | 255 | 41 | 41 | 12 | 13 | 7.61 | 100.24 |
| beige, dark beige or pale brownish-beige fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 97 | MD881 | 64.23 | 1.45 | 27.23 | 4.73 | 0.043 | 0.51 | 0.87 | 0.11 | 0.71 | 0.10 | 112 | 164 | 57 | 23 | 47 | 19 | 76 | 44 | 221 | 17 | 182 | 19 | 60 | 11 | 15 | 1.44 | 100.29 |
| 97 | MD883 | 67.45 | 1.53 | 24.59 | 4.18 | 0.041 | 0.56 | 0.79 | 0.14 | 0.62 | 0.09 | 109 | 147 | 48 | 22 | 37 | 20 | 85 | 57 | 259 | 20 | 213 | 42 | 97 | 13 | 12 | 1.51 | 99.04 |
| 97 | MD885 | 64.92 | 1.44 | 26.77 | 4.61 | 0.042 | 0.49 | 0.72 | 0.15 | 0.75 | 0.10 | 125 | 163 | 54 | 26 | 48 | 20 | 109 | 42 | 221 | 17 | 208 | 38 | 51 | 11 | 15 | 1.97 | 100.61 |
| 98 | MD860 | 66.07 | 1.42 | 24.82 | 5.00 | 0.044 | 0.50 | 0.86 | 0.23 | 0.95 | 0.10 | 136 | 149 | 45 | 26 | 39 | 22 | 141 | 51 | 230 | 18 | 279 | 39 | 76 | 15 | 13 | 2.42 | 100.10 |
| 98 | MD861 | 66.69 | 1.47 | 24.37 | 4.71 | 0.047 | 0.56 | 1.01 | 0.23 | 0.80 | 0.11 | 131 | 155 | 50 | 33 | 42 | 21 | 137 | 55 | 244 | 18 | 289 | 44 | 84 | 11 | 15 | 2.78 | 100.59 |
| 99 | MD880 | 66.20 | 1.49 | 25.06 | 4.74 | 0.049 | 0.56 | 0.97 | 0.13 | 0.69 | 0.11 | 119 | 165 | 54 | 27 | 46 | 22 | 90 | 57 | 243 | 19 | 252 | 43 | 82 | 13 | 15 | 1.51 | 100.71 |
| 99 | MD882 | 67.11 | 1.46 | 24.65 | 4.72 | 0.051 | 0.54 | 0.64 | 0.15 | 0.59 | 0.11 | 109 | 148 | 48 | 26 | 45 | 21 | 76 | 55 | 248 | 19 | 235 | 45 | 82 | 12 | 13 | 1.15 | 100.23 |
| 99 | MD884 | 66.69 | 1.48 | 24.63 | 4.74 | 0.049 | 0.56 | 0.85 | 0.19 | 0.70 | 0.11 | 128 | 150 | 51 | 31 | 44 | 21 | 90 | 55 | 250 | 17 | 199 | 38 | 72 | 13 | 13 | 2.14 | 99.58 |
| 99 | MD887 | 65.93 | 1.49 | 25.19 | 5.14 | 0.055 | 0.67 | 0.63 | 0.10 | 0.66 | 0.13 | 135 | 156 | 55 | 38 | 47 | 23 | 82 | 56 | 245 | 19 | 225 | 57 | 87 | 17 | 18 | 1.17 | 101.11 |
| grayish-beige fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 100 | MD859 | 69.71 | 1.51 | 22.09 | 3.79 | 0.043 | 0.56 | 0.85 | 0.35 | 1.01 | 0.10 | 97 | 150 | 38 | 19 | 34 | 20 | 107 | 41 | 305 | 18 | 215 | 39 | 72 | 13 | 11 | 2.38 | 99.80 |
| 100 | MD871 | 68.71 | 1.52 | 22.35 | 4.25 | 0.054 | 0.64 | 1.05 | 0.21 | 1.05 | 0.16 | 113 | 149 | 43 | 22 | 38 | 21 | 152 | 46 | 297 | 17 | 322 | 44 | 80 | 12 | 11 | 2.32 | 99.71 |
| brownish-beige fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 101 | MD889 | 66.92 | 1.45 | 23.47 | 5.33 | 0.058 | 0.67 | 0.83 | 0.18 | 0.96 | 0.13 | 154 | 152 | 49 | 26 | 47 | 25 | 109 | 50 | 263 | 17 | 242 | 54 | 92 | 14 | 11 | 1.61 | 100.13 |
| reddish-brownish fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 102 | MD863 | 68.11 | 1.43 | 21.18 | 5.62 | 0.076 | 0.92 | 1.27 | 0.16 | 0.98 | 0.25 | 118 | 144 | 54 | 37 | 56 | 29 | 120 | 49 | 272 | 17 | 316 | 49 | 105 | 16 | 12 | 1.44 | 100.71 |
| 102 | MD865 | 70.34 | 1.31 | 19.36 | 5.33 | 0.081 | 0.97 | 1.37 | 0.22 | 0.85 | 0.16 | 125 | 128 | 45 | 26 | 48 | 28 | 117 | 38 | 263 | 12 | 282 | 21 | 55 | 10 | 10 | 1.23 | 100.35 |
| 102 | MD872 | 66.88 | 1.48 | 22.41 | 5.84 | 0.079 | 0.95 | 1.09 | 0.13 | 0.94 | 0.21 | 119 | 163 | 59 | 34 | 55 | 33 | 101 | 42 | 279 | 18 | 281 | 40 | 97 | 13 | 13 | 1.24 | 100.40 |
| 102 | MD873 | 65.64 | 1.43 | 23.29 | 6.00 | 0.071 | 0.86 | 1.45 | 0.12 | 0.92 | 0.21 | 125 | 154 | 61 | 41 | 59 | 29 | 105 | 50 | 245 | 18 | 256 | 43 | 85 | 12 | 11 | 1.68 | 100.57 |
| 102 | MD874 | 67.10 | 1.46 | 22.45 | 5.37 | 0.067 | 0.80 | 1.16 | 0.26 | 1.16 | 0.18 | 131 | 157 | 54 | 26 | 50 | 28 | 159 | 57 | 271 | 18 | 353 | 40 | 106 | 11 | 14 | 7.50 | 100.52 |
| 102 | MD875 | 66.86 | 1.42 | 22.39 | 5.72 | 0.070 | 0.77 | 1.28 | 0.23 | 1.06 | 0.20 | 150 | 149 | 57 | 34 | 53 | 29 | 166 | 50 | 250 | 18 | 450 | 60 | 82 | 12 | 14 | 2.91 | 100.27 |
| 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 | 10 | 12 | 1.48 | 100.61 |
| 102 | MD878 | 65.92 | 1.51 | 22.98 | 6.28 | 0.080 | 0.98 | 0.92 | 0.20 | 0.94 | 0.19 | 136 | 157 | 60 | 40 | 57 | 36 | 91 | 51 | 267 | 21 | 272 | 44 | 101 | 13 | 13 | 1.39 | 100.53 |
| 102 | MD896 | 66.85 | 1.42 | 22.46 | 6.07 | 0.078 | 0.88 | 0.87 | 0.07 | 1.10 | 0.20 | 112 | 148 | 61 | 43 | 57 | 34 | 94 | 52 | 258 | 19 | 253 | 57 | 96 | 13 | 16 | 0.81 | 99.97 |
| 102.01 | MD866 | 67.05 | 1.47 | 21.79 | 5.72 | 0.065 | 0.79 | 1.22 | 0.33 | 1.40 | 0.17 | 137 | 145 | 56 | 36 | 55 | 32 | 187 | 52 | 291 | 17 | 359 | 53 | 108 | 13 | 11 | 3.08 | 100.53 |
| 102.01 | MD867 | 65.85 | 1.41 | 22.60 | 6.02 | 0.073 | 0.87 | 1.25 | 0.29 | 1.42 | 0.21 | 132 | 148 | 58 | 37 | 58 | 33 | 178 | 51 | 254 | 15 | 335 | 46 | 97 | 13 | 15 | 3.12 | 100.14 |
| 102.01 | MD877 | 66.78 | 1.47 | 21.81 | 6.18 | 0.078 | 1.05 | 1.10 | 0.17 | 1.17 | 0.20 | 130 | 157 | 60 | 36 | 57 | 35 | 105 | 40 | 281 | 19 | 283 | 41 | 98 | 13 | 14 | 0.90 | 100.38 |
| 102.01 | MD879 | 66.17 | 1.42 | 22.73 | 5.67 | 0.064 | 0.84 | 1.22 | 0.32 | 1.40 | 0.16 | 120 | 147 | 53 | 24 | 45 | 28 | 109 | 42 | 227 | 16 | 202 | 52 | 89 | 12 | 16 | 2.71 | 99.76 |
| 102.01 | MD892 | 70.76 | 1.32 | 18.89 | 5.63 | 0.070 | 1.05 | 0.99 | 0.14 | 0.93 | 0.22 | 133 | 123 | 48 | 30 | 46 | 32 | 95 | 35 | 276 | 14 | 218 | 20 | 44 | 10 | 14 | 1.01 | 99.84 |
| 102.01 | MD897 | 66.69 | 1.41 | 21.72 | 6.18 | 0.082 | 0.95 | 1.32 | 0.26 | 1.18 | 0.22 | 147 | 147 | 58 | 38 | 57 | 33 | 177 | 47 | 259 | 18 | 403 | 52 | 106 | 13 | 15 | 2.79 | 99.90 |
| 102.02 | MD864 | 67.68 | 1.52 | 22.33 | 5.29 | 0.072 | 0.81 | 1.17 | 0.08 | 0.88 | 0.16 | 124 | 160 | 53 | 33 | 47 | 32 | 89 | 45 | 299 | 18 | 263 | 46 | 84 | 10 | 14 | 1.09 | 100.41 |
| 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 | 13 | 12 | 1.77 | 100.36 |
| 102.02 | MD870 | 65.50 | 1.43 | 23.70 | 5.61 | 0.058 | 0.73 | 1.57 | 0.18 | 1.00 | 0.22 | 130 | 151 | 53 | 34 | 51 | 29 | 120 | 57 | 237 | 18 | 238 | 57 | 103 | 13 | 14 | 2.38 | 100.31 |
| red-brownish fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 103 | MD894 | 64.15 | 1.47 | 22.34 | 7.91 | 0.090 | 1.06 | 1.03 | 0.25 | 1.53 | 0.17 | 133 | 154 | 70 | 48 | 67 | 38 | 113 | 45 | 254 | 18 | 309 | 36 | 89 | 11 | 15 | 1.25 | 99.96 |
| gray-brown fired at 1200°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 104 | MD895 | 64.89 | 1.42 | 24.82 | 5.10 | 0.057 | 0.76 | 0.87 | 0.39 | 1.56 | 0.13 | 139 | 148 | 57 | 39 | 56 | 35 | 152 | 83 | 278 | 25 | 332 | 95 | 214 | 10 | 14 | 2.63 | 100.30 |
| 104 | MD869 | 65.64 | 1.44 | 24.34 | 4.88 | 0.049 | 0.63 | 1.11 | 0.30 | 1.46 | 0.15 | 143 | 155 | 54 | 29 | 48 | 24 | 152 | 46 | 237 | 16 | 230 | 25 | 83 | 19 | 10 | 2.79 | 99.54 |

Table 2: Musawwarat. Results of the chemical analysis by WD-XRF (by Gerwulf Schneider, Rudolf Naumann and Malgorzata Daszkiewicz). LOI = loss on ignition at 900 °C; TOTAL = original sum before normalization to 100 %. Values for S and Cl have not been included in this table, as they mostly amounted to less than 0.01 %. Trace elements determined with lower precision are given in brackets.

ware pottery, but is also present in one fineware sherd. In the case of MGR group 104, represented by one fragment of fineware and one fragment of coarse

ware, at the present stage of research it is difficult to decide whether these samples belong to one or two different reference groups.

| fineware | coarse ware | MGR group | Reference group | Clay type | Production region |
|----------|-------------|-----------|-----------------|----------------------------|-------------------|
| 3 | | 95 | Mus 1 | | |
| 2 | | 96 | Mus 2 | | |
| 1 | | 96.01 | | coloured by iron compounds | |
| 3 | | 97 | | kaolinit bearing | |
| 2 | | 98 | Mus 3 | clays | |
| 4 | | 99 | | | Musawwarat |
| 2 | | 100 | | | |
| | 1 | 101 | | Wadi clay | |
| | 9 | 102 | | with temper | |
| | 6 | 102.01 | Mus 4 | (conglomerats of quartz | |
| | 3 | 102.02 | | with whitish fired matrix) | |
| 1 | | | | | |



defined by Edwards (1999, 17-26), who however concedes that “by the conclusion of the season’s work, many of the distinctions appeared increasingly arbitrary and it seems likely that these represent variations of a local fabric type, which becomes increasingly coarse in larger heavier-walled vessels” (Edwards 1999, 17). It is interesting to note that the distinction made between H-wares (“wadi clays”; see Edwards 1999, 18) and B1 (“mixed clay”; see Edwards 1999, 18) as maintained in the primary publication – “Fabric B1 is probably of mixed clays, but distinct from the local H series” (Edwards 1999, 18) – is not reflected in the MGR analysis. MGR group 102 also includes the earlier samples MD2592 (GA/372) and MD2596 (GA/273) from Musawwarat, which had been identified as H6 and B1 respectively (Daszkiewicz and Schneider 2001, 82-89, tab. 1-4; cf. Gerullat 2001, 64). These two samples come from trenches 2251 and 2022, i.e. the room tentatively identified as the potter’s workshop in courtyard 224 and the main room of Temple 200.¹⁵ The significance of this finding has to be evaluated in future analyses on larger sample series including material from other archaeological contexts in Musawwarat.

Finewares from Musawwarat were made from ceramic bodies prepared using a variety of recipes featuring clays which contain kaolinite and are coloured by iron compounds. Nine samples of MGR groups 97–99 were of very similar ceramic bodies differing from the rest of the fineware samples by a lower content of Na₂O (average 0.16 %) and by a slightly lower content of CaO. Three fineware samples belonging to MGR groups 96 and 96.01 are characterised by the highest Al₂O₃/SiO₂-ratio. Three fineware samples from MGR group 95 have an Al₂O₃/SiO₂-ratio similar to groups 97–99, but a content of Na₂O twice as high. The two samples constituting MGR group 100 are from two red slipped fineware bowls. 2013.224.1 (= ZN837) is reported to come from context [626], a fireplace formed by an inverted jar, underlying the main deposit in trench 224.12 (Edwards 1999, 9, 36). According to Edwards, material from [626] and [628] might predate the material of the main dump. 2013.224.13 (= ZN 794) comes from context [616], a distinct layer in the upper eastern part of the main dump (Edwards 1999, 10), which displayed a conspicuous concentration of red slipped fineware sherds (Edwards 1999, 35). While Edwards (1999, 35) states that for him “it remains uncertain whether these are also local products”, the present analysis indicates that indeed they are, as they consist of raw materials sour-

ced from the same region as the other samples in the series. The chronological attributions made by Edwards will have to be re-evaluated in future. Two of the samples which represent smaller MGR groups (2013.224.13, 31) come from the same depositional context, [616] (Edwards 1999, 10). That this layer produced sherds with properties diverging from the larger groups – shapes and decoration types vary, too – suggests that the stratigraphic differentiation may reflect a true difference in the find assemblages and two distinct depositional events. Another ‘diverging’ sample, 2013.224.37 (= ZN821), derives from a vessel of which only this one example has been recovered from the deposit, a carinated fineware bowl of unusually fine execution, which imitates a metal vessel.

In sum, it is now possible to identify one major fabric group of coarse ware (reference group Mus 4 in SDB) manufactured from wadi clays – and thus corresponding to fabric group H in Edward’s classification – as well as three fineware groups (reference groups Mus 1–3 in SDB) which seem to represent the bulk of the local pottery production present in the dump of courtyard 224. Future studies shall evaluate this result and investigate the position of the groups identified in the present study in the overall ceramic corpus from Musawwarat.

APPENDIX 1

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, 1150 and 1200 °C in air, static, with a heating rate of 200 °C/h and a soaking time of 1 h at the peak temperature. The fragments were then glued on to paper.

Chemical analysis

In the present sample series chemical analysis by WD-XRF (Wavelength-dispersive X-ray fluorescence) was used to determine the content of major elements, including phosphorus and a rough estimation, after loss on ignition, of sulphur and chlorine (measurements were made by Gerwulf Schneider and Rudolf Naumann using an Axios spectrometer). All samples were prepared by pulverising fragments weighing approximately 1.5 g, having first removed their

¹⁵ For the provenancing see Gerullat 2001, 68.



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 1 h), 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. The precision for major elements is better than 1 %, for trace elements this rises up to 20 % depending on the concentrations. Some trace elements are determined with lower precision (Cu, La, Ce, Pb). Accuracy is tested by analysing international reference samples and by exchange of samples with other laboratories. For major elements and the most important trace elements it is between 5 and 10 %. The results of chemical analysis given in the table include major elements in per cent and trace elements in parts per million (ppm). For easier comparison the major elements are normalised to a constant sum of 100 %. Major element contents are calculated as oxides. Total iron is calculated as Fe₂O₃; Si = silicone, content recalculated as SiO₂; Ti = titanium, content recalculated as TiO₂; Al = aluminium, content recalculated as Al₂O₃; Fe = total iron content recalculated as Fe₂O₃; Mn = manganese, content recalculated as MnO; Mg = magnesium, content recalculated as MgO; Ca = calcium, content recalculated as CaO; Na = sodium, content recalculated as Na₂O; K = potassium, content recalculated as K₂O; P = phosphorous, content recalculated as P₂O₅; V = vanadium; Cr = chrome; Ni = nickel; Cu = copper; Zn = zinc; Rb = rubidium; Sr = strontium; Y = yttrium; Zr = zirconium; Nb = niobium; Sn = tin; Ba = barium; La = lanthanum; Ce = cerium; Pb = lead; Th = thorium.

Measurement of physical ceramic properties

Measurement of physical ceramic properties (open porosity, water absorption and apparent density) was carried out by hydrostatic weighing. Prior to measurement samples were boiled in distilled water for two hours in order to fully saturate all open pores with water. Next, the samples were cooled to room temperature and weighed twice, making note of the mass of the sample immersed in water (*m_{ww}*), and the mass of the moist sample weighed in air (*m_w*). Samples were then weighed for a third time in air, having first been dried to a constant mass in a dryer at 105 °C and cooled to room temperature in a desiccator. This was the method used to determine the mass of the dry sample (*m_s*).

Open porosity, i.e. the percentage of the amount of water absorbed by a given volume of sample was determined using the formula $P_v = \frac{m_w - m_s}{m_w - m_{ww}} \cdot 100$ and

expressed as a percentage. Water absorption, i.e. the percentage mass gain of the sample soaked in water in relation to the mass of the dry sample, was determined using the formula $N = \frac{m_w - m_s}{m_s} \cdot 100$ and expressed as a percentage. Apparent density, i.e. mass of sample in relation to volume of sample, was determined using the formula $d_v = \frac{m_s}{m_w - m_{ww}} \cdot \rho_{H_2O}$ and expressed in g/cm³. ρ_{H_2O} = bulk density of water at temperature of measurement, in this analysis temperature of measurement is room temperature¹⁶ and $\rho_{H_2O} = 1 \text{ g/cm}^3$.

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¹⁶ The term 'room temperature' refers to a temperature of 20 °C.



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ZUSAMMENFASSUNG

Dieser Aufsatz präsentiert die Ergebnisse einer archäometrischen Analyse von 39 Keramikproben aus dem Keramikdeposit, das 1997 in Hof 224 der Großen Anlage in Schnitt 224.12 partiell ausgegraben wurde. 19 Proben von Gefäßen grober Ware bilden eine Gruppe, die aus Wadi-Tonen mit geringem Kaliumgehalt hergestellt wurde (Referenzgruppe Mus 4 in der SDB). Einzelne Vertreter dieser Gruppe wurden in der Erstvorlage des Keramikkorpus aus Hof 224 von David Edwards (1999, 17-26) als fabrics B1 (B = gemischte Tone), H1 und H3 (Wadi-Tone) bestimmt. Diese Unterscheidung spiegelt sich in der aktuellen Analysereihe nicht wider. Zu der genannten Gruppe gehören auch die in früheren Jahren analysierten Proben MD2592 (GA/372) und MD2596 (GA/273), die vorher ebenfalls als fabrics H6 und B1 angesprochen worden waren (Daszkiewicz und Schneider 2001, 82-88, tab. 1-4).

Die in der Probenserie erfassten Feinwaren bestehen aus keramischen Massen, die aus kaolinitischen

Tonen mit hohem Eisengehalt hergestellt wurden. Variationen in der Bruchfarbe sind auf unterschiedliche Mischungen dieser Grundmaterialien zurückzuführen. Neun Proben der MGR-Gruppen 97–99 bestehen aus sehr ähnlichen keramischen Massen, die von den anderen Proben durch einen geringeren Na₂O-Gehalt (Durchschnitt 0.16 %) und einen geringeren CaO-Gehalt unterschieden sind. Drei Proben der MGR-Gruppen 96 und 96.01 sind durch die höchsten Werte im Al₂O₃/SiO₂-Verhältnis charakterisiert. Drei Proben der MGR-Gruppe 95 weisen ein ähnliches Al₂O₃/SiO₂-Verhältnis wie MGR-Gruppen 97–99 auf, besitzen aber doppelt soviel Na₂O.

Die restlichen Proben können zu kleineren Gruppen geordnet werden, deren Zusammengehörigkeit in der vorgelegten Analyse partiell mit anderen Parametern – gleiche Form, gleiche Oberflächenbehandlung oder gleicher Deponierungskontext – einhergeht. Die geochemischen Parameter zeigen jedoch, dass alle in dieser Serie analysierten Proben aus Rohmaterialien gefertigt wurden, die derselben geologischen Region entstammen. Demzufolge sollten alle Gefäße der lokalen Produktion zuzuordnen sein, oder mit anderen Worten: in Musawwarat hergestellt worden sein. Zukünftige Untersuchungen im Rahmen des Projekts „Meroitische Feinkeramik: Produktion, Distribution, Nutzung“ im Berliner Exzellenzcluster TOPOI sollen die Ergebnisse dieser ersten Studie evaluieren und die Position der hier vorgestellten Gruppen im keramischen Gesamtrepertoire von Musawwarat präzisieren.