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A new series of laboratory analyses of coarse wares from 'pottery courtyard' 224 of the Great Enclosure in Musawwarat es-Sufra (Sudan)[1]

A substantial ceramic deposit was identified in courtyard 224 of the Great Enclosure in Musawwarat es-Sufra and explored in a first excavation in 1997.[2] New investigations at the site started in January 2014 and produced about 9000 sherds, of which 10% are fineware. The classification of this pottery in several MGR/fabric-groups was based on results of archaeometric studies which were undertaken in 2013 and could be successfully adopted for the finewares in the current season.[3] As no samples of handmade coarse ware had been analysed in 2013, and macroscopic differences of the material used for handmade and some wheelmade coarse ware sherds were obvious, special attention was given to the coarse ware material. A series of 35 samples (hand- and wheelmade) was collected for archaeometric analyses. All samples, except two which derived from the topmost layer of windblown sand [224.14-001], were collected within the main ash deposit [224.14-002], which consisted of extremely loose dusty grey ash, mixed with a large number of finds. This paper is intended to present the results of the archaeometric studies and will not include typological analyses.[4]

Abridged MGR analysis and chemical analysis by WD-XRF were conducted on 34 coarse ware pottery fragments and one fineware fragment.[5] On the completion of the MGR and the chemical analysis each of the analysed ceramic fragments was entered into a database of pottery from Sudan.[6] Additionally, physical ceramic properties (open porosity, water absorption and apparent density) were determined for 35 sherds. All analysed samples, the results of the MGR analysis and the values of physical ceramic properties are listed in table 1. On colour figure 5 seven examples of refired samples representing local and nonlocal fabrics are shown. Subsequent multivariate statistical analyses encompassed all samples analysed in this series – the results of the chemical analysis taken for this procedures are given in table 2 – as well as samples of fine and coarse wares analysed in a previous series as far as they belong to the local reference groups Mus 1–4 (see Näser and Daszkiewicz 2013).

Results of the laboratory analyses

The results of the MGR analysis (tab. 1) show that 15 samples analysed in this series belong to MGR group 102 (and subgroups of this group) which is known from the 2013 analysis of coarse wares (Näser and Daszkiewicz 2013). This MGR group comprises only wheelmade coarse ware samples. After the observations made in the field it is probable that all fabrics of coarse wares of MGR 102 correspond to locally available natural mixtures of clay and non-plastic inclusions, such as the one sampled from an outcrop at the edge of the inner part of Hafir Khalifa in front of Gebel Ma´afer (fig. 1).

The other 20 analysed samples represent new MGR groups (MGR 105–119)[7]. Surprisingly, seven of these 20 samples show a thermal behaviour like

1 We thank Claudia Näser for commenting on an earlier version of this paper.

2 Wenig and Wolf 1998: 29–33; Edwards 1998, 1999.

3 Näser and Daszkiewicz 2013.

4 For this part and the archaeological background see Näser and Wetendorf in this volume. For a description of the archaeometric methods used see Näser and Daszkiewicz 2013: 20–21.

5 This one handmade 'fineware' fragment was, despite its thin-walled shape, handed in for analysis as a coarse ware sample. Visually it is not matching the known fineware groups – which are all wheelmade, stamped and/or painted, or red-slipped and polished –, but its physical ceramic properties do. We are currently working on a terminology and definitions adequately distinguishing the different ware groups.

6 M. Daszkiewicz has been analysing archaeological pottery from Sudan since 1991; the database (SDB) currently encompasses 1185 ceramic fragments.

7 The term 'group' is used even in relation to those groups which are represented solely by one sample. It is unlikely that only a single vessel was made from one ceramic body, hence it is assumed that the sample represents a group of vessels made from the same material.

Fig. 1: Outcrop at the edge of the inner part of Hafir Khalifa in front of Gebel Ma'afer (photograph: M. Wetendorf).

Sample ID	Context	Ware	Forming technique	Thickness of wall [cm]	Fabric by Edwards	Lab. No.	Physical ceramic properties Po [%]	N [%]	dv [g/cm^3]	MGR-analysis thermal behaviour at 1200°C Matrix type	Matrix colour	MGR group (SDB)
Local at Musawwarat, reference group Mus 4												
IA-224.14-002-031	IA-224.14-002-008	coarse ware	wheelmade	0,8	H2	AD 089	40,1	25,9	1,55	SN	reddish-brownish	102
IA-224.14-002-032	IA-224.14-002-001	coarse ware	wheelmade	1,3	H2	AD 090	43,7	29,7	1,47	SN	reddish-brownish	102
IA-224.14-001-001	IA-224.14-001-001	coarse ware	wheelmade	0,8	H1	AD 107	34,3	20,8	1,65	SN	reddish-brownish	102
IA-224.14-002-035	IA-224.14-002-001	coarse ware	wheelmade	0,8	H1?	AD 093	25,2	14,0	1,79	SN	darker than 102	102,01
IA-224.14-002-036	IA-224.14-002-001	coarse ware	wheelmade	0,9		AD 094	31,3	18,4	1,70	SN	darker than 102	102,01
IA-224.14-002-037	IA-224.14-002-008	coarse ware	wheelmade	0,9	H1	AD 095	32,9	20,0	1,64	SN	darker than 102	102,01
IA-224.14-002-038	IA-224.14-002-010	coarse ware	wheelmade	0,8	H1?	AD 096	33,3	18,7	1,78	SN	darker than 102	102,01
IA-224.14-002-043	IA-224.14-002-010	coarse ware	wheelmade	0,8		AD 101	32,2	18,1	1,78	SN	darker than 102	102,01
IA-224.14-002-048	IA-224.14-002-047	coarse ware	wheelmade	0,9	H1?	AD 106	39,4	24,5	1,61	SN	darker than 102	102,01
IA-224.14-002-030	IA-224.14-002-001	coarse ware	wheelmade	1,0	H2?	AD 088	43,9	30,2	1,45	SN	paler than 102	102,02
IA-224.14-002-041	IA-224.14-002-010	coarse ware	wheelmade	0,8	H1?	AD 099	38,4	24,7	1,56	SN	paler than 102	102,02
IA-224.14-002-044	IA-224.14-002-026	coarse ware	wheelmade	0,8	H1?	AD 102	36,1	21,8	1,65	SN	paler than 102	102,02
IA-224.14-002-033	IA-224.14-002-001	coarse ware	wheelmade	1,3	H1	AD 091	33,6	19,1	1,75	SN	more reddish than 102	102,03
IA-224.14-002-034	IA-224.14-002-001	coarse ware	wheelmade	1,2	H1?	AD 092	36,5	22,0	1,66	SN	paler than 102	102,04
IA-224.14-002-040	IA-224.14-002-010	coarse ware	wheelmade	1,4	H1.1	AD 098	36,7	21,5	1,71	SN	paler than 102	102,05
Probably local at Musawwarat or regional												
IA-224.14-002-016	IA-224.14-002-001	coarse ware	handmade	0,9	H6	AD 074	31,1	18,6	1,67	SN/ovF	brown-red	105
IA-224.14-002-017	IA-224.14-002-010	coarse ware	handmade	0,8	H6	AD 075	33,0	21,1	1,57	SN/ovF	brown-red	105
IA-224.14-002-018	IA-224.14-002-008	fine ware	handmade	0,5	H6	AD 076	28,9	16,7	1,73	SN/ovF	brown-red	105
IA-224.14-002-024	IA-224.14-002-010	coarse ware	handmade	0,8	H7	AD 082	37,1	24,5	1,51	ovF (sovM) BL	red-brown	110
IA-224.14-002-026	IA-224.14-002-010	coarse ware	handmade	0,8	H7.1	AD 084	33,0	19,3	1,71	SN	red-brown	111
IA-224.14-002-042	IA-224.14-002-052	coarse ware	handmade	0,7	H7	AD 100	35,8	22,4	1,59	ovF	red-brown	115
IA-224.14-002-045	IA-224.14-002-050	coarse ware	handmade	0,6		AD 103	34,4	22,3	1,54	ovF	red-brown	116
IA-224.14-002-046	IA-224.14-002-050	coarse ware	wheelmade	1,1		AD 104	30,8	18,7	1,65	ovF (rim ovM)	red-brown	117
IA-224.14-002-047	IA-224.14-002-042	coarse ware	wheelmade	1,2		AD 105	31,6	18,3	1,73	SN	reddish-brown	118
Imports - various Nile alluvial clays												
IA-224.14-002-019	IA-224.14-002-001	coarse ware	handmade	0,6	H6.1	AD 077	33,5	19,9	1,69	sMLT matt	brown	106
IA-224.14-002-025	IA-224.14-002-008	coarse ware	handmade	0,7	H7.1	AD 083	38,6	23,6	1,63	sMLT matt	brown	106
IA-224.14-002-021	IA-224.14-002-010	coarse ware	handmade	0,9	H6.1	AD 079	40,7	25,5	1,60	ovM	red-brown	108
IA-224.14-002-028	IA-224.14-002-010	coarse ware	wheelmade	0,9	H8.1	AD 086	34,7	20,3	1,71	ovM	red-brown	108
IA-224.14-002-022	IA-224.14-002-001	coarse ware	handmade	0,7	H7	AD 080	33,0	23,2	1,42	ovM	brownish	109
IA-224.14-002-023	IA-224.14-002-008	coarse ware	handmade	0,7	H7	AD 081	37,4	22,8	1,64	ovM	brownish	109
IA-224.14-001-002	IA-224.14-001-001	coarse ware	handmade	0,9		AD 108	45,2	31,4	1,44	sovM (rim ovM)	red-brown	119
Imports - variuos clay of different origin												
IA-224.14-002-020	IA-224.14-002-008	coarse ware	handmade	0,6	H6.1	AD 078	36,7	23,0	1,60	BL ovF matt	violet-brown	107
IA-224.14-002-027	IA-224.14-002-001	coarse ware	handmade	0,7	H8	AD 085	30,3	17,2	1,76	ovF/sovM	red-brown	112
IA-224.14-002-029	IA-224.14-002-001	coarse ware	handmade	0,7	H9	AD 087	27,0	15,4	1,75	ovF	brownish-red	113
IA-224.14-002-039	IA-224.14-002-010	coarse ware	wheelmade	1,1		AD 097	36,0	21,3	1,69	ovF	brown	114

Table 1: List of analysed samples. Concordance of sample and laboratory numbers (identification number in the Daszkiewicz – Schneider database). Values of physical ceramic properties: P = open porosity, N = water absorption, dv = apparent density. Results of MGR-analysis: SN = sintered, ovF = over-fired, sovM = slightly over melted, BL = bloated, ovM = over-melted (prepared by: M. Daszkiewicz).

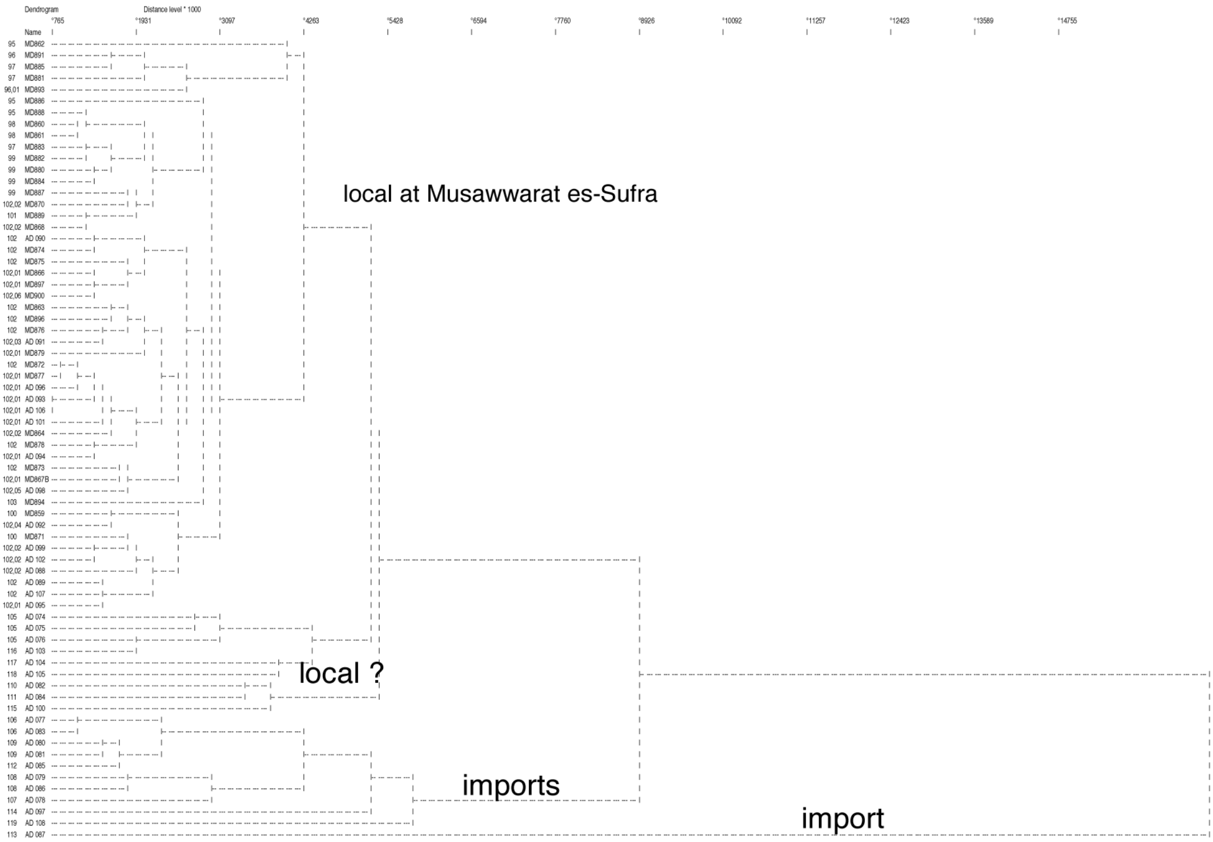

Fig. 2: Dendrogram of cluster analysis using Euclidean Distance and aggregative clustering of a distance matrix using average linkage with the following elements: Si, Ti, Al, Fe, Mg, Na, Ca, K, V, Cr, Ni, Rb, Sr, Y, Zr, Ce and La, data logged (analysis using license Weierstrass Institute for Applied Analysis and Stochastics, Leibniz Institute in Forschungsverbund Berlin e.V., prepared by: M. Daszkiewicz).

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	Pb	Th)	l.o.i.	TOTAL
group	No.	per cent by weight										ppm															%	%
	Local at Musawwarat, reference group Mus 4																											
102	AD 089	67,40	1,49	21,76	5,46	0,061	0,80	1,02	0,37	1,47	0,17	131	155	46	33	48	32	184	44	309	18	300	42	80	14	8	2,76	100,43
102	AD 090	66,15	1,45	22,77	5,41	0,057	0,85	1,39	0,30	1,46	0,17	132	152	50	38	50	31	167	57	258	17	369	44	88	10	11	3,70	100,26
102	AD 107	66,78	1,47	21,61	5,88	0,069	0,87	1,57	0,28	1,26	0,21	115	159	50	30	54	34	172	42	290	17	253	43	85	12	10	1,96	99,65
102,01	AD 093	67,45	1,50	21,38	6,19	0,078	0,98	0,96	0,23	1,01	0,21	132	154	54	40	54	35	100	42	302	20	287	31	83	10	8	0,23	100,89
102,01	AD 094	66,19	1,47	21,88	6,74	0,095	1,12	1,10	0,16	1,01	0,22	152	160	64	43	61	36	102	47	285	17	283	38	99	13	12	0,78	100,62
102,01	AD 095	67,28	1,43	20,74	6,12	0,069	0,98	1,24	0,25	1,50	0,40	129	151	50	26	57	34	168	41	279	18	351	40	90	13	10	2,10	99,42
102,01	AD 096	67,42	1,50	21,29	6,13	0,077	0,97	1,19	0,21	1,00	0,21	129	152	53	35	60	33	106	41	284	18	249	46	96	13	10	0,67	99,93
102,01	AD 101	67,51	1,49	21,33	6,14	0,078	0,98	1,02	0,23	1,02	0,21	132	171	59	40	59	34	102	46	288	19	268	36	94	12	15	0,81	100,50
102,01	AD 106	67,49	1,49	21,25	6,12	0,078	1,01	0,99	0,22	1,13	0,21	125	154	54	39	56	33	117	45	295	18	306	34	89	13	12	1,33	99,73
102,02	AD 088	70,33	1,45	19,70	4,71	0,060	0,77	1,35	0,34	1,12	0,17	119	147	42	32	45	28	148	40	314	17	371	34	81	12	9	3,08	100,54
102,02	AD 099	68,50	1,45	21,25	5,03	0,055	0,71	1,14	0,36	1,33	0,18	135	151	46	29	45	27	120	40	283	16	239	33	80	13	14	2,36	99,98
102,02	AD 102	68,43	1,49	21,80	4,78	0,054	0,73	1,30	0,27	1,02	0,13	125	151	42	22	42	25	111	39	293	19	245	47	79	11	9	2,15	99,66
102,03	AD 091	67,58	1,44	21,28	5,95	0,074	0,96	1,42	0,14	0,96	0,19	116	156	56	36	55	34	96	41	278	18	268	55	91	13	9	1,35	100,46
102,04	AD 092	68,70	1,46	21,44	4,91	0,054	0,84	0,95	0,37	1,10	0,18	93	146	45	33	46	28	109	41	292	16	247	38	82	14	10	1,12	100,55
102,05	AD 098	64,51	1,46	24,42	6,23	0,069	1,01	1,06	0,09	0,90	0,26	147	156	56	37	63	30	100	57	247	19	287	50	83	12	9	0,98	100,54
	Probably local at Musawwarat or regional																											
105	AD 074	72,23	1,33	17,35	5,30	0,051	0,92	0,92	0,15	1,46	0,29	113	137	61	46	102	35	105	42	347	15	413	35	73	8	9	1,04	99,99
105	AD 075	69,49	1,33	17,28	5,64	0,052	1,22	1,30	0,29	3,03	0,38	122	142	63	38	102	45	125	44	332	16	385	25	75	11	9	1,45	99,26
105	AD 076	69,79	1,29	17,21	5,72	0,055	1,32	1,41	0,28	2,53	0,40	117	133	49	37	66	44	160	42	296	14	357	34	76	14	11	1,61	99,74
110	AD 082	63,22	1,45	21,41	9,36	0,068	1,10	1,60	0,45	1,02	0,33	143	135	65	42	75	31	124	30	315	25	263	23	69	7	13	0,53	99,53
111	AD 084	63,56	1,63	20,56	7,71	0,108	1,68	2,12	0,90	1,31	0,44	153	144	55	49	75	42	160	31	294	20	396	14	53	9	11	1,18	99,42
115	AD 100	67,48	1,37	18,16	7,77	0,115	1,66	1,27	0,32	1,52	0,35	142	150	67	47	77	49	141	34	288	17	349	38	58	11	11	1,04	100,04
116	AD 103	70,30	1,32	17,56	5,83	0,059	1,23	1,44	0,21	1,64	0,40	125	138	47	35	69	38	153	40	322	13	389	44	59	15	6	0,84	99,30
117	AD 104	66,97	1,30	19,46	5,36	0,061	0,98	1,48	0,70	2,92	0,76	128	130	40	32	55	36	137	40	266	12	236	19	63	10	8	1,31	100,26
118	AD 105	68,96	1,33	19,22	5,78	0,061	1,03	1,37	0,35	1,53	0,37	161	124	43	28	52	32	243	49	304	13	312	26	35	8	8	4,46	100,30
	Imports - various Nile alluvial clays																											
106	AD 077	60,12	1,77	17,29	10,26	0,175	2,76	4,26	1,11	1,85	0,42	166	140	78	65	103	55	275	34	298	28	465	31	65	6	10	1,54	99,28
106	AD 083	60,19	1,78	17,48	10,38	0,180	2,75	3,70	1,04	2,03	0,46	177	146	80	65	103	56	275	34	304	27	495	35	60	<5	7	1,24	100,09
108	AD 086	65,94	1,50	15,14	8,83	0,145	2,29	3,10	0,93	1,67	0,46	152	133	67	47	88	50	261	30	297	22	479	17	50	7	11	1,43	100,00
108	AD 079	65,96	1,52	15,00	8,80	0,144	2,25	2,82	1,37	1,80	0,34	142	143	73	53	88	55	246	30	316	22	500	21	66	8	10	1,33	100,24
109	AD 080	62,11	1,66	17,04	9,76	0,151	2,61	3,24	1,21	1,83	0,39	170	143	76	57	96	55	256	35	302	26	532	16	67	8	12	1,77	100,19
109	AD 081	62,96	1,63	16,52	9,84	0,152	2,64	3,11	0,95	1,80	0,41	161	143	79	67	105	62	261	33	306	24	511	29	69	11	11	0,86	100,51
119	AD 108	58,73	1,77	17,48	10,71	0,124	2,29	3,77	1,09	2,59	1,44	185	150	78	72	112	52	505	36	308	28	458	58	69	10	8	9,02	100,13
	Imports - variuos clay of different origin																											
107	AD 078	67,26	1,38	14,46	7,58	0,116	2,42	2,67	1,21	2,49	0,41	140	122	60	42	79	48	235	31	332	19	438	35	50	7	11	1,29	99,25
112	AD 085	62,64	1,73	17,06	9,80	0,146	2,50	3,42	0,89	1,42	0,39	159	138	75	56	95	56	241	33	327	26	463	29	69	7	11	1,38	99,69
O1;113	AD 087	64,02	0,98	19,02	6,14	0,077	1,05	1,69	1,26	5,49	0,26	58	56	37	23	76	163	137	55	571	35	755	116	163	38	nd	0,86	100,26
114	AD 097	61,21	1,46	15,74	8,77	0,134	3,57	4,09	2,33	2,34	0,36	151	143	77	57	58	47	314	30	306	19	418	37	61	<5	8	0,87	100,55

Table 2: Results of chemical analysis by WD-XRF (by G. Schneider, R. Naumann, and M. Daszkiewicz).l.o.i. = loss on ignition at 900°C; TOTAL = original sum before normalization to 100%. Trace elements determined with lower precision are given in brackets (prepared by: M. Daszkiewicz).

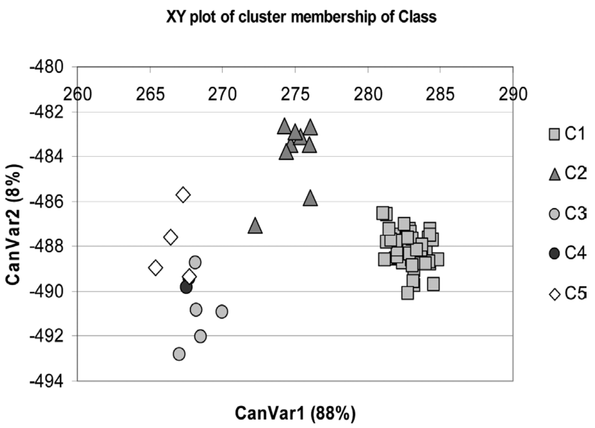

Fig. 3: Discriminant analysis. C1 = cluster includes all samples belonging to Musawwarat reference groups Mus 1–Mus 4; C2 = samples made from various wadi clays (local or regional production?); C3 = samples made from various alluvial clays (imports); C4 = two samples matching El-Zuma; C5 = various imported vessels (analysis using license Weierstrass Institute for Applied Analysis and Stochastics, Leibniz Institute in Forschungsverbund Berlin e.V., prepared by: M. Daszkiewicz).

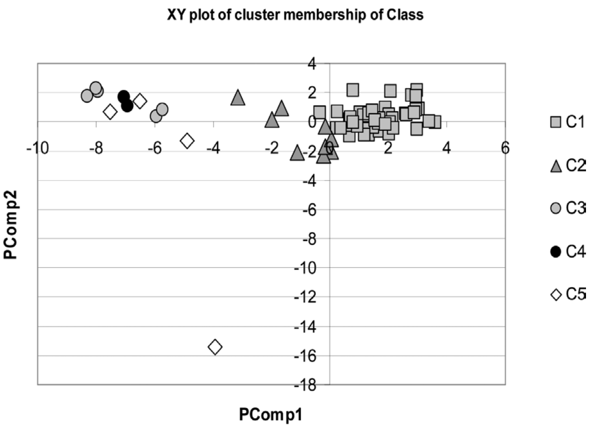

Fig. 4: Principal component analysis. C1 = cluster includes all samples belonging to Musawwarat reference groups Mus 1–Mus 4; C2 = samples made from various wadi clays (local or regional production?); C3 = samples made from various alluvial clays (imports); C4 = two samples matching El-Zuma; C5 = various imported vessels (analysis using license Weierstrass Institute for Applied Analysis and Stochastics, Leibniz Institute in Forschungsverbund Berlin e.V., prepared by: M. Daszkiewicz).

pottery manufactured from alluvial clays (on colour figure 5 two such samples with sMLT[8] and ovM[9] matrix type are shown). Six of them are handmade coarse ware vessels and one represents a wheel-made coarse ware vessel. These seven samples are made from four different Nile alluvial clays (tab. 1). Very probably they have not been manufactured at Musawwarat because a transport of Nile alluvial clay seems unlikely and, moreover, they have been made from different Nile alluvial clays. This raises the question why vessels which were clearly imported have been found buried in the ashes[10] identified as belonging to a pottery workshop? Could they represent damaged vessels used as a cover for the bonfires? This finding clearly shows that we should not automatically assume that all vessels from the pottery workshop area represent local products, even if they are looking like pottery wasters (see e.g. Daszkiewicz and Bobryk 1998).

Two of the samples from Nile alluvial clay are matching a known reference group: Samples of the handmade vessels AD080 and AD081 are similar in thermal behaviour as well as in chemical composition to a group of pottery found in El-Zuma (samples provided for analysis by Mahmoud El-Tayeb; Daszkiewicz 2014). This group of pottery is local at El-Zuma as its composition and thermal behaviour matches local raw materials, e.g. a ceramic body taken from a local potter (sampled by M. Daszkiewicz and G. Schneider in 2008).

Sample AD108, the only sample from Nile alluvial clay not found in the ash layer, has a high phosphorus content and also contains carbonates of a different provenance as is shown by the much higher Sr/Ca ratio. It is very similar in composition to samples made of Nile alluvial clays from the Fourth Cataract region (samples from two sites given for analysis by E. Kolosowska and H-P. Wotzka).

According to the results of the MGR analysis (MGR groups 105, 110–111, 115–118) and the chemical composition, nine of the pottery fragments (handmade and wheelmade) correspond to various wadi clays. However, up to now no comparison was found for them. Based on the cluster analysis (fig. 2), the discriminant analysis (fig. 3) and principal component analyses (fig. 4) for some of these samples a local or – taking into account their geochemical parameters – at least a regional provenance may be accepted.[11]

Three analysed pottery fragments not made from Nile alluvial clays have no comparisons in the SDB

8 sMLT (semi-melted) = the surface of the sample becomes over-melted, changes in the shape of the sample occur (not just rounded edges), but there is no bloating.

9 ovM (over-melted) = the surface of the sample becomes over-melted and its edges rounded.

10 Except AD107 (made of alluvial clay) and AD108 (Mus 4) which were found in the topmost layer of windblown sand.

11 In November 2014, fieldwork was undertaken by M. Daszkiewicz, G. Schneider and M. Wetendorf and several samples of raw materials were collected. After the analysis of these samples we hope to be able to answer further questions about the provenance.

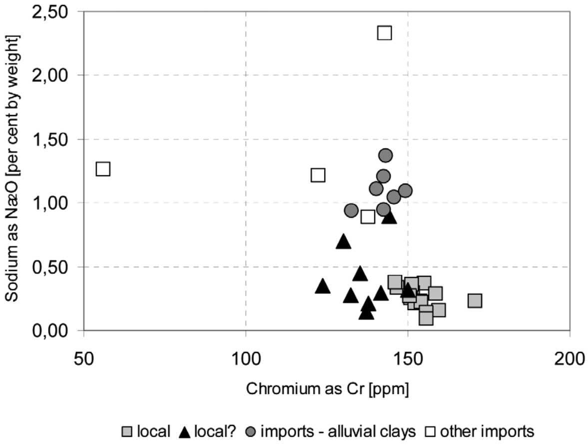

Fig. 5: Content of chromium (as Cr in part per million) versus sodium (as Na2O in per cent by weight) (prepared by: M. Daszkiewicz).

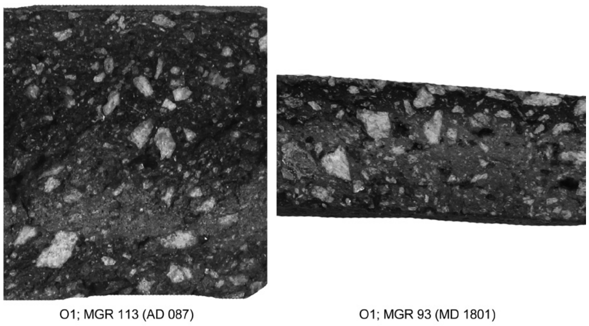

Fig. 6: Two samples belonging to clay type O, reference group O1. Left = sample fromMusawwarat AD087, MGR 113; right = sample from Hamadab MD1801, MGR 93 (sample analysed in the frame of the DAI project Hamadab and Meroe) (macro-photos of cross-sections: M. Baranowski).

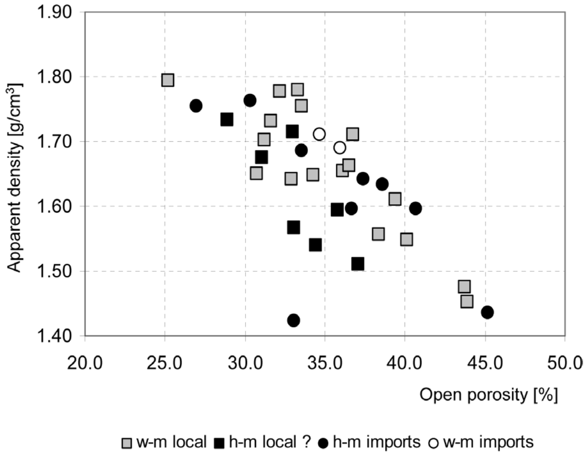

Fig. 7: Open porosity versus apparent density (prepared by: M. Daszkiewicz).

database but in contrast to the nine samples discussed above it is not probable that they are local. One of them (AD097) has a chemical composition with a high iron content similar to Nile alluvial clays, but an ovF matrix type[12]. Such parameters are similar to ceramic bodies high in iron, which are prepared by the admixture of 'clays from the mountains' as they were received for analysis from the potter in Omdurman (sampled by M. Daszkiewicz and G. Schneider in 2008). AD097 also differs in a high sodium content from all other samples (fig. 5).

As can be seen on the diagram plotting contents of sodium versus contents of chromium (fig. 5) one sample is very different in chromium content. This sample of handmade coarse ware (AD087) was made from a material which is very different in its geochemical parameters. It has a low titanium content and very high contents of potassium and rubidium as well as lanthanum and cerium. Besides, it has a very low vanadium content (c. three times lower than in the local MGR group 102) but a high iron content and a very low chromium content (56 ppm in contrast to 123–171 ppm in the local Mus 4 group). Pottery fragments of the same clay type have been found in Hamadab (one sample), in Muweis (two samples) as well as in Musawwarat (one further sample). According to the SDB classification, these samples are classified as clay type O, reference group O1, MGR 113 (for principles of classification, see Daszkiewicz and Schneider 2012). These samples are identical in their fabric (see examples AD087 from Musawwarat and MD1801 from Hamadab in fig. 6).

Three samples of handmade vessels (AD074–076) are macroscopically identical in terms of texture, structure and colour of the cut section and the fresh break, and belong to the same MGR group. However, they differ significantly in contents of magnesium and element ratios potassium/rubidium and calcium/strontium. It is open whether the observed differences are due to alterations of the samples in the ash layer.[13]

The measurements of physical ceramic properties (fig. 7) show that handmade vessels generally have the same open porosities as wheelmade ones. This equally low porosity of the handmade vessels may be due to their thin walls of 0.6–0.9cm in comparison to 0.8–1.4cm of wheelmade vessels. Further studies taking into consideration the diverse vessel shapes and also looking into the functional properties are

12 ovF (over-fired) = the sample changes in shape, but there is no bloating, nor does the surface of the sample become over-melted.

13 We are currently preparing an experiment with accelerated alterations using ashes from the main ash deposit, from which most of the analysed samples derive.

planned, as e.g. big thick-walled wheelmade vessels may have been intended for cooling water and their high open porosity may therefore be intentional.

Conclusions

The new series of analyses discussed here proved that finewares as well as wheelmade coarse wares have been made from wadi clays with the same geochemical parameters. But besides, a large number of coarse wares was imported from workshops using Nile alluvial clays. It is important to analyse more vessels made from Nile alluvial clays, also from other sites, to find out from where these vessels originate. A number of questions arise from these results. Why were these coarse ware vessels brought to Musawwarat? Did they come there as containers of goods, have they been brought because of their special function, or did they just come with people? Hopefully, the planned analysis of functional properties will supply us with data to answer these questions. Other analyses which are currently conducted and from which we hope to get a clearer picture, include the study of pottery fragments of similar fabrics from the nearest sites (e.g. Wad ban Naga) as well as investigations of raw materials from different sources in and near Musawwarat.

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Zusammenfassung

Der Beitrag präsentiert die Ergebnisse einer neuen Serie von Analysen, die an handgemachter und scheibengedrehter Grobkeramik aus dem ‚Keramikhof' 224 in der Großen Anlage vorgenommen wurde. Die für die Analysen ausgewählte Keramik stammt, bis auf zwei Ausnahmen, die aus der Flugsandschicht [224.14-001] kommen, aus dem Aschedeposit [224.14-002]. Die Ergebnisse zeigen, dass feine (eine Probe) und scheibengedrehte grobe Ware aus Waditonen mit den gleichen geochemischen Parametern hergestellt wurde. Im Gegensatz dazu ist ein großer Teil der groben handgemachten Ware aus alluvialen Niltonen gemacht und damit importiert, wenn man nicht den nicht sehr wahrscheinlichen Transport von Rohtonen annimmt. Die analysierten Keramikscherben lassen sich, neben vier deutlich verschiedenen Proben importierter Keramik, klar drei Gruppen zuordnen: 15 Proben passen zur Referenzgruppe Mus 4, der lokalen Keramik in Musawwarat; neun Proben entsprechen verschiedenen, wahrscheinlich lokalen oder regionalen Waditonen, und sieben Proben entsprechen vier Gruppen von Niltonen unterschiedlicher Herkunft, wobei eine Gruppe zu Analysen lokaler Keramik von El-Zuma passt. An diese Ergebnisse schließt sich eine Reihe von Fragen an. Sind diese Gefäße als Transportbehälter oder auf Grund spezieller funktionaler Eigenschaften nach Musawwarat gekommen und von woher? Weitere Untersuchungen, die diesen Fragen nachgehen, sind in Arbeit.