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WHEEL-MADE POTTERY OF THE M.C. III AND L.C. I PERIODS IN CYPRUS IDENTIFIED BY NEUTRON ACTIVATION ANALYSIS*

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Until recently many archaeologists believed that the potters of the Middle Cypriote III and Late Cypriote I periods (around 1600 B.C.) did not use the potter's wheel for the production of any of their wares and this had become the prevalent view. An effect of this belief was that any wheel-made pottery from this time period found in Cyprus was automatically classified as an import, often from Syria or Palestine. It should be pointed out that Sjöqvist particularly took strong exception to this view.[1]

Recently neutron activation studies[2] have shown that a particular style of wheel-made pottery from this period, Bichrome Ware, considered by archaeologists to be Syro-Palestinian, was instead produced of eastern Cypriote clay. An additional typological analysis of the shapes of Palestinian, Syrian, and Cypriote pottery showed the Bichrome Ware to be a variant member of the Cypriote White Painted Ware family upon which some innovative features of the decorations had been grafted.[3]

It is worthwhile to extend the neutron activation studies to other styles of wheel-made pottery from this time period in Cyprus, and at the same time to go back and examine a number of the original tomb reports

to determine if there is still an archaeological basis for the earlier belief. An examination of Cypriote tomb inventories showed that the wheel-made variety was at times more plentiful than its hand-made counterpart. For instance, in Tomb 2 at Enkomi, Dikaios reports eight pieces of Black Slip Ware, all of which are wheel-made.[4] Plain Ware, which has no decoration and was for common use, was usually made in the area in which it was found and this kind of ware according to Cypriote tomb reports is often exclusively wheel-made. For instance, the Enkomi tombs: 35 wheel-made sherds of this ware[5] were found in Tomb 2 and 118 in the large assemblage[6] of Tomb 10. Dikaios[7] attributes these wheel-made vessels to the first burial layer in Tomb 10, which contains a large quantity of M.C. III typical ware, such as White Painted V ware and hand-made red slip and black slip wares. In the same group there is a wheel-made red slip juglet and a few wheel-made plain bowls as well as a Monochrome bowl which may place the burial in L.C. I, but the large percentage of M.C. III wares in the tomb suggests the transitional period M.C. III and L.C. I. Surprisingly no reference is made to any hand-made Plain Ware from these tombs. Thus, it would seem from the tomb reports that there are indeed some plain Cypriote pottery being made on a wheel. As already pointed out by Sjöqvist, the factor which obscured this evidence is the fact that certain styles of Cypriote ware continued to be hand-made throughout much of the Cypriote Late Bronze Age.

The large quantity of wheel-made vessels already caught the eye of Westholm who remarked on the amount of wheel-made pottery which he attributed to Syria: "The comparatively large number of foreign wares in this tomb is worthy of notice, especially as most of the classes are represented by several vases."[8] Dikaios states that among the pottery

from Enkomi, there are many wares which he considered foreign only because the wheel technique was not used in Cyprus at that time.[9]

Neutron activation measurements were made on wheel-made Plain Ware and wheel-made Black Slip Ware found in Cyprus as well as hand-made ware of accepted Cypriote origin. In these, determinations of the abundances of some 40 trace and major elements are measured, from which 18 of the best measured and most distinctive elements were used to classify the pottery. In Table I and Fig. 1 are shown the data for two groups of hand-made eastern Cypriote pottery of the period under discussion and two groups of wheel-made pottery which were excavated in eastern Cyprus. For each group, the mean values of the abundances of the 18 elements are tabulated along with the root-mean-square deviations for each element. The two groups of hand-made pottery are composed of nine pieces of Milia Hand-Made Ware and nine pieces of Kalopsidha White Painted Hand-Made Ware. The two groups of wheel-made pottery are composed of 13 pieces of Milia Black Slip Wheel-Made Ware and 10 pieces of Enkomi Plain Wheel-Made Ware. The group of wheel-made pottery from Enkomi agrees in its chemical composition with the hand-made pottery group from Kalopsidha so closely that the cannot be distinguished from one another. The other two groups, consisting of the hand-made and wheel-made vessels from Milia, are also quite similar. It is therefore probable that the wheel-made pottery has the same general provenance as the hand-made pottery, i.e. the eastern part of Cyprus.

For our study we also selected vessels which had been designated typologically by other archaeologists. In the basement of the Cyprus Museum, in Nicosia, we found several likely candidates. The first piece, #A1467 is in the Nicosia Museum (see Fig. 2). Its description in the

museum's registrar is: "Syrian Ware Wide Neck. Squat body with base ring with long cylindrical neck with plain rim and handle from rim to shoulder, buff slip, dark and light brown paint, around the rim, band, three bands one on the front and two at side of neck. The one on the front, two lattice triangles conjoined at apex one above other between triple bands. The bands of straight lines extending down to the middle of the body. Wavy lines between thin, round neck-base and middle of body, horizontal lines. Point on handle destroyed. Ht. 0.185 cm." We chose this particular tankard (which actually is 18.5 cm in height), not only because of its distinct family resemblance to the hand-made Cypriote White Painted Wares III and V, but also its shape and decoration are reminiscent of the Bichrome Ware which we had studied previously. Professor Åström, who mentions this particular vessel, also noticed the Bichrome effect of its decoration.[10] The museum description of the second piece #RR1748 (see Fig. 3) is: "Painted Weight (sic) Ware amphora. Nearly spherical body standing base ring. Cylindrical neck and vertical handles on shoulder. On the body pattern consisting of rows of lattice bands and zig zag lines with dots. Round the middle of the body black broad zone. Ht. 26 cm." This vessel was chosen for our study mainly because of its shape. It is a hand-made krater and its handles are inserted into the body. The third piece, registered as #RR3066 (see Fig. 4) is a hand-made White Painted storage jar, or pithos with the description: "Imported painted Middle Bronze age amphora. Round neck and shoulder brownish bands. On body vertical bands. Ovoid body, flat base, two vertical handles about middle body. Ht. 40 cm." Einer Gjerstad in his *Studies on Prehistoric Cyprus* doesn't specifically say that the vessel is of Cypriote manufacture, but he does include it in the main body

of the White Painted V family, which is all hand-made.[11] Åström calls this particular vessel an amphora,[12] and finds it to be a member of the White Painted V group which he links to the earlier White Painted III.[13] He says of it: "The amphora ...., with vertical handles on the shoulder, is of Syrian or Palestinian derivation, the shape being common in Middle Bronze and Late Bronze. Similar shapes are known from Egypt and Asia Minor. The date of this White Painted V amphora is uncertain, either M.C. III and L.C. I. It is decorated with framed, broad bands, which are typical of White Painted V Ware and occur both in M.C. III at Kalopsidha and L.C. I at Enkomi."[14] We further chose as a fourth piece a wheel-made White Painted jug which was excavated at Ras Shamra, and which is now in the Louvre Museum. (Fig. 5). It is similar typologically to White Painted jugs found in Cyprus and to the three other pieces previously discussed.

The results of the neutron activation analysis shown in Table II, Fig. 6, indicate that the four vessels are produced from a similar clay and have a chemical composition which is similar to the hand-made and wheel-made groups shown in Table I and Fig. 7. To illustrate it further, in Table III and Fig. 7, we positioned the chemical compositions of the White Painted wheel-made jug from Ras Shamra next to the two groups of hand-made Cypriote wares from Milia and Kalopsidha from Table I, as well as a mixed group of tablets and a jug, local to Ras Shamra. The White Painted wheel-made jug which was excavated in Ras Shamra is similar in its clay composition to the Cypriote hand-made ware, but is completely different from the Ras Shamra clay.

Conclusion:

The chemical data which is presented in this study shows that many of the wheel-made ceramic wares which were found in Cyprus in Middle Cypriote III and Late Cypriote I contexts, were not imported to Cyprus from Syro-Palestine but were made in eastern Cyprus. The wheel-made Plain White Ware and the Black and Red Slip Wares were similar typologically to their hand-made Cypriote antecedents, which they slowly replaced. It would, however, be a mistake to assume that on the day that the wheel-made variety was introduced, the hand-made type disappeared from the market. The potters using the hand techniques could have easily continued in their trade concurrently with their "modern" neighbors.

Thus the chemical tests on the wheel-made White Painted family indicate that the wheel-made style was a continuation of the long tradition of White Painted Cypriote Ware. Their typological similarities to other Cypriote White Painted Wares have been noticed by many archaeologists. These wheel-made White Painted vessels, such as the tankards (MUNC.4) had a close parallel in the hand-made White Painted III tankard of the Middle Cypriote period. These eastern Cypriote workshops also produced wheel-made White Painted Ware which was then exported to Syria as we saw in Table III, and probably to Palestine and to Egypt.

The present work also indicates the Cypriote potters knew of the wheel and actually made use of it in M.C. III and L.C. I periods. It is no longer valid to attribute all wheel-made ceramics of these periods which are found in Cyprus to Syro-Palestine or Egypt. It is therefore important to reexamine deductions which have been based on the premise that Cypriote ceramics of this period are imports just becuase they were

fashioned on the wheel. It is also important to reexamine the dating of tomb collections and stratigraphic materials which were attributed to a later period only because of the appearance of a large assemblage wheel-made pottery.

Acknowledgments:

We are indebted to Prof. E. Gjerstad, Prof. P. Åström and the Mediterranean Museum in Stockholm for making a large number of Cypriote wares available for our studies. We thank Dr. V. Karageorghis, the Director of the Department of Antiquities of Cyprus, for his continuous encouragement and assistance. We are indebted to I. Nicolaou, the Head Curator for allowing us to study as well as to sample pottery in the Cyprus Museum. The late Mrs. A. Pieridou was most gracious in helping us locate some of the vessels in the museum basement. We are grateful to Mr. N. Constantinides for his patience and assistance in the museum, as well as to Mrs. S. Kromholz for her help with the registrar and Mr. A. Kromholz and Mr. S. Sarafjan for the photography done for this study. The Ras Shamra samples were collected in the Louvre Museum with the kind assistance of Miss Annie Coubet and Dr. P. Amiet. Prof. C. Schaeffer most kindly allowed us to see and sample ceramics from his private collection.

FOOTNOTES AND REFERENCES

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†I. Perlman is now at the Hebrew University in Jerusalem.

1. Erik Sjöqvist, Problems in the Late Cypriote Bronze Age (Stockholm, 1940), p. 87-90.
2. Michal Artzy, F. Asaro, and I. Perlman, "The Origin of the 'Palestinan' Bichrome Ware," J. Am. Oriental Soc. 93, p. 446-461 (1974).
3. Michal Artzy, "The Bichrome Ware in its Cypriote Context," Alter Orient und Altes Testament, (22), p. 9-16 (1974).
4. P. Dikaios, Enkomi Excavations 1948-1958 I (Mainz am Rhein, 1969-1971), p. 345.
5. Ibid., p. 336-347.
6. Ibid., p. 357-394.
7. Ibid., p. 358-359.
8. A. Westholm, "Some Late Bronze Tombs at Milia," Quarterly of the Dept. of Antiquities in Palestine, VIII, p. 1-20 (1939).
9. Dikaios, op. cit., p. 226.
10. Paul Åström, Late Cypriote Bronze Age (Lund, 1972), p. 270.
11. Einer Gjerstad, Studies on Prehistoric Cyprus (Uppsala Universitet Ansskrift, 1926), p. 171-176. Illustration of vessels, p. 173-4.
12. Paul Åström, Middle Cypriote Bronze Age, (Lund, 1957), p. 76, Fig. XVIII:10.
13. Ibid., p. 66.
14. Ibid., p. 223.

CONCORDANCE OF GROUP MEMBERS

Table I:

Mla. Handmade. 9 pieces:

Mla., 31, 32, 34-36, 56, 58, 62, 66

Kal. W.P. Handmade. 9 pieces:

Kal., 17, 19, 20, 22, 24, 27, 28, 30, 33

Mla. B.S. Wheelmade. 13 pieces:

Mla., 68-78, 84, 86

Enk. Wheelmade. 10 pieces:

Enk., 8, 9, 13, 101, 107-112

Table II:

MUNC 4 is #A1467 in the Cyprus Museum in Nicosia.

MUNC 6 is #RR1748 in the Cyprus Museum in Nicosia.

MUNC 7 is #RR3066 in the Cyprus Museum in Nicosia.

RASH 8 is A018646 in the Louvre Museum.

Table III:

RASH.8, see Table II

Mla. Handmade, see Table I

Kal. W.P. Handmade, see Table I

Rash. Local, 7 pieces:

Rash. 36-39, 41, 46, 71

Table I. Elemental abundances[a] from neutron activation studies of hand-made and wheel-made pottery groups from Cyprus.

	Mla. Hand-made[b] (9 Pieces) M ± σ	Kal. W. P. Hand-made[c] (9 Pieces) M ± σ	Mla. B. S. Wheel-made[d] (13 Pieces) M ± σ	Enk. Wheel-made[e] (10 Pieces) M ± σ
Fe%	5.06 ± 0.49	5.65 ± 0.37	4.77 ± 0.15	5.52 ± 0.33
Ta	0.643 ± 0.063	0.543 ± 0.046	0.621 ± 0.027	0.525 ± 0.030
Sc	20.97 ± 2.41	24.05 ± 1.65	19.88 ± 0.68	23.90 ± 0.99
Co	27.42 ± 2.84	28.44 ± 1.88	28.40 ± 2.37	28.55 ± 1.32
Cs	3.6 ± 0.6	3.4 ± 0.5	4.0 ± 0.3	3.7 ± 0.4
Cr	384 ± 94	314 ± 41	330 ± 59	324 ± 46
Hf	3.40 ± 0.27	2.60 ± 0.29	2.77 ± 0.23	2.64 ± 0.28
Th	6.69 ± 0.77	5.38 ± 0.57	6.82 ± 0.38	5.33 ± 0.29
Ni	235 ± 26	176 ± 20	302 ± 22	192 ± 28
Rb	66 ± 14	48 ± 9	68 ± 6	57 ± 16
La	20.5 ± 1.5	17.5 ± 1.5	19.6 ± 1.6	17.1 ± 0.9
Lu	0.445 ± 0.027	0.320 ± 0.014	0.259 ± 0.020	0.306 ± 0.015
U	2.37 ± 0.77	1.84 ± 0.16	1.43 ± 0.14	3.08 ± 1.48
Ti%	0.445 ± 0.027	0.458 ± 0.028	0.379 ± 0.029	0.424 ± 0.039
Mn	1044 ± 104	1056 ± 101	769 ± 162	1087 ± 78
Na%	1.179 ± 0.213	1.468 ± 0.239	0.718 ± 0.094	1.473 ± 0.139
Al%	— [f]	6.60 ± 0.56	— [f]	— [f]
Ca%	9.5 ± 2.1	11.6 ± 1.4	7.8 ± 0.7	9.3 ± 1.5

[a]The numbers for the respective elements are group mean values (M) and the standard deviations (±σ). All are in units of parts-per-million unless designated "(%)" and the latter are in per cent.

[b]Mla. Hand-made is a group of hand-made White Painted and Plain Wares from Milia.

[c]Kal. W.P. Hand-made is a group of hand-made White Painted Ware from Kalopsidha.

[d]Mla. B.S. Wheel-made is a group of wheel-made Black Slip Ware from Milia.

[e]Enk. Wheel-made is a group of wheel-made Plain Ware from Enkomi. The Enkomi sherds from the Swedish Cyprus expedition were apparently contaminated with measurable amounts of gold, silver, and uranium, and we cannot use these elements for classification purposes.

[f]At the time these were analyzed, aluminum was not measured.

Table II. Elemental abundances[a] from neutron activation studies of single hand-made and wheel-made vessels.

	MUNC-4[b]	MUNC-6[c]	MUNC-7[d]	RASH-8[e]
Fe%	5.13 ± 0.07	5.08 ± 0.07	4.95 ± 0.07	5.13 ± 0.07
Ta	0.535 ± 0.005	0.510 ± 0.004	0.517 ± 0.004	0.476 ± 0.0004
Sc	21.97 ± 0.07	22.49 ± 0.08	21.55 ± 0.07	21.95 ± 0.07
Co	31.06 ± 0.45	28.42 ± 0.44	29.55 ± 0.42	27.31 ± 0.38
Cs	3.8 ± 0.3	2.9 ± 0.3	4.0 ± 0.3	2.7 ± 0.2
Cr	313 ± 5	273 ± 4	288 ± 4	251 ± 4
Hf	3.02 ± 0.08	2.85 ± 0.08	2.81 ± 0.08	2.86 ± 0.08
Th	5.44 ± 0.11	4.67 ± 0.13	4.95 ± 0.11	4.11 ± 0.31
Ni	218 ± 21	170 ± 22	196 ± 19	169 ± 18
Rb	61 ± 10	49 ± 11	76 ± 10	67 ± 12
La	17.9 ± 0.6	14.4 ± 0.5	17.0 ± 0.6	15.1 ± 0.5
Lu	0.264 ± 0.016	0.273 ± 0.014	0.284 ± 0.015	0.269 ± 0.014
U	2.17 ± 0.03	1.61 ± 0.03	3.08 ± 0.03	1.66 ± 0.02
Ti%	0.433 ± 0.021	0.454 ± 0.017	0.439 ± 0.017	0.356 ± 0.020
Mn	1106 ± 11	1010 ± 10	1029 ± 8	981 ± 12
Na%	1.427 ± 0.016	1.916 ± 0.019	1.194 ± 0.014	1.242 ± 0.016
Al%	6.42 ± 0.19	6.46 ± 0.12	6.43 ± 0.13	5.74 ± 0.24
Ca%	10.4 ± 0.6	8.3 ± 0.5	8.6 ± 0.5	13.5 ± 0.6

[a]Abundances are in parts-per-million except for those elements which have a % sign after the chemical symbol. These latter abundances are in percent. The entry after the ± sign is the precision of measurement (one standard deviation).

[b]MUNC.4 is a wheel-made White Painted Ware tankard from the Museum in Nicosia.

[c]MUCN.6 is a hand-made White Painted Ware krater from the Museum in Nicosia.

[d]MUNC.7 is a hand-made White Painted Ware storage jar from the Museum in Nicosia.

[e]RASH.8 is a wheel-made White Painted jug from Ras Shamra in the Louvre Museum.

Table III. Elemental abundances[a] from neutron activation studies of Ras Shamra wheel-made White Painted jug and Cypriote hand-made pottery groups.

	RASH 8[b] M ± σ	Mla. Hand-made[c] (9 Pieces) M ± σ	Kal. WP Hand-made[d] (9 Pieces) M ± σ	Rash. local[e] (7 Pieces) M ± σ
Fe%	5.13 ± 0.07	5.06 ± 0.49	5.66 ± 0.32	2.04 ± 0.10
Ta	0.476 ± 0.0004	0.643 ± 0.063	0.551 ± 0.030	0.366 ± 0.031
Sc	21.95 ± 0.07	20.97 ± 2.41	24.06 ± 1.48	8.87 ± 0.57
Co	27.31 ± 0.38	27.43 ± 2.84	28.27 ± 1.97	16.74 ± 1.71
Cs	2.7 ± 0.2	3.6 ± 0.6	3.8 ± 0.4	1.3 ± 0.5
Cr	251 ± 4	384 ± 94	313 ± 38	546 ± 106
Hf	2.86 ± 0.08	3.40 ± 0.27	2.66 ± 0.15	1.55 ± 0.12
Th	4.11 ± 0.31	6.69 ± 0.77	5.49 ± 0.39	3.01 ± 0.16
Ni	169 ± 18	235 ± 26	178 ± 15	154 ± 8
Rb	67 ± 12	66 ± 14	54 ± 16	26 ± 5
La	15.1 ± 0.5	20.5 ± 1.5	17.9 ± 1.1	19.9 ± 2.4
Lu	0.269 ± 0.014	0.445 ± 0.027	0.318 ± 0.015	0.276 ± 0.022
U	1.66 ± 0.02	2.37 ± 0.77	2.00 ± 0.30	1.26 ± 0.14
Ti%	0.356 ± 0.020	0.445 ± 0.027	0.466 ± 0.021	0.129 ± 0.075
Mn	981 ± 12	1044 ± 104	1036 ± 106	942 ± 114
Na%	1.242 ± 0.016	1.179 ± 0.213	1.370 ± 0.240	0.152 ± 0.027
Al%	5.74 ± 0.24	—— [f]	7.25 ± 0.50	2.30 ± 0.23
Ca%	13.5 ± 0.6	9.9 ± 2.6	11.0 ± 1.1	23.8 ± 2.4

[a]The numbers for the respective elements in the pottery groups are group mean values (M) and the standard deviation (±σ). For Rash 8, a single vessel, the numbers are the elemental abundance (M) for the single vessel and the precision of measurement (±σ).

[b]RASH. 8 is a wheel-made White Painted jug from Ras Shamra.

[c]Mla. Hand-made (see Table I).

[d]Kal. W.P. Hand-made (see Table I).

[e]Rash. local is a group of local tablets and a jug from Ras Shamra.

[f]At the time these were analyzed, aluminum was not measured.

FIGURE CAPTIONS

Fig. 1. The bars represent mean values for the indicated pottery groups: the hatched zone on each is ± the standard deviation for the group. The value for each element in units of parts-per-million unless designated "%". "Mla. hand", a group of 9 pieces of handmade ware from Milia. "Mla. B.S.Wheel", a group of 13 pieces of wheel-made Black Slip ware from Milia. "Kal. W. P.hand", a group of 9 pieces of handmade White Painted ware from Kalopsidha. "Enk. Wheel", a group of 10 pieces of wheel-made plain ware from Enkomi.

Fig. 2. Wheel-made White Painted tankard #A1467 from the Cyprus Museum.

Fig. 3. Handmade White Painted krater-amphora #RR1748 from the Cyprus Museum.

Fig. 4. White Painted storage jar #RR3066 from the Cyprus Museum.

Fig. 5. Wheel-made White Painted jug found in Rash Shamra, now #A018646 in Louvre Museum.

Fig. 6. The bars represent elemental abundance values for the individual pieces represented in Figs. 2, 3, 4, and 5.

Fig. 7. Rash 8 is repeated from Fig. 6, Mla. hand. and Kal. hand from Fig. 1. Rash. local is a group of local tablets and a jug from Rash Shamra.

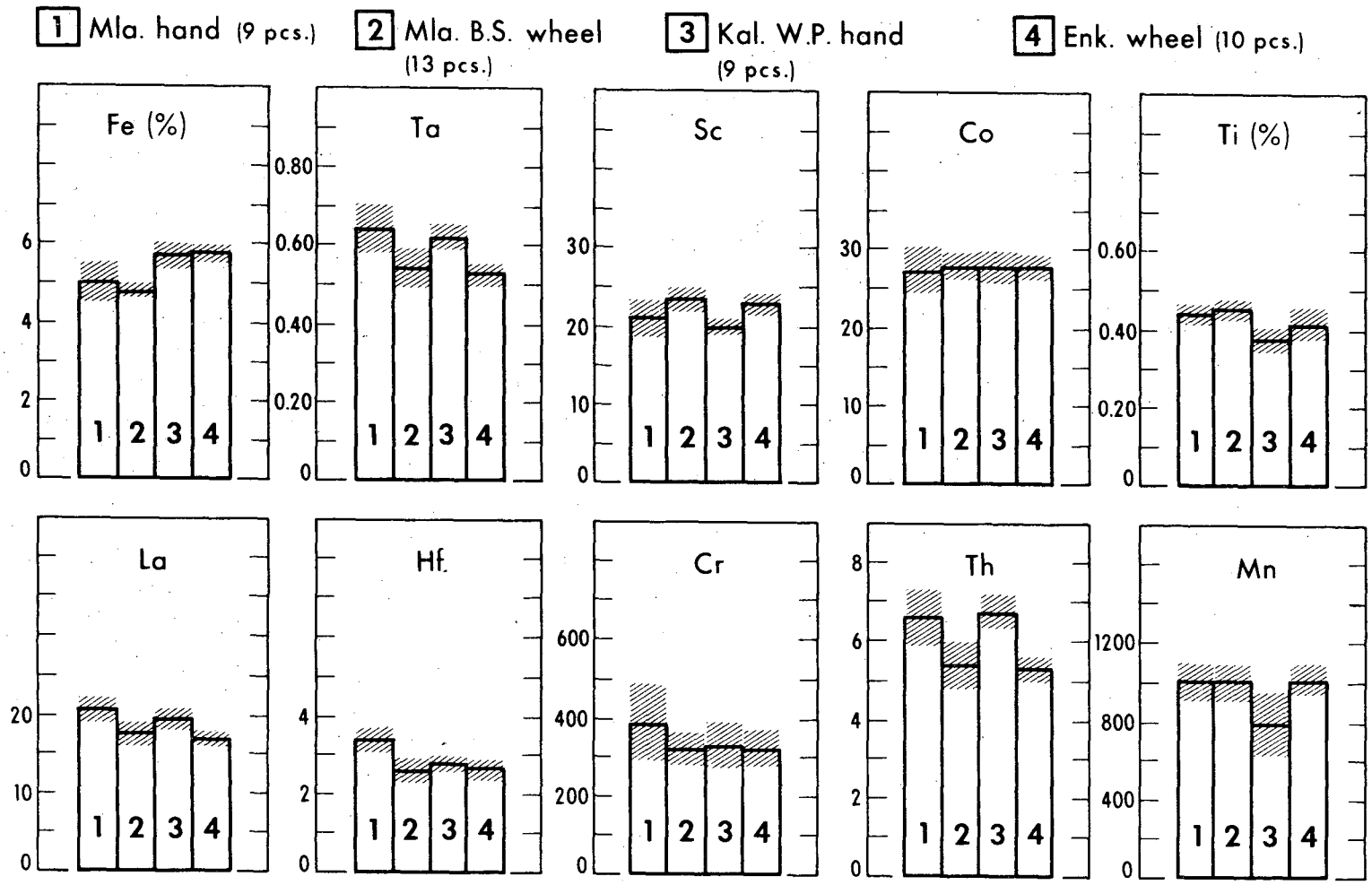

Fig. 1.

XBL 759-4000

XBL 759-4002

Fig. 2

XBL 759-4001

Fig. 3

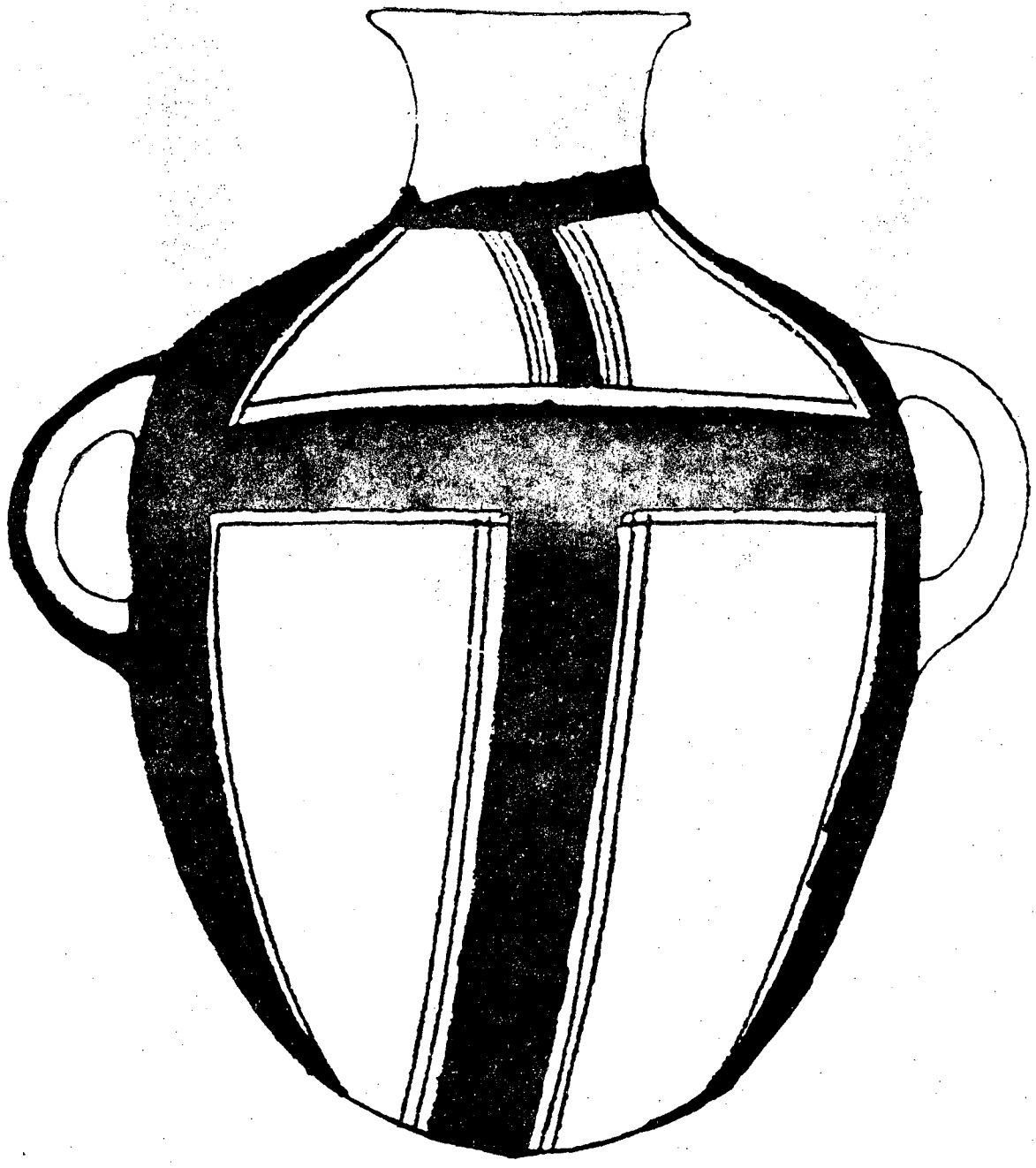

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Fig. 4.

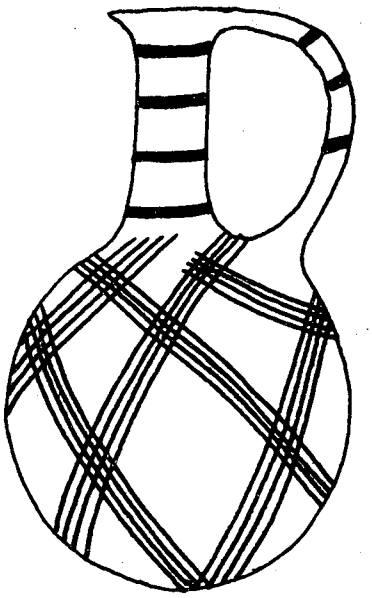

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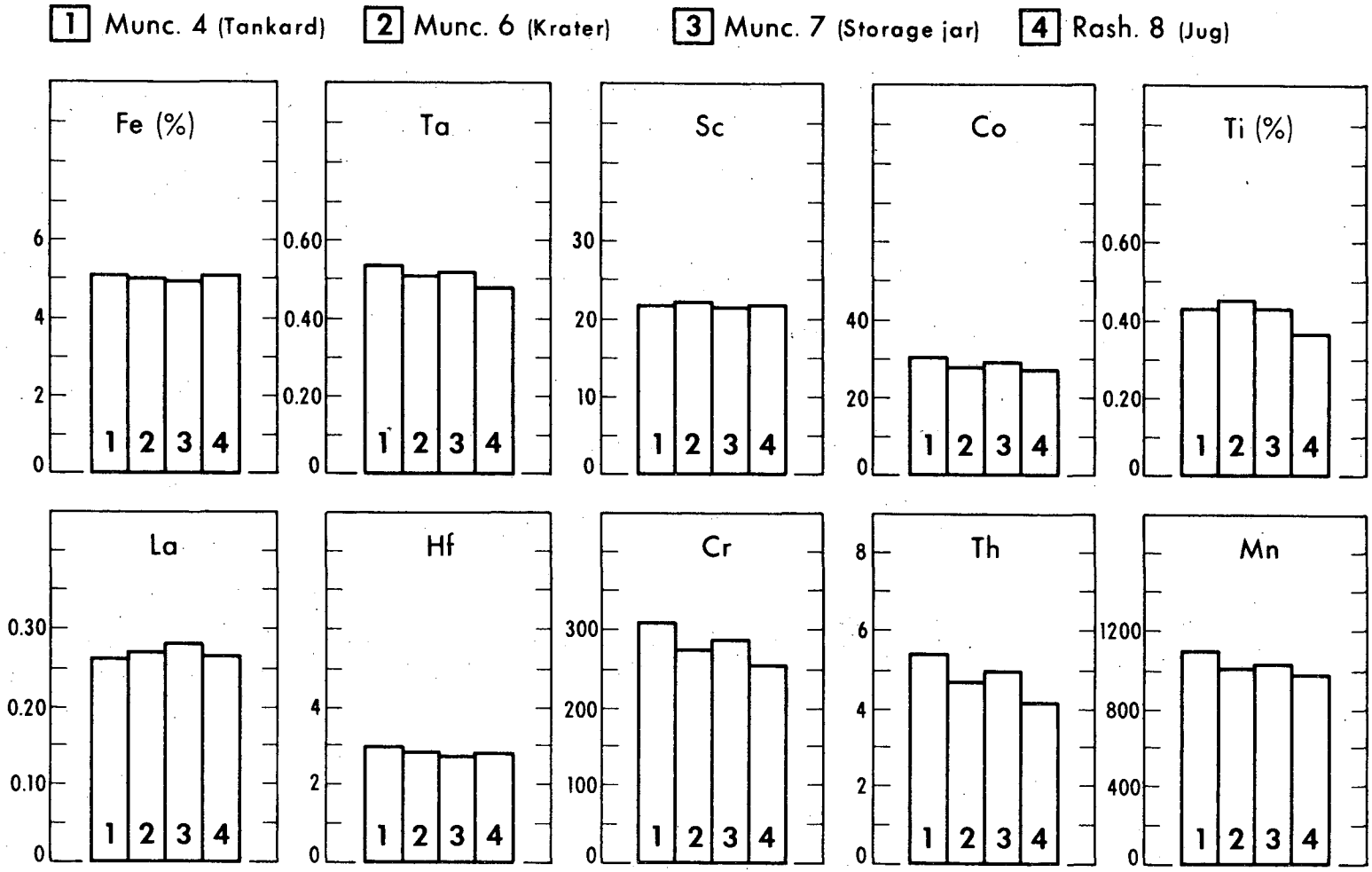
Fig. 5.



XBL 759-3998

Fig. 6.

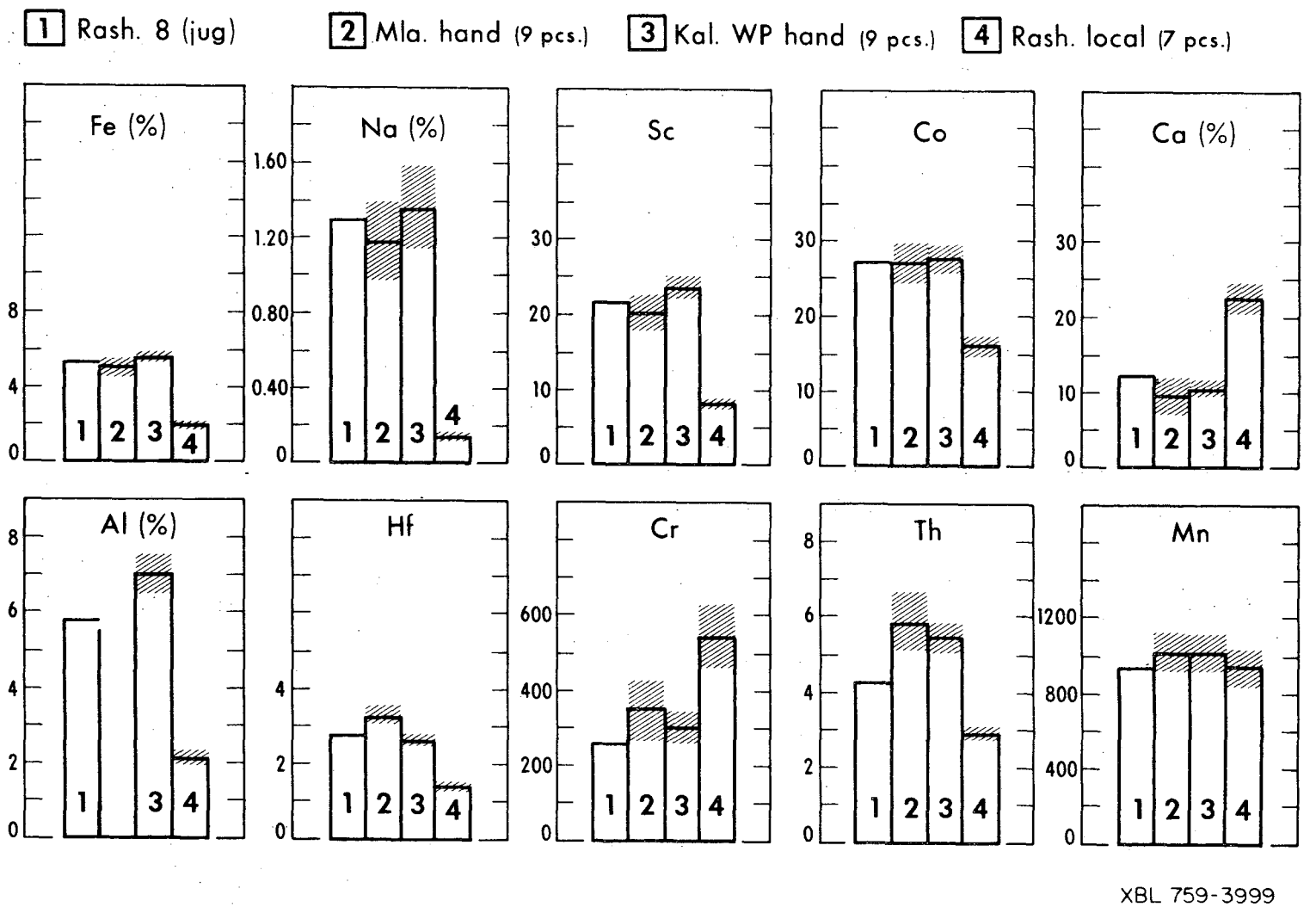

1 Rash. 8 (jug)
2 Mla. hand (9 pcs.)
3 Kal. WP hand (9 pcs.)
4 Rash. local (7 pcs.)
Fe (%)
Na (%)
Sc
Co
Ca (%)
Al (%)
Hf
Cr
Th
Mn
XBL 759-3999

Fig. 7.

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