NEUTRON ACTIVATION ANALYSIS OF AEGEAN-STYLE IIIC POTTERY FROM MAA: PALAEOKASTRO, CYPRUS, AND A DISCUSSION ON THE FOUNDATION OF THE SITE

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Abstract: *Neutron Activation Analysis was carried out in Bonn on 12th century BC Aegean-style pottery from Maa: Palaeokastro. The results gave rise to a survey of maritime trade at Maa and of winds and currents in the east Mediterranean, leading to a discussion of the date and reason for the foundation of the site.*

Keywords: *Cyprus, Neutron Activation Analysis, Maa: Palaeokastro*

Introduction

A programme of Neutron Activation Analysis (NAA) was carried out by the present authors[3] on 12th century BC Aegean-style pottery from ten Cypriot sites to obtain their chemical profile to add to that of Sinda.[4] The NAA succeeded in isolating the profiles of six more sites: Enkomi (CypI), Kition/Hala Sultan Tekke (CypJ), Hala Sultan Tekke (CypT), Alassa (CypF), Kourion (CypN) and Kouklia (CypG and CypS) (Fig.1). This allowed the movement of pottery between the sites to be followed and Cypriot exports in Turkey, Egypt and the Levant to be assigned to their parent sites. No chemical profile could be obtained for Apliki, Athienou, Idalion and Kalavasos. One key harbour site we were not able to sample for lack of funding was Maa: Palaeokastro. This 12th century BC (Table 1)[5] fortified settlement is situated on the west coast of Cyprus on a long southward running promontory with a sheltered bay each side of it to the west and to the east offering protected harbours. Coastal plains extend 3–5 kilometres from the peninsular to the foothills of the Troodos mountains. A particular reason for sampling this site was to see if a chemical group of pottery recently isolated by NAA at Tarsus came from it.[6] The group should come archaeologically from west Cyprus, but its chemical profile did not match that of Kouklia, which exported pottery to Tarsus. The NAA at Maa was finally made possible by a grant from the Honor Frost Foundation, to whom we are exceedingly grateful.

The primary aim of the Maa project was to carry out NAA of 30 pieces of 12th century BC Aegean-style pottery from the site in order to try and obtain their chemical profile. This would allow the exchange of pottery between Maa and other Cypriot sites with known chemical profiles to be monitored and, most importantly, exports from Maa to the east Mediterranean, such as the group at Tarsus, might be identified. A secondary aim of the project was to see if the results from NAA would give a hint as to the reason for the foundation of the site.

Sampling strategy

The sampling strategy dealt with the corpus of decorated Aegean-style pottery at the site, since the fine plain ware was not necessarily of Aegean derivation and the remaining wares were local. We were careful to choose a variety of possible Aegean-style types. Thus, the 30 samples include examples which are representative of the wares and decoration of the entire Aegean-style pottery corpus at the site, in as much as the coarser ware Aegean-style vessels do not always react well to NAA, which is better suited to fine wares. A macroscopic study and thin section petrography together with the NAA were a desideratum but would not have been possible financially. Consid-

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3 Mountjoy and Mommsen 2015.

4 Mommsen and Sjöberg 2007, 359–71.

5 This table is partly based on Mountjoy 2018a, 22 Table 1. The term Equivalent Pottery Phase is used to emphasise the distinction between pottery terminology, which is based on wares or similar criteria, and chronological phasing (see Mountjoy 2018a, 23,26), since they are often erroneously used interchangeably.

6 Mommsen et al. 2011; Mountjoy et al. 2018.

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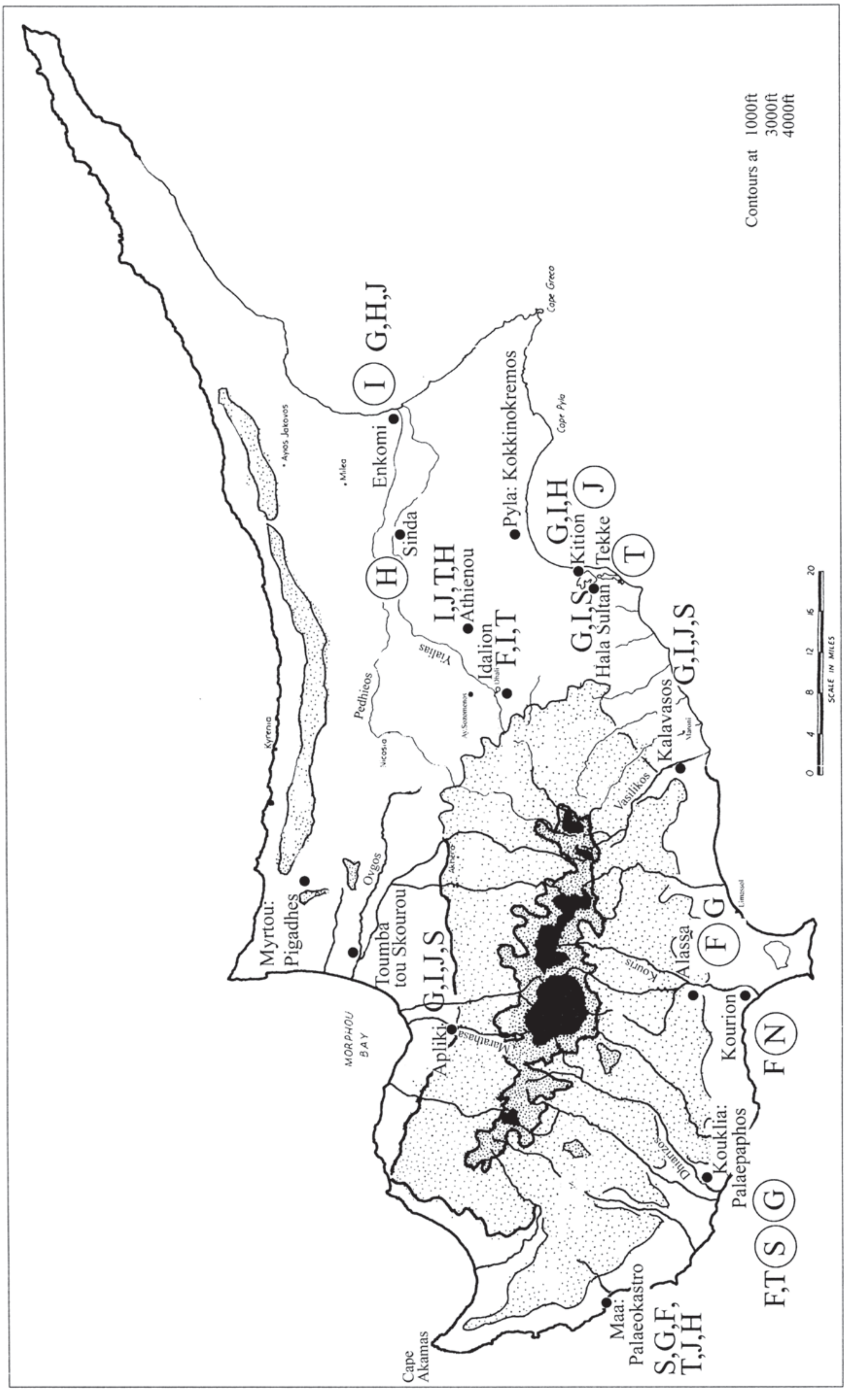

Fig. 1 Cyprus. To show the location of the sites and the chemical profiles obtained by NAA. The encircled letter by a site is the chemical profile of the site; the letters not encircled denote imports from other sites.

ering costs and based on our experience that 10–15 samples are generally enough to define a chemical profile, our sampling procedure was aimed at a minimum of 30 sherds of the same pottery phase per site, using meaningful pieces rather than closed linear body sherds, which can give chemical information but no information on the trade of shapes for their contents or on the identity of workshops. The pieces were chosen for NAA based on observations after drawing and cataloguing the whole group to which the pieces belong. The paste of fine ware Aegean-style pottery from different Cypriot sites does not differ much when viewed initially. However, the decorative syntax and use of motifs can offer insight into variations if one is handling large amounts of contemporary pottery from different sites. Thus, samples are first chosen from large groups with similar syntax and

	Equivalent Pottey Phase	Chronological Phase	Equivalent Pottery Phase	Stratigraphic Phase		
	Argolid	Cyprus		Enkomi	Sinda	Maa
1220	LHIIIB2 Late					
1210						
1200			Local IIIB			
1190	Destruction	LCIIC		Level IIB		
1185			LCIIC Final (IIIC Early 1)	Destruction	I Destruction	
1180	LHIIIC Early 1		CypIIIC Early 1			
1170	Destruction					Constr.?
						Constr.? Floor II
1160				Level IIIA	II	Destruction
1150	LHIIIC Early 2	LCIIIA	CypIIIC Early 2			Floor I Abandoned
1140	LHIIIC Middle 1 (Developed)			Destruction	Destruction	
1130			CypIIIC Middle	Level IIIB Early	III	
1120	LHIIIC Middle 2 (Advanced)			Destruction	Abandoned	
1110						
1100	Destruction					
1090				Level IIIB Late Floor III		
1080	LHIIIC Late	LCIIIB	CypIIIC Final			
1070				Floor II		
1060	Sub-Mycenaean			Destruction		
1050				Level IIIC Floor I		

Table 1 The Cypriot pottery phases (based on Mountjoy 2018a, 22 Table 1).

decorative motifs to try and get the chemical profile of the site. At the same time, a further group is chosen consisting of sherds with differing syntax and motifs. Some may fit into the local profile and some may belong to other sites with known chemical profiles or may form an unknown group, as the foundation of another profile. Once a chemical profile is isolated, it is possible to pick out imports from it visually elsewhere. The author (PAM), for example, added two sherds found at Tel Abu Hawam to a chemical analysis of Mycenaean pottery from that site on the premise that one came from the East Aegean-West Anatolian Interface based on its slip and decoration and one came from Tiryns based on its decorative motif. And indeed, NAA demonstrated the first had the MilD chemical profile belonging to Miletos, while the second had the Tiryns profile of TIR.[7]

In another NAA programme, financed by the Austrian Academy and entitled: "Pottery of the 13th–11th centuries BC on Cyprus and the connections between the Aegean and Cyprus", a further nine Aegean-style samples from Maa have been analysed by R. Jung and H. Mommsen. The project involves pottery from Pyla: Kokkinokremos, Maa and Enkomi. It concentrates on unpainted Late Bronze Age (LBA) pottery. Thus, most of the pottery sampled consisted of cooking pots,[8] unpainted tableware and Canaanite amphorae; decorated pottery was only sampled in very small amounts, as comparative material.

Neutron activation analysis and statistical data evaluation

The determination of the minor and trace elemental composition of sherds excavated at Maa was carried out using the routine NAA procedure of the Bonn archaeometry laboratory. This has been in use for about 30 years to specify the site of origin of archaeological pottery products and has been described at length, for example, in Mountjoy and Mommsen (2015).[9] Therefore, only the salient facts will be summarised here. A sample of about 80 mg is taken, either by drilling with a pure pointed corundum drill head or by scraping with a corundum scraper; the latter process can take place on the back of the sherd or on the section, depending on the circumstances. The irradiation of the samples occurs at the research reactor of the Reactor Institute Delft, Delft University of Technology, for 10 h at a neutron flux of 5 x 10^{12} neutrons/(cm^2 and s). The Bonn pottery standard[10] calibrated with the Berkeley pottery standard[11] is normally used. By measuring each sample three times during a period of about four weeks, 30 elemental concentrations can be determined, some with the high precision of about 1 or 2 %. This elemental pattern is characteristic for the clay paste prepared in a pottery workshop and points to its geographical location, since it is quite unlikely for the same pattern to be found at different sites. The comparison of the patterns and the forming of groups of samples with similar statistical composition and, hence, similar origin are carried out by a procedure developed in Bonn, which can consider experimental uncertainties and varying amounts of diluting temper, such as sand or calcite, in the clay paste.[12]

Results of statistical group formation and the Cypriot compositional patterns

The elemental composition of the 30 samples from MAA is recorded in Table 2. The group membership of each sample is given in Table 3 together with its correcting best relative fit (dilution or enhancement) factor regarding the average grouping values. The addition of the few new Cypriot group members from Maa to the current large groups changes the average group patterns presented in Mountjoy and Mommsen (2015) only a very little.[13] The assignment of these different patterns CypF, CypG, CypH, CypJ, CypS and CypT to their Cypriot production sites is discussed below. The clear separability of these groups is shown in the discriminant analysis in Figure 2. Only one sample, Maap 27, belongs to a known group (KnoL), which describes products from central Cretan workshops and is probably an import from outside Cyprus.[14] A new group of five sam-

7 Zuckerman et al. in preparation.

8 Jung and Mommsen 2017, 127–145.

9 Mountjoy and Mommsen 2015, 521; recently Gilboa et al. 2017, 561, 587 and references therein.

10 Mommsen and Sjöberg 2007, 360: composition of the Bonn standard given.

11 Perlman and Asaro 1969, 26: composition of the Berkeley standard given.

12 Beier and Mommsen 1994a, 1994b.

13 Mountjoy and Mommsen 2015, 428ff.

14 Gilboa et al. 2017, 567. A clay sample (Bonn label Crete 4T) taken recently at a large clay bed visible from the Patsidon-Vathypetrou road, crossing central Crete at coordinates 35.19884° N, 25.16116 E, also matches the pattern KnoL.

Sample	As	Ba	Ca%	Ce	Co	Cr	Cs	Eu	Fe%	Ga
Maap 1	5.04	908.	4.94	54.2	20.0	101.	2.96	0.94	3.78	12.9
Maap 2	4.18	430.	5.34	63.7	21.1	139.	4.97	1.06	4.24	14.3
Maap 3	6.09	1319.	7.35	62.8	24.9	125.	3.28	1.29	4.09	11.9
Maap 4	7.49	394.	9.96	40.6	18.1	392.	1.96	0.93	3.60	7.53
Maap 5	5.68	611.	8.87	60.6	20.0	82.6	3.46	1.20	3.93	10.5
Maap 6	2.01	413.	5.16	44.3	24.4	113.	3.38	0.72	4.85	18.3
Maap 7	5.68	609.	6.21	42.6	26.2	211.	1.80	0.98	5.69	13.2
Maap 8	5.57	370.	7.77	72.6	22.6	130.	6.43	1.19	4.75	19.2
Maap 9	3.73	753.	11.1	59.8	24.1	106.	3.75	1.13	4.09	12.6
Maap 10	7.57	1410.	9.80	55.9	21.6	167.	3.14	1.08	4.55	17.1
Maap 11	9.29	616.	10.6	60.9	21.2	135.	4.57	1.09	4.58	15.7
Maap 12	5.58	425.	8.91	49.4	27.0	283.	3.32	0.94	4.99	13.4
Maap 13	7.90	512.	8.37	59.3	23.2	159.	4.91	1.09	5.26	10.3
Maap 14	4.55	1736.	12.6	50.3	16.9	93.1	2.90	1.09	3.22	9.14
Maap 15	2.72	2375.	10.3	57.7	34.0	195.	2.83	1.28	4.40	15.7
Maap 16	2.63	457.	7.20	45.6	26.1	377.	2.90	0.99	5.94	14.2
Maap 17	2.75	330.	8.64	51.9	22.7	146.	2.99	1.06	4.89	15.8
Maap 18	4.31	323.	7.45	71.2	21.9	138.	6.73	1.23	5.08	9.33
Maap 19	11.8	570.	12.5	29.4	21.4	297.	1.93	0.89	4.78	8.02
Maap 20	10.1	668.	9.19	32.5	24.0	269.	2.24	1.00	5.40	12.9
Maap 21	6.83	264.	9.97	60.7	23.1	152.	5.78	1.06	5.25	13.4
Maap 22	9.03	253.	15.6	38.3	18.2	319.	2.31	0.93	3.69	7.56
Maap 23	4.75	533.	16.6	41.7	16.9	373.	1.65	0.98	3.47	5.40
Maap 24	3.15	421.	5.49	45.0	21.7	120.	2.71	0.80	4.63	13.5
Maap 25	2.24	628.	7.55	51.2	20.0	111.	4.37	0.81	4.26	16.3
Maap 26	7.65	523.	10.7	46.7	28.6	319.	3.94	1.09	5.03	14.8
Maap 27	19.2	535.	8.81	59.2	29.3	322.	7.44	1.14	5.11	15.4
Maap 28	6.44	767.	13.0	40.6	20.1	373.	1.61	1.04	3.40	9.85
Maap 29	2.22	623.	7.71	57.3	19.9	105.	4.30	0.95	4.15	16.0
Maap 30	7.07	720.	5.64	69.4	26.0	321.	1.61	1.22	5.30	14.1
ave. err.	0.12	35.	0.19	0.35	0.12	0.89	0.097	0.020	0.013	2.1
in%	2.0	5.2	2.1	0.7	0.5	0.4	2.7	2.0	0.3	16.

Sample	Hf	K %	La	Lu	Na%	Nd	Ni	Rb	Sb	Sc
Maap 1	3.51	1.35	24.2	0.32	0.44	19.0	121.	54.3	0.40	12.8
Maap 2	3.90	1.69	31.0	0.36	0.70	23.8	145.	86.4	0.42	14.9
Maap 3	3.73	1.39	29.7	0.38	0.42	30.0	201.	62.6	0.45	14.9
Maap 4	3.63	1.81	18.7	0.34	1.55	17.5	187.	54.5	0.48	16.8
Maap 5	3.67	1.40	28.0	0.37	0.40	26.2	161.	66.3	0.50	14.2
Maap 6	3.39	1.35	21.3	0.31	0.63	18.2	102.	57.9	0.49	17.2
Maap 7	3.52	1.16	16.6	0.40	0.89	18.0	159.	41.7	0.41	22.8
Maap 8	4.30	2.23	36.2	0.45	0.99	27.3	152.	116.	0.51	18.0
Maap 9	3.52	1.57	27.5	0.35	0.37	21.4	175.	72.6	0.59	15.3
Maap 10	3.90	1.75	26.3	0.41	0.86	25.2	120.	65.2	0.47	18.0
Maap 11	3.96	2.02	27.1	0.38	0.93	28.1	144.	97.9	0.63	16.9
Maap 12	3.68	1.42	23.6	0.37	0.66	16.1	165.	65.2	1.24	19.4
Maap 13	3.94	2.05	28.2	0.44	1.14	19.9	129.	94.3	0.50	21.3
Maap 14	2.85	1.34	25.8	0.33	0.77	24.7	81.7	60.6	0.31	13.6
Maap 15	3.58	1.35	30.4	0.34	0.64	24.7	376.	56.6	0.39	14.3
Maap 16	3.93	1.35	22.5	0.42	0.79	17.5	86.6	64.9	0.37	23.5
Maap 17	3.63	1.20	24.7	0.38	0.56	22.0	136.	54.1	0.35	18.4

Sample	Hf	K %	La	Lu	Na%	Nd	Ni	Rb	Sb	Sc
Maap 18	4.26	2.27	35.5	0.48	0.98	27.2	105.	124.	0.55	20.0
Maap 19	2.44	1.24	14.8	0.39	1.58	17.4	168.	45.2	0.40	22.4
Maap 20	2.90	1.40	16.3	0.43	1.43	12.0	191.	46.4	0.42	24.0
Maap 21	3.87	2.14	28.9	0.43	1.22	27.0	110.	106.	0.43	21.2
Maap 22	3.06	1.45	18.9	0.33	1.20	18.8	133.	43.8	0.47	16.5
Maap 23	3.02	1.00	21.2	0.33	1.37	23.5	175.	26.1	0.52	15.1
Maap 24	3.48	1.05	21.4	0.31	0.56	14.2	82.7	47.2	0.34	16.8
Maap 25	3.64	1.55	22.9	0.30	0.34	20.4	72.3	87.2	0.55	15.8
Maap 26	3.47	1.64	23.1	0.37	1.01	15.7	278.	70.1	0.64	21.7
Maap 27	3.81	2.07	29.2	0.36	0.74	22.3	279.	106.	1.10	20.7
Maap 28	3.28	1.42	20.9	0.32	1.43	19.7	229.	37.0	0.56	15.7
Maap 29	3.52	1.52	26.0	0.32	0.40	18.9	154.	83.6	0.53	15.2
Maap 30	5.17	1.94	31.9	0.43	0.75	27.7	279.	64.9	0.66	20.1
ave. er.r	0.052	0.027	0.068	0.012	0.004	2.8	34.	2.3	0.026	0.020
in%	1.4	1.7	0.3	3.1	0.5	13.	21.	3.3	5.0	0.1

Sample	Sm	Ta	Tb	Th	U	W	Yb	Zn	Zr
Maap 1	4.00	1.06	0.58	7.46	1.19	1.66	2.06	83.3	139.
Maap 2	4.37	1.10	0.52	8.88	1.26	1.47	2.26	92.9	180.
Maap 3	5.58	1.25	0.70	8.02	1.50	1.80	2.40	73.8	165.
Maap 4	3.60	0.63	0.56	5.98	1.89	1.34	1.97	99.3	163.
Maap 5	4.83	1.04	0.64	7.85	1.62	1.76	2.32	72.7	140.
Maap 6	2.63	0.98	0.39	6.40	1.28	1.77	1.77	95.7	81.4
Maap 7	3.27	0.77	0.50	5.80	1.03	1.94	2.24	72.2	166.
Maap 8	5.43	1.12	0.83	11.1	2.31	2.08	2.73	98.4	158.
Maap 9	4.60	1.00	0.65	7.95	1.79	1.71	2.21	78.4	139.
Maap 10	4.72	0.86	0.66	7.93	1.74	2.20	2.43	90.8	182.
Maap 11	4.44	1.04	0.61	9.40	2.62	2.37	2.20	86.4	193.
Maap 12	3.82	0.98	0.57	6.56	1.39	2.24	2.19	89.1	132.
Maap 13	4.42	0.95	0.66	9.43	1.73	2.64	2.42	82.9	170.
Maap 14	5.04	0.74	0.68	7.30	1.64	1.86	2.10	69.5	132.
Maap 15	5.15	1.50	0.67	6.89	1.66	1.56	2.25	58.7	145.
Maap 16	3.74	0.96	0.57	6.99	1.46	1.57	2.28	77.0	157.
Maap 17	3.97	0.91	0.56	6.84	1.26	2.38	2.17	82.3	120.
Maap 18	5.61	1.04	0.77	10.7	2.30	2.77	2.79	90.7	149.
Maap 19	3.03	0.44	0.52	4.03	1.36	2.09	2.12	87.5	109.
Maap 20	3.68	0.56	0.68	4.47	1.47	1.92	2.20	98.6	125.
Maap 21	4.48	0.98	0.72	9.40	1.80	2.81	2.32	96.3	136.
Maap 22	3.71	0.51	0.58	5.62	1.77	2.12	1.97	73.2	118.
Maap 23	4.08	0.57	0.58	5.83	1.98	2.00	1.97	70.0	147.
Maap 24	2.92	1.05	0.39	6.97	1.33	1.22	1.82	83.0	149.
Maap 25	3.35	1.02	0.45	7.76	1.57	1.39	1.87	71.8	130.
Maap 26	3.97	0.70	0.63	7.58	1.49	1.63	2.29	92.8	124.
Maap 27	4.39	0.74	0.59	12.2	2.40	1.94	2.17	98.1	124.
Maap 28	3.74	0.48	0.57	5.85	1.70	0.95	2.06	94.6	117.
Maap 29	4.47	1.06	0.52	8.09	1.59	1.40	1.98	86.6	154.
Maap 30	4.94	0.91	0.71	13.4	2.11	1.60	2.63	97.0	215.
ave. err.	0.16	0.045	0.053	0.060	0.19	0.18	0.047	1.9	21.
in%	3.7	5.0	8.8	0.8	12.	9.8	2.1	2.3	15.

Table 2 Raw concentration data of the 30 samples from Maa in µg/g (ppm) if not indicated otherwise, and below the average experimental uncertainties (measurement errors), also in % of C, to indicate the measurement precision of the NAA procedure for this element.

Sample No. Maap	DPCP No.	Group	Fit Factor
1	30	CypG	1.09
2	3	X072	0.96
3	4	CypG	0.93
4	109	CypJ	0.99
5	31	CypG	0.99
6	8	Pair 254	1.01
7	150	CypF	1.02
8	78	X140	0.92
9	23	CypG	0.98
10	130	CypS	0.93
11	104	X140	1.04
12	125	Pair 37	0.98
13	123	X140	1.02
14	98	Single	1.00
15	107	Single	1.00
16	120	Single	1.00
17	155	CypS	0.98
18	100	X140	0.91
19	68	CypT	1.05
20	94	CypT	0.95
21	90	X140	1.01
22	99	CypJ	1.03
23	92	Single	1.00
24	45	Pair 254	1.00
25	42	X072	1.02
26	122	CypH	0.95
27	119	KnoL	0.97
28	126	Single	1.00
29	61	X072	1.02
30	57	Single	1.00

Table 3 Correlation of sample numbers to DPCP (= Mountjoy 2018a) numbers. The NAA group of each sample and its best relative fit factor regarding its group is also given.

ples all from Maa, Group X140, is of unknown origin. Four other samples belong to this group: they comprise two deep bowls from the Maa Jung project,[15] one Levanto Helladic bowl FS 296 from Kalavasos (Kalv 21), which has been published as a single,[16] and one piece of a Black on Red (BoR) juglet from Megiddo.[17] This distribution of members and a comparison with groups formed with

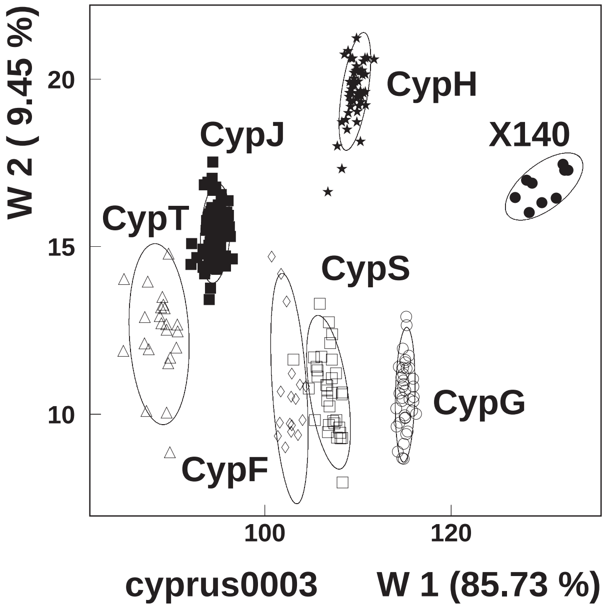

Fig. 2 Result of a discriminant analysis of the 269 samples, corrected for dilution, assuming 7 clusters as indicated. The groups with more than 3 members in the Bonn databank are shown. The discriminant functions W1 and W2 are plotted, which cover 85.7 and 9.5 %, respectively, of the between-group variance. The ellipses drawn are the 2 σ (sigma) boundaries of the groups. The different groups are well separated.

data from Berkley points to Cyprus as the probable origin for group X140.

A further small and only loosely connected group, Group X072, of three samples (Maap 2, 25, 29) has large spread values but is well separated from all other samples in our data bank. No conclusions as to provenance can be drawn from the samples of this tentatively formed group, nor from the two sample pairs, Pair 254, Maap 6 + 24, and Pair 37, Maap 12 + Maaj 10, the latter a sample from the Jung project.[18] The same is true for the six samples that are chemical loners. Whereas chemical profiles with two or more members of different vessels point to the existence of a still unknown pottery workshop, this cannot be stated with certainty for chemical loners, since they might be contaminated by admixtures distorting their true profile. A petrographic analysis might help to clarify the situation. If the basaltic admixtures, often encountered in this southern Troodos region, are detected, they may be the cause of the variability, which cannot be corrected by a best relative fit.[19]

15 Maaj4 + 8, unpublished, Jung project in progress.
16 Mountjoy and Mommsen 2015, 466 Fig. 30 and 497 Cat. S21.
17 Kleiman et al. 2019.
18 Maaj 10, unpublished. Jung project in progress.
19 Sterba et al. 2009, 1585ff.

Work by Bryan et al.[20] isolated a group possibly from Maa, Group 18, with many members; it was based on distribution arguments. A re-evaluation of the data with the Bonn statistical procedure supports the existence of this group (with three fewer members, but two new ones).[21] A comparison of the revised Group 18new with our data bank of clay patterns shows (after calibration of the Manchester values to the Bonn values) that it is statistically similar to our group CypG. Therefore, it can now be stated with certainty that all members of Group 18new were made at Kouklia, provided the clays in the region of Maa and of Kouklia have a different composition. The 24 samples assigned to groups, out of the 30 samples taken from Maa for this project, did not produce a good local reference pattern for the site.

The pottery

The pottery from Maa sampled by NAA is presented below according to the parent site from which NAA has shown it was exported. The sample number is preceded by S on Figures 3–7; the second number is the DPCP number (Table 3). No pottery catalogue is given here, as the pieces are already catalogued in Mountjoy (2018a).[22]

The absence of a local profile at Maa is surprising, but there is no guarantee that further sampling would provide one. The possibility that a local profile is masked by a large number of imports may also not apply, as, so far, NAA has demonstrated that 12th century BC Aegean-style imports, at least of decorated vessels, between sites on the island do not seem to be very plentiful.

ALASSA CypF (Fig. 3)

The deep bowl **S7** may have multiple-looped spirals, a motif which was at home in the East Aegean-West Anatolian Interface, especially on Astypalaia and Kos.[23] The very wide reserved band just below the interior rim is a Minoan feature;[24] the Greek mainland reserved rim band is much narrower and first appears in LH IIIC Middle,[25] whereas the Minoan one appears in LM IIIC Early.[26]

SINDA CypH (Fig. 3)

The deep bowl **S26** has a narrow zonal decoration. Narrow zonal motifs are a feature of CypIIIC Early 2 and continue into CypIIIC Middle.[27]

KOUKLIA: PALAEPAPHOS CypG (Fig. 3)

There are two chemical profiles for Kouklia, CypG and CypS; the latter, which is less common, differs by having higher scandium and iron and lower tantalum.[28] The CypG deep bowls **S1, S5** and **S9** all have the monochrome interior, which is feature of Kouklia; it is more common than the type with a linear interior. **S1** also has the Minoan type of wide reserved internal rim band. **S1** depicts an antithetic spiral without the usual loops; the spirals flank a hanging tassel on the obverse and a tassel pendent from a lozenge on the reverse. The use of an antithetic spiral without a central triglyph appears at Mycenae in late LH IIIC Early 1/ early LH IIIC Early 2.[29] **S9** has a large fish filling the entire side of the vessel. A large pictorial motif filling the entire decorative zone is a Minoan syntax.[30] There are one or two others from Maa, such as a duck protome,[31] also found on a Kouklia export to Tarsus[32] and on another at Tarsus, probably also exported from Kouklia.[33] The large **S5** is a rosette deep bowl, a type which appeared in LH IIIB2 in a syntax with no other decoration apart from a dotted rim;[34] the type continued into LH IIIC Early with the addition of linear decoration.[35] The usual triglyph found on this type is replaced on **S5** by a vertical tight wavy line, which is also in use in LH IIIB2[36] and continues in LH IIIC.[37]

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20 Bryan et al. 1997, 38, 40.

21 Removing the three samples HST45, HST89 and PYV0 (all singles in our evaluation) and adding two samples to group 18: MAA24 (was group 15) and ARP40 (was group 1) in Bryan et al. (1997).

22 Mountjoy 2018a, 845–883.

23 For the motif, see Mountjoy 2018a, 1259 and Fig. 674.

24 Mountjoy 1999b, 512–513.

25 Popham and Milburn 1971, 401, 339 Fig. 4.2–3, 5, 11.

26 Mook and Coulson 1997, 345.

27 For examples, see Mountjoy 2018a, 1077 Fig. 583 quirk, 1084 Fig. 589 wavy line.

28 Mountjoy and Mommsen 2015, 426–427.

29 French 2007, 531 Fig. 4 bottom row left, right.

30 For example, Warren 2007, 337 Fig. 2 P241, 338 Fig. 3 P250.

31 Mountjoy 2018a, 821 Fig. 404.21.

32 Mountjoy et al. 2018, 14 Fig. 4 S25.

33 Vermeule and Karageorghis 1982, XIII.10.

34 Mountjoy 1986, 131 Fig. 162.

35 Mountjoy 1986, 151 Fig. 190.

36 Voigtländer 2003, pl. 25 S170–175.

37 Mountjoy 1986, Fig. 190.3.

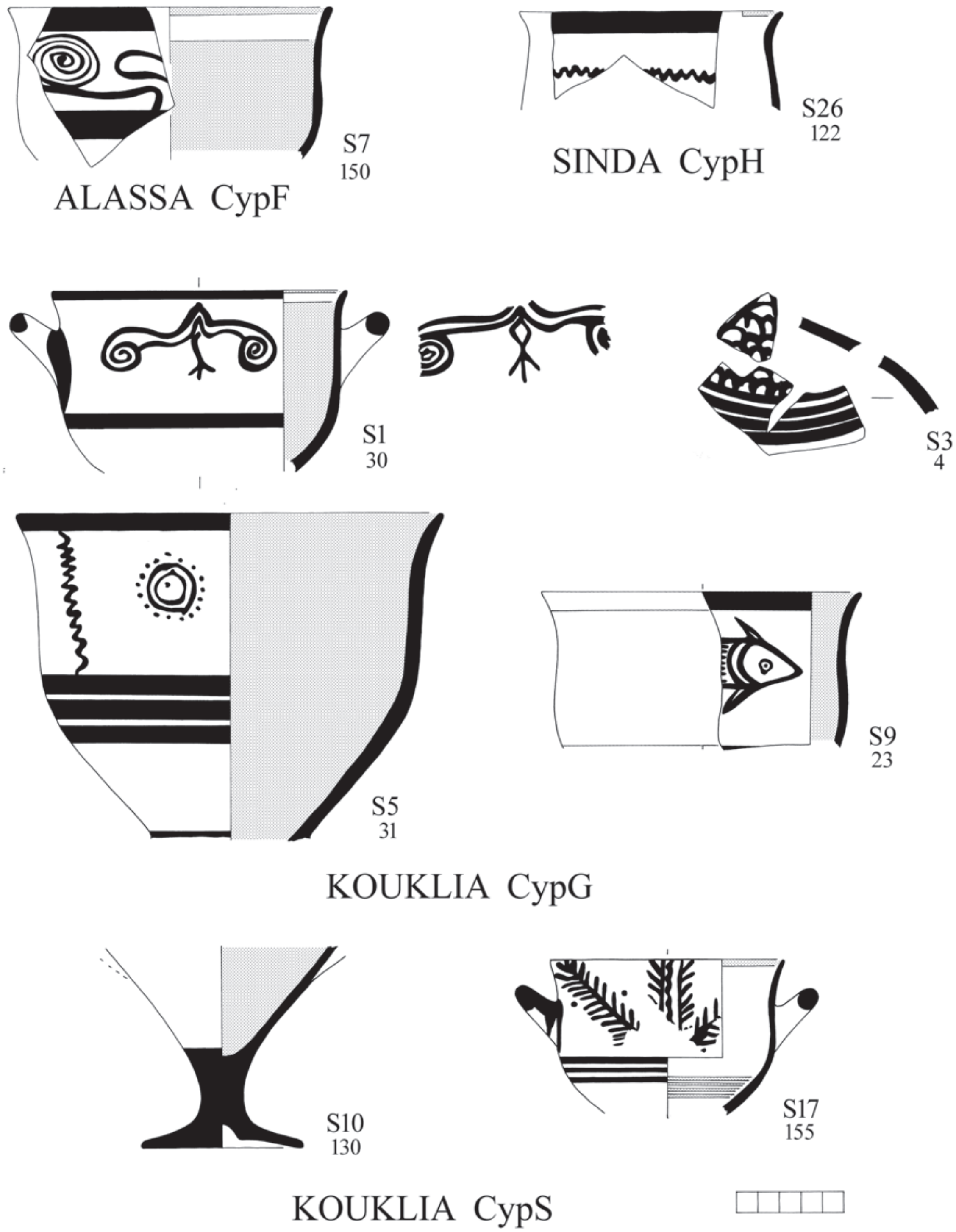

Fig. 3 Imports to Maa from Alassa, Sinda and Kouklia. Scale 1:3.

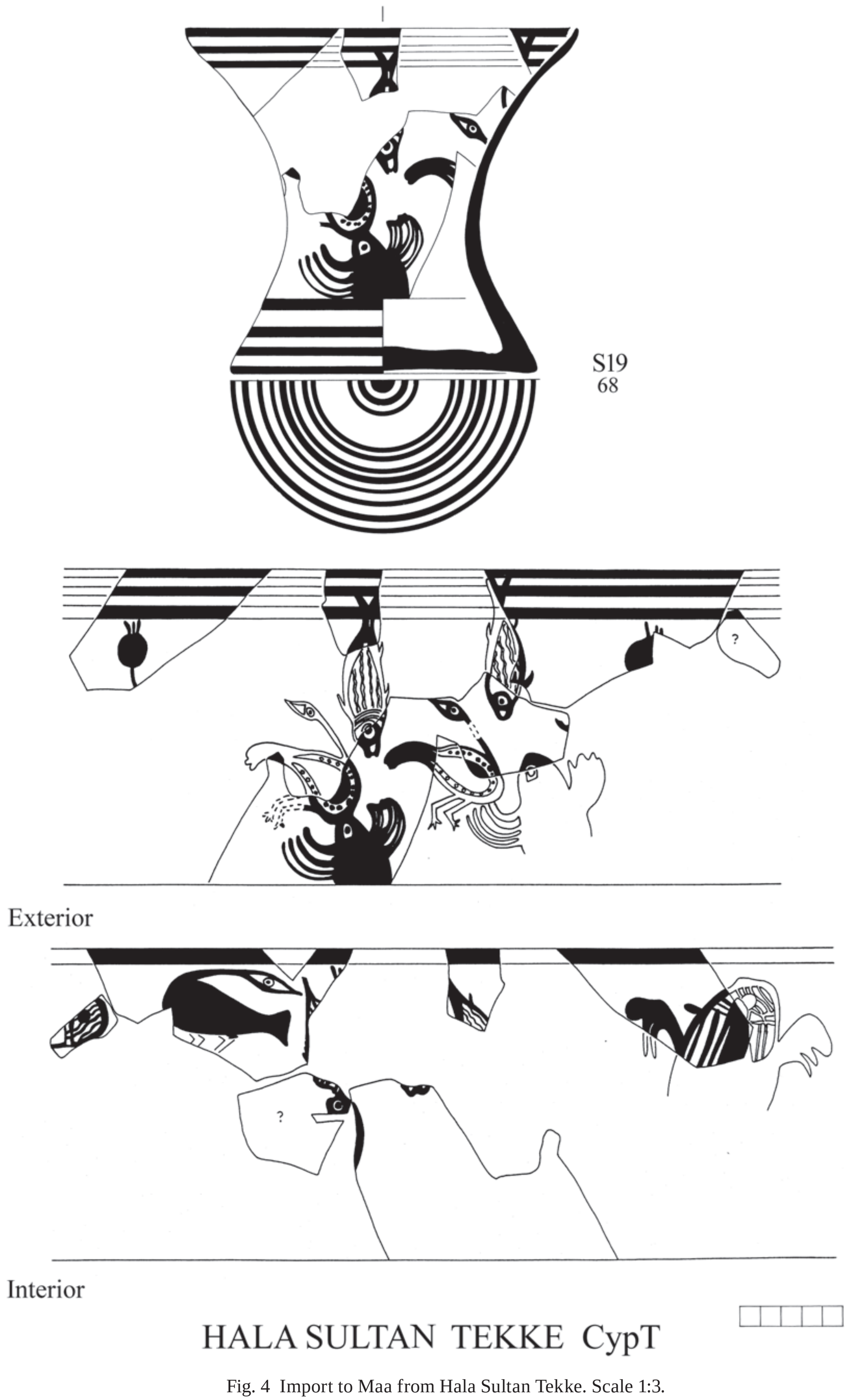

Fig. 4 Import to Maa from Hala Sultan Tekke. Scale 1:3.

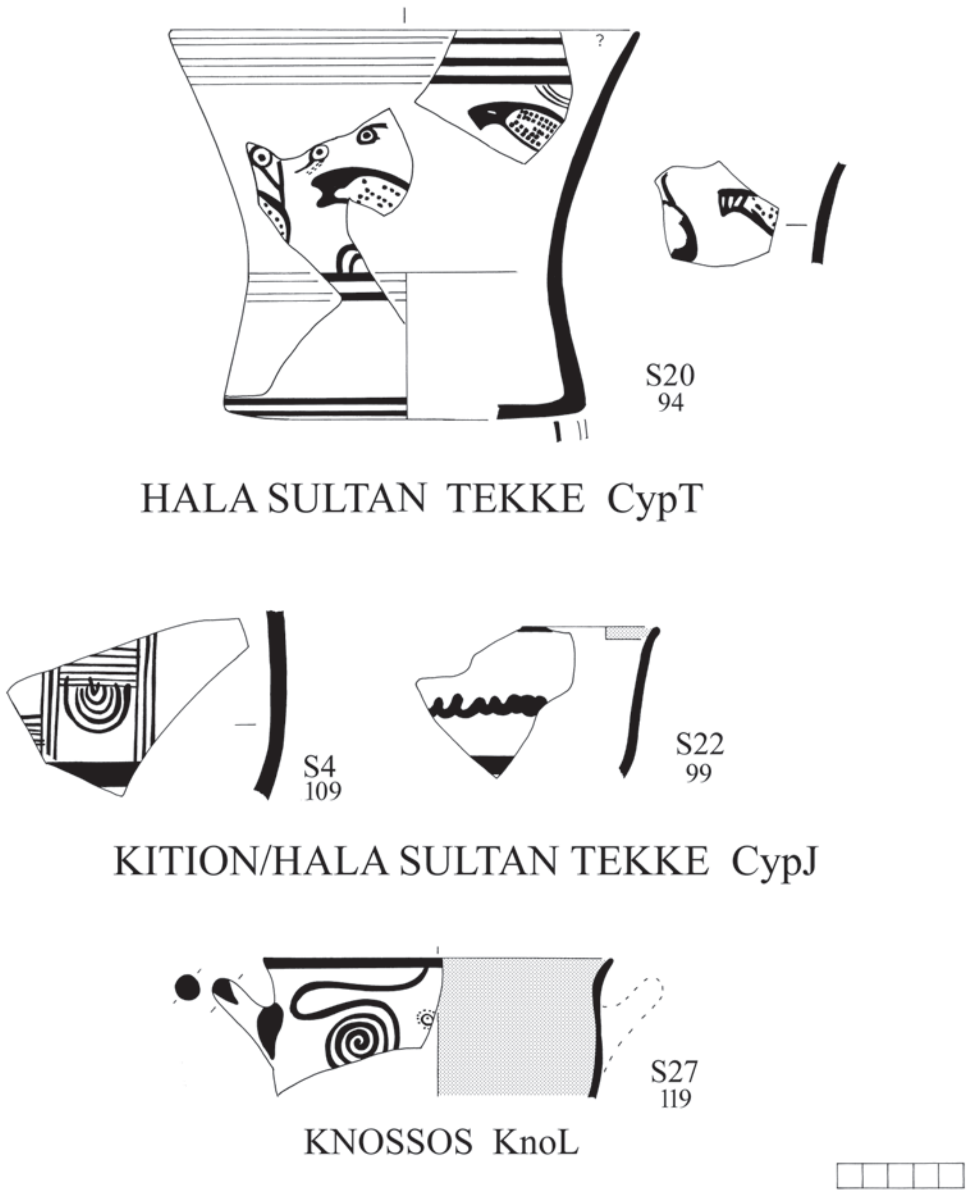

Fig. 5 Imports to Maa from Hala Sultan Tekke, Kition/Hala Sultan Tekke and Knossos. Scale 1:3.

The closed shape **S3** is a Levanto-Helladic type, the large piriform jar FS 36, which was locally produced on Cyprus after imports from the Greek mainland ceased due to troubles there.[38] The motif of a scale pattern, mostly inverted, is a popular motif on this shape.

KOUKLIA: PALAEPAPHOS CypS (Fig. 3)

A conical kylix **S10** and a deep bowl **S17** belong to this chemical profile. **S10** has the usual monochrome base and lower body found on this shape.[39] **S17** has a herringbone tree. It is derived amongst other sources from a Rude/Pastoral Style motif.[40]

38 For Levanto-Helladic types, see Mountjoy 2018a, Section I.1 33–62.

39 For the complete shape, see Mountjoy 2018a, 870 Fig. 433 Maa 88.

40 For example, Mountjoy 2018a, Kition 646 Fig. 322 no. 470, Enkomi 148 Fig. 78 no. 4. For a discussion of the origins of the herringbone tree, see Mountjoy 2010, 7.

The use of three external belly bands instead of one or two also recalls Rude/Pastoral Style vases.[41] There are two more Aegean-style IIIC imports belonging to the CypS profile resulting from the Jung NAA project. Altogether there are eight imports at Maa from both NAA projects: four from CypG and four from CypS.

HALA SULTAN TEKKE CypT (Figs. 4–5)

Two mugs, **S19** and **S20**, were imported from Hala Sultan Tekke. Pictorial mugs are not common[42] and decoration on the interior and exterior is rare. The interior of **S19** is so worn that most of the decoration is missing. On the exterior, and possibly also on the interior, a row of birds is being eaten by a row of large fish (or turtles?). Pomegranates or poppies appear in the background. It is probable that poppies are represented, as stamens are present, and pomegranates hang downwards on the tree, not upwards. However, there are examples of poppies with stamens bending over and so hanging downwards, such as on a Minoan vessel from Vronda.[43] On the other hand, while two examples from Minoan Chalasmenos hanging downwards have the typical pointed spikes found on the top of the pomegranate, they are shown on single stalks rising from the ground, as if they are poppies.[44] The painters themselves do not always seem to be sure what they are representing. Plain White Ware from Hala Sultan Tekke was also found at Maa, together with examples from Enkomi and Kouklia.[45]

S20 is worn. It may show birds with dot-filled bodies going right, particularly on the small sherd. On the right side of the centre group, the bird's head may be looking back over its shoulder towards its black painted tail; the two semicircles below the tail may represent its feet. The bird on the far left has a pelican beak. The top right of the picture shows another bird's body with wing above. However, it is possible that birds' bodies are not represented but fish tails, in which case, the curved wing top right and the feet bottom centre might be flippers similar to the fish on **S19**, suggesting that these birds were also being eaten. These two mugs are unique so far in their decoration.

KITION/HALA SULTAN TEKKE CypJ (Fig.5)

CypJ, the profile assigned to Kition, is shared by samples from Kition and Hala Sultan Tekke. They could not be separated, possibly as the proximity of the clay sources used for this profile is geologically similar.[46] CypJ definitely applies to Kition, as the Proto-White Painted pottery analysed belonged to CypJ; Hala Sultan Tekke had been abandoned at the time Proto-White Painted came into fashion. It is possible that all the CypJ pottery belongs to Kition, partly because Hala Sultan Tekke has its own chemical profile, CypT, and partly because 16 Kition samples belonged to CypJ but only eight Hala Sultan Tekke samples; however, CypT is not well enough represented to be considered as the main Hala Sultan Tekke chemical profile, since only six of the 30 Hala Sultan Tekke samples belong to it.[47]

The krater **S4** has a panelled pattern, while the deep bowl **S22** has the popular decorative syntax of a narrow zonal pattern, this time with a floating wavy line composed of joined semicircles. This type of wavy line comes from Crete.[48] Neither vessel has a monochrome interior.

CENTRAL CRETE KnoL (Fig. 5)

The deep bowl **S27** is assigned to Central Crete. An antithetic spiral flanks a very small dot rosette.[49]

PAIR 37 (Fig. 6)

The pair consists of two deep bowls. The second member of this pair is S10 in the sampling series of R. Jung. **S12** has a triglyph composed of vertical tight wavy lines. A similar triglyph is depicted on a deep bowl from Athienou[50] with a quadruped as the main motif. **Jung S10** depicts a herringbone tree similar to **S17**. Both vessels have a linear interior.

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41 See Mountjoy 2018a, Section I.3 72 Fig. 29 Kition no. 470 and other examples.

42 See Mountjoy 2004, 191 Fig. 1.1 for an example from Miletos.

43 Day and Snyder 2004, Fig. 5.11.4.

44 Tsipopoulou 2004, 119 Fig. 8 12-99-18, 95-227.

45 Bryan et al. 1997, 56.

46 Mountjoy and Mommsen 2015, 425, 443.

47 Mountjoy and Mommsen 2015, 444 Fig. 11, 449 Fig. 15.

48 See Mountjoy 2018a, 1260 Fig. 677.

49 For a Minoan parallel, see Popham 1970, pl. 47f middle row left.

50 Mountjoy 2018a, Athienou 521 Fig. 265.13.

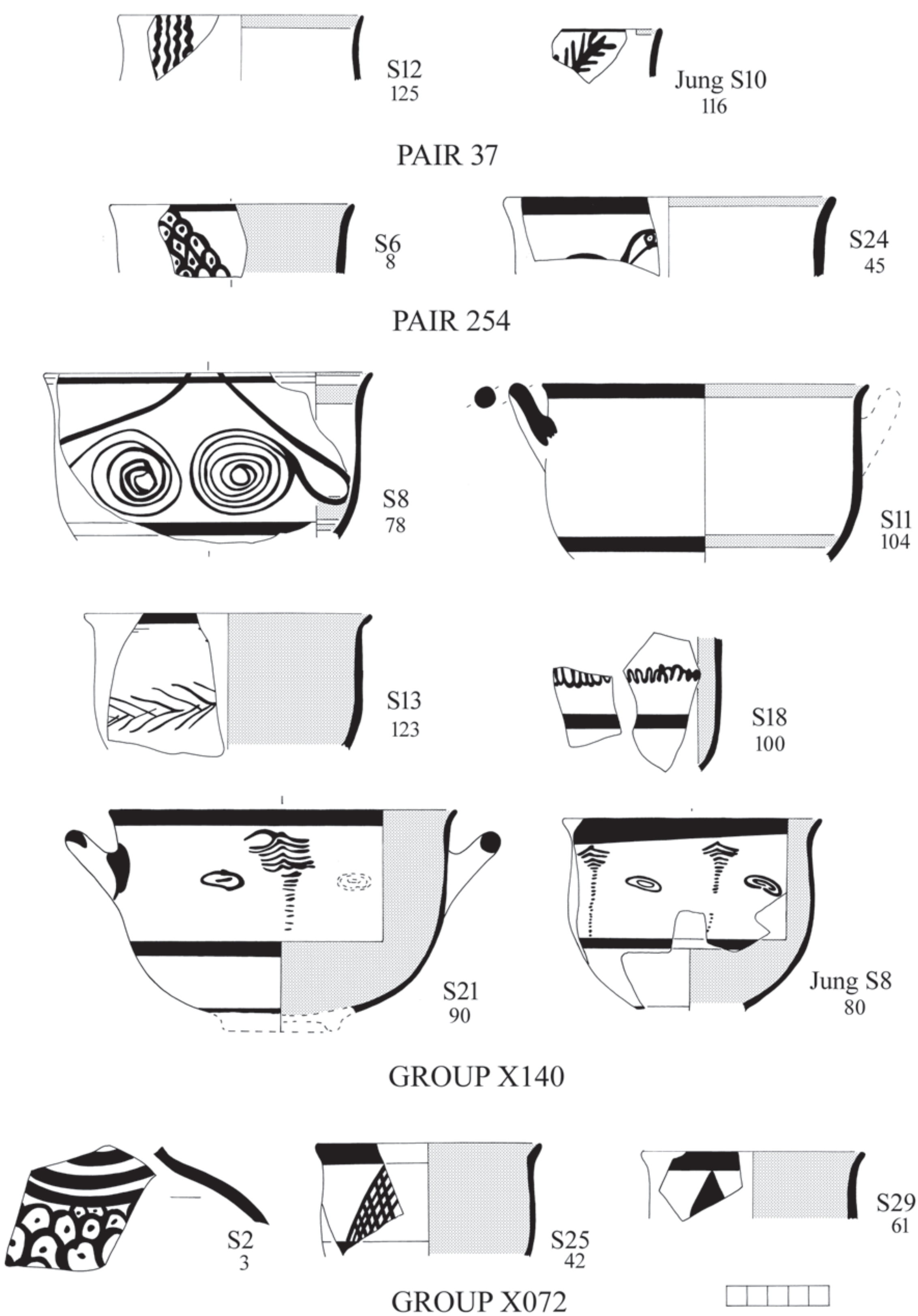

Fig. 6 Pairs and small groups. Scale 1:3.

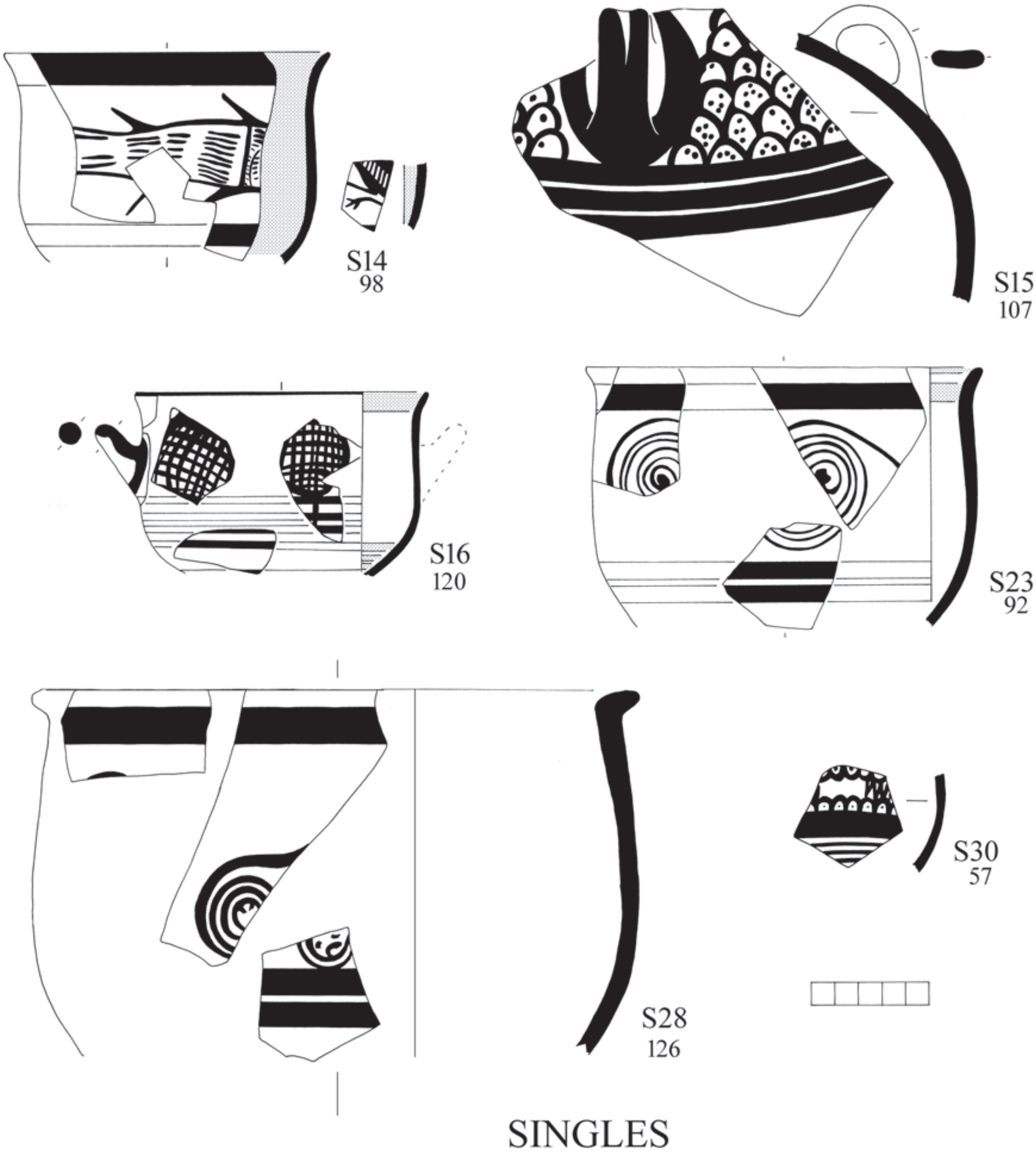

Fig. 7 Singles of unknown origin. Scale 1:3.

PAIR 254 (Fig. 6)

This pair also consists of two deep bowls. **S6** has triangular patch with dot fill; the motif will have sat on the belly band, thus, occupying the entire height of the decorative zone.[51] The triangular patch is common in late LC IIC (CypIIIC Early 1). It is present on Crete in LM IIIB[52] but not common, the same as on the Greek mainland.[53] **S24** has a large bird, also filling the decorative zone. **S6** has a monochrome interior and **S24** a linear interior.

GROUP X140 (Fig. 6)

This group has five members from the present sampling project and two additional ones from the earlier Jung project. It might be that it represents the Maa chemical profile, but the presence of only seven members from our sample of 30 sherds and

[51] See Mountjoy 2018a, 1093 Fig. 598.

[52] Hatzaki 2005, 139 Fig. 4.11.10.

[53] Mountjoy 1999a, Korinthia no. 188, Attica no. 330; Voigtländer 2003, pl. 47 HS 101, pl. 83 G20–21.

the Jung sample of nine Aegean-style sherds is not really enough members to be compelling. A LC IIC Levanto-Helladic rounded bowl from Kalavasos, which was a single, can now be reassigned to this group.[54] It has an unusual knobbed rim, which also appears on a similar bowl from Kalavasos, which is assigned to Kouklia,[55] suggesting that the group is indeed from the west of the island. All the Maa samples in the group are deep bowls. One of the Jung samples is of great interest, as it is almost a twin to **S21**.

S8 depicts a large antithetic spiral filling the entire decorative zone with the loops running down to the belly band; there is no central triglyph. **S11** is a linear deep bowl. It does not have the usual flaring rim but a short everted one, giving rise to straight sides rather than the usual bell shape.[56] A vase from Hala Sultan Tekke has a similar profile,[57] and possibly two vases from Enkomi,[58] but this is uncertain as the lower body of both is missing. **S13** and **S18** both have narrow zonal decoration, the former with untidy horizontal chevrons, the latter with a tight wavy line. Both vessels have a monochrome interior. A vertical version of the chevrons on **S13** is depicted with a backbone as a tree on a vase from Ankastina.[59] **S21** depicts quirk flanking chevrons. The chevrons are the thin thread chevrons from Crete.[60] The uppermost chevron has a tail on the tip. The quirk type is FM 29.3, rockwork. **Jung S8** is remarkably similar to **S21.** It differs in having no tail on the chevron tip and a circumcurrent syntax rather than the facial one of **S21**. Both vessels have a monochrome interior. If this chemical group represents the Maa chemical profile, these two vessels might represent a local syntax.

GROUP X072 (Fig. 6)

The group consists of two deep bowls and a piriform jar. The piriform jar, **S2**, is the Levanto-Helladic FS 36 with an inverted scale pattern. It is similar to **S3**, except that the scale pattern is filled with dots. Both deep bowls, **S25** and **S29**, have a large triangle filling the height of the decorative zone; that of **S25** is cross-hatched and has a parallel on a krater from Ankastina,[61] while that of **S29** is painted solid; both have a monochrome interior.

SINGLES (Fig. 7)

There are six singles, which is an average number for a chemical analysis of 30 sherds.[62]

S14 is a deep bowl with a large pictorial filling motif of a fish with groups of bars along its body; a sherd from the reverse has a bird extant; the interior is monochrome. Two other deep bowls, **S16** and **S23**, each have a linear interior. **S16** depicts either an antithetic spiral with cross-hatched centre or bird bodies, such as those on a vase from Kouklia.[63] **S23** has a running or stemmed spiral; it is a large vase with a slightly everted rim, which has the banding of the stemmed bowl, a feature which a recent excavation in the Argolid has shown to appear in LH IIIB2.[64] The krater **S28** depicts a stemmed spiral with traces of four semicircles in its centre; the interior is worn, so, no decoration is preserved. There are two piriform jars: the large Levanto-Helladic FS 36 **S15** with the usual inverted scale pattern with dot fill, this time with multiple dots, and the small FS 48 **S30** with the framed decorative zone, which began in LH IIIB2,[65] but with the local preference of a dot in each semicircle.

SUMMARY

Surprisingly the analysis has isolated imports at Maa from five other Cypriot sites, the largest number of sites represented at any Cypriot site where NAA has been carried out, but no recognisable chemical profile from the site itself. One group with seven members might represent the local profile, but it is not large enough to be convincing. Six of the imports to Maa were from Kouklia: Palaepaphos, the nearest large site round the south coast to the east. This was followed by two imports each from Hala Sultan Tekke and Kition/Hala Sultan

[54] Mountjoy and Mommsen 2015, 466 Fig. 30 S21; Mountjoy 2018a, 767 Fig. 378.17.

[55] Mountjoy and Mommsen 2015, 455 Fig. 21 S12; Mountjoy 2018a, 767 Fig. 378.18.

[56] Compare with bowls Mountjoy 2018a, 1010–11 Figs. 528–529, 1088–1089, Figs. 593–594.

[57] Mountjoy 2018a, 1089 Fig. 594.327.

[58] Mountjoy 2018a, 1010 Fig. 528j–k.

[59] Mountjoy 2018a, 926 Fig. 459.5.

[60] Mountjoy 2018a, 1261 Fig. 678.

[61] Mountjoy 2018a, 926 Fig. 459.5.

[62] Two more are present among the nine Aegean-style sherds from Maa analysed in the Jung project.

[63] Mountjoy 2018a, 816 Fig. 401.4.

[64] French and Stockhammer 2009, 210 Fig. 19.3–5.

[65] Mountjoy 1986, 93, 121 Fig. 149.2–3.

Tekke and single imports from Alassa and Sinda (see Fig. 1). The common denominator of these five sites is that all have connections to the copper industry and, through that, to the shipping of copper. The number of pieces from Maa positively assigned to these sites is very small, but the link to the copper industry is intriguing. Even though this link may be by chance, it is worth taking a look at these five sites, since they might give some background information to the reason for the foundation of Maa.

The copper industry at the sites from which exports were found at Maa

Kouklia: Palaepaphos, with most exports to Maa, is located on a coastal strip close to the delta of the Dhiarizos river; the Troodos mountains rising behind it meant that communication would probably have been maritime along the coast. Kouklia was a so-called gateway site in that the copper mined and smelted in the pillow lavas in the foothills of the Troodos came down to it by various routes to be sent abroad.[66] Kouklia today is an inland site. The harbour is thought to have been situated east of the Sanctuary at Loures, which would have been a protected cove at that time but is now buried under silt from the Dhiarizos river.[67] It is clear that the area of Kouklia conducted maritime trade, as, most importantly, NAA has shown that Kouklia was the most prominent exporter of fine ware pottery and its contents internally round the island, as well as being the second largest exporter to the Levant after Kition/Hala Sultan Tekke.[68] An anchorage south of Kouklia, at Kouklia: Achni, has recently been located.[69] A hundred and twenty stone anchors have been recorded on the sea bed, consisting of 96 single-holed and 24 three-holed types broadly consistent with examples found in Middle/LBA and Early Iron Age contexts. This is currently the second largest collection of stone anchors at a single site in the eastern Mediterranean and doubles the number of known examples found in Cypriot waters. As such, Howitt-Marshall has suggested that in spite of its exposed position, Achni was a way-station from the end of the Middle Bronze Age onwards, where maritime traffic could pick up provisions and water.[70] Kouklia: Palaepaphos nearby was one of the few sites on the island not to collapse following widespread destruction and abandonment during the demise of the LBA. It is reasonable to assume, therefore, that the anchorage at Achni continued to function as a maritime terminus well into the Early Iron Age before silting-up with alluvium from the nearby Dhiarizos river.[71]

Continuing eastwards round the south coast, the next site with an export to Maa was **Alassa** in the Kouris river valley. The settlement at Alassa has been excavated at an upper and a lower site, about 250 m from each other. The upper site, Alassa: Paliotaverna, had two large ashlar buildings with storage areas for large pithoi and seems to have been a centre of regional administration. Pithos fragments impressed with chariot scenes and other motifs from cylindrical rollers have been uncovered here and at the lower site, Pano Mandilaris.[72] Alassa was on the copper route running from the mines in the Troodos foothills down to the coast via Kourion: Bamboula. It was thought that, after primary smelting at the mining sites, the copper alloys were resmelted at Alassa,[73] but recent work suggests this may not be the case.[74] The NAA samples to establish the chemical profile of Alassa, CypF, were taken from pottery from Pano Mandilaris;[75] however, the proximity of the upper and lower Alassa sites suggests the same clay source would have been used at both sites**.** Alassa was abandoned, probably late in CypIIIC Early 1 (early in LC IIIA).[76]

Continuing eastwards, the next site from which exports came to Maa was the busy port of **Hala Sultan Tekke** lying on the west side of the Larnaka Salt Lake, which provided a large sheltered harbour. A lot of copper working was carried out in the town, as large amounts of slag bear witness.[77] The site was abandoned in CypIIIC Middle (LC IIIA) after destruction and a short squatter reoccupation.[78]

Kition, situated across the Salt Lake from Hala Sultan Tekke, also had a good harbour. The north-

66 Iacovou 2012, 58, 2013, 285–287.

67 Iacovou 2008, 271, 2012, 62–64, 2013, 285–287.

68 Mountjoy and Mommsen 2015.

69 Howitt-Marshall 2012.

70 Howitt-Marshall 2012, 113, 116–117.

71 Howitt-Marshall 2012, 115.

72 Hadjisavvas 1996, 32.

73 Hadjisavvas 1989, 40–41, 1996, 25, 28.

74 Hadjisavvas 2017, Appendix IV.

75 Mountjoy and Mommsen 2015, 448–451.

76 Mountjoy 2018a, 25 Table 2**.**

77 For example, Fischer and Bürge 2018, 491–492.

78 Mountjoy 2018a, 25 Table 2.

ern part of the town was built on a low plateau which runs parallel to the present coast-line; the harbour lay south of a marshy region in a bay towards the north part of the plateau about 500 m inland from the present coast-line. It was connected to the sea by a navigable channel in the area of the temples of Area II.[79] Areas I and II, the two more fully excavated areas, revealed a lot of copper working.

The last export to Maa is from the inland site of **Sinda**, which is situated in the Mesaoria plain about 15 km from Enkomi. It has been suggested that the function of this fortified site was to control the copper route from metallurgical sites in the foot hills of the Troodos to Enkomi by protecting the crossing of the Pedhieos River and the road along it.[80] Sinda was abandoned in CypIIIC Middle (LC IIIA).[81] Enkomi, which lay about 4 km inland on the combined estuaries of the Pedhieos and Yalias rivers, had a port protected from the prevailing south winds; it was reached by a channel running inland from the Bay of Salamis.[82]

The results of the brief survey of the five sites suggest that, although a harbour is not extant today, Kouklia had the facilities to be a large maritime trade hub in the west of the island; it was also secure enough to be one of the few sites to survive the troubles in the late 13th–early 12th centuries. Alassa gives evidence of regional administration; Hala Sultan Tekke and Kition had a lot of copper working and were also maritime hubs; Kition, too, survived the 13th–12th century troubles; Sinda may have controlled the copper route to Enkomi.

Although NAA could only assign a very small number of the Maa vessels to specific sites and their presence at Maa may be fortuitous, it is also worth examining the situation at Maa regarding links to the copper industry. Transport to and from Maa would also have been maritime, taking advantage of its good anchorage.

The range of imported goods, other than Aegean-style pottery, found at the site might suggest it was founded as a prominent trading site on the island and beyond based on its good anchorage. But this may not be the case.

MAA: A MARITIME TRADING CENTRE ON AND BEYOND THE ISLAND?

Did Maa produce its own fine ware pottery containers to trade for their contents?

It seems that Maa might not have produced its own fine ware pottery, although the possibility that Group X140 might represent the local chemical profile must be kept in mind. Apart from the present NAA analysis, an earlier analysis of the unpainted Plain White Wares has shown that they were also imported, coming from Enkomi, Kition and, in particular, from Hala Sultan Tekke,[83] while a group thought to be local pottery from Maa[84] has now been reassigned to Kouklia CypG (see above). Thus, there is evidence that even plain and local wares were imported**.** Water might have been a problem for pottery production at Maa, as there was none on the plateau, but there were springs nearby in the eastern bay, which could have been used.[85] Indeed, petrography and chemical analysis have shown that a very small number of so-called Canaanite jars were produced locally.[86] Nevertheless, for fine wares and their contents, it seems, at the moment, that Maa could have been dependent on external sources.

Cabotage

The fact that some of the pottery sampled from Maa came from other sites on the island, mostly coastal, suggests cabotage, that is, ships tramped along the coast from port to port trading and exchanging goods.[87] There might have been a deliberate policy of sending pottery to Maa only in the case of nearby Kouklia, 26 km away, which had a larger percentage of exports to Maa. It is also possible that the two opulent vessels from Hala Sultan Tekke might have been a special order for feasting or some other activity. The Plain White Ware may have come via Kouklia; it could be that Kouklia also imported its plain wares from Hala Sultan Tekke and elsewhere; more sampling is needed to investigate this possibility.

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79 Karageorghis 1976, 14, 94; Gifford 1985, 385 Fig. 4.

80 Adelman in Furumark and Adelman 2003, 66.

81 Mountjoy 2018a, 25 Table 2.

82 Howitt-Marshall 2012, 114.

83 Bryan et al. 1997, 56.

84 Bryan et al.1997, No. 18, 38–39.

85 Karageorghis and Demas 1988, 1–2 Fig. 1 with fn.1 for the suggestion that the water table, possibly higher than today, could have provided water at points 50–200 m from the settlement.

86 Jones and Vaughan 1988.

87 See Tartaron 2013, 32 (7) for a definition.

Furthermore, although the few pieces of vessels of vitreous materials uncovered at Maa belonged to divergent types with a wide geographical spread covering Syria/Mesopotamia, Egypt and North Syria,[88] the number of vessels is minute. This again suggests cabotage. Ships tramping could take on goods unloaded at harbours by vessels carrying out down-the-line trading in which goods moved across territories.[89]

Was Maa a major metallurgical site exporting abroad or just carrying out metallurgy for local use?

There is evidence of metallurgy at Maa,[90] but it is generally accounted to be on a limited scale for local use based on the small amount of copper slag and copper artefacts present.[91] Metallurgy does not seem to have been a prominent activity at the site.

Do imported Syro-Palestinian amphorae, the so-called Canaanite jars, at Maa suggest international trade?

The presence of large numbers of Canaanite jars at Maa might be evidence of international trade at the port. They have been assigned by petrography and chemical analysis (atomic absorption) as products of the central Levant and southern Palestine, with only a few jars being locally produced.[92] However, these jars may have been sent to Kouklia and forwarded on to Maa. Hadjikosti has already raised the question as to whether Maa imported the jars directly or whether they came from Kouklia: Palaepaphos or other island administrative centres.[93]

Does the presence of Near Eastern weights at Maa suggest international contacts?

Weights used in Near Eastern systems of metrology[94] are present at Maa[95] and also at Kalavasos,[96] which had extensive storage facilities. However, Near Eastern systems of weight metrology were in use on Cyprus as early as LC I,[97] so were well-established internally by late LCIIC-early LC IIIA, thus, rendering it unlikely that Maa had direct international contacts in its use of the weights.

Fragments of impressed pithoi at Maa in Area III Building III Floor II have suggested extensive storage,[98] leading to the identification of the northern part of the building (Rooms 82, 84 and 85) as a storage depot for surplus agricultural products.[99] No petrography is mentioned, so it is unclear if the pithoi were locally produced or sent from Kouklia or elsewhere. Pithoi with rolled impressions have additionally been found at Alassa, where there were also capacious storage facilities (see above).[100]

The presence of weights, storage facilities and impressed pithoi at Maa suggest parallels, albeit on a much smaller scale, to the administrative centres at Kalavasos and Alassa. These two sites were part of the copper production network.

The copper production network

Keswani has noted that the growth of Cypriot copper production and trade in the LBA not only necessitated more participants for the processes of mining, smelting, refining and production of goods but also involved a large number of other individuals with different skills, such as sailors, merchants, builders, masons and potters, working in different places.[101] The network of connections between the mining sites, close to the cupriferous pillow lavas in the foothills of the Troodos, the smelting sites and the routes to the refining and port sites required an infrastructure. This is thought to comprise a hierarchical system of sites catering for different functions. It began with the mining sites and pottery producing sites; they were connected to larger and smaller inland towns, usually at a nexus of routes, the larger towns for administration, and both large and small towns for production, storage and transport; finally, coastal sites took care of shipping, administration and ceremonial aspects.[102]

88 Peltenburg 1988, 314–316.
89 See Tartaron 2013, 32 (4), 34–35.
90 Muhly and Maddin 1988; Zwicker 1988.
91 J.Muhly pers. com. 27 Feb. 2018; Karageorghis and Demas 1988, 262.
92 Hadjikosti 1988, 340–385; Jones and Vaughan 1988, 393.
93 Hadjikosti 1988, 361.
94 Courtois 1984, 85; Keswani 2004, 84.
95 Courtois 1988.
96 Knapp 2008, 341.
97 Keswani 2004, 84 with references.
98 Porada 1988, 301–313.
99 Karageorghis and Demas 1988, 33–34.
100 Hadjisavvas 1996, 32.
101 Keswani 2004, 156.
102 See Keswani 1993; Knapp 2008, 138–144 with Fig. 23, 166–167.

Kalavasos offers an example of such an infrastructure. The site lies at a nexus of inland routes a few kilometres from the coast, west of the Vasilikos river and about 8 km south of the copper mines. At this site, which was abandoned in late LC IIC on the cusp of the change from Local IIIB to CypIIIC Early 1 pottery (Table 1), the late LC IIC local classes of decorated pottery were in use, that is the island-produced copies of Levanto-Helladic pottery, together with the Rude/Pastoral Style, Simple Style and early examples of some of the 14 Bowl Types. The NAA has shown that Kalavasos imported all these pottery types from other Cypriot sites.[103] Although it was a large storage and administrative centre, which one would expect to be producing all its own different pottery wares, this does not seem to have been so in the case of decorated pottery. The NAA isolated no local chemical group from the 30 decorated samples taken,[104] although a cooking ware group has been assigned as local.[105] Three other sites analysed by NAA also did not have their own chemical profile: Apliki, a mining site, Athienou a cult and possible metallurgical smelting site,[106] both of which continued into CypIIIC Early 1, and Idalion: Kafkallia, a LC IIC site, about which too little is known for any conclusions to be drawn. Apliki and Athienou imported fine wares from other sites, particularly the four main sites of Enkomi, Kition, Hala Sultan Tekke and Kouklia.[107] These two sites may not have made their own fine decorated pottery, although Apliki probably made its own coarse wares, such as crucibles. The latter has possibility been demonstrated for Kalavasos by petrography, which showed that the tuyères and crucibles at this site matched the local coarse ware pottery.[108] It is possible that Apliki and Athienou received their fine wares as part of the copper production support system described above, Apliki as a mining site and Athienou, if not as a metallurgical site, then as a site on the copper route. I have suggested that Kalavasos also seems to have had this arrangement, although it was an administrative centre, and supplied olive oil and grain;[109] thus, fine decorated pottery could be added to the list of support items. Keswani has already suggested that pottery was possibly one of the items which were supplied to inland centres as part of the support system.[110] The evidence of NAA suggests that this may well be the case.

To return to the question of whether Maa was a maritime trading centre on and beyond the island

The maritime angle

Anchorage at Maa

The southward jutting peninsula of Maa is flanked by a bay to the west and to the east.[111] The long shore drift moving down the coast from the north would have silted up the western bay rendering it too shallow for deeper-hulled vessels, but the eastern bay, with its long, protected beach, could have been the main harbour of Maa. The coast and relative sea level have changed greatly on Cyprus; thus, the depth of the harbour cannot be estimated; however, LBA ships did not need particularly deep harbours. They may have had a 1-m draft when fully loaded, thus, needing a l.5-m depth for anchorage.[112]

Shipping normally went anti-clockwise round the island due to the prevailing winds and currents,[113] which would have made clockwise communication difficult. However, shipping was able to travel from Kouklia to Maa, since the Akamas promontory cuts off the prevailing north-west wind. In like manner, shipping could also have travelled westward along the south coast from Kition/Hala Sultan Tekke to Kouklia, as the prevailing north-west winds are blocked by the position of the island and the currents are weaker. There were also localised winds which would have blown in different directions at different times of the year.

Thus, ships could have stopped at Maa and loaded up to go westwards or southwards. However, a factor which must also be considered is the position of Maa in relation to sailing routes, since

103 Mountjoy 2018b, 190–192 Tables 3–6.

104 Mountjoy and Mommsen 2015, 496–497.

105 Bryan et al. 1997, 38 Group 16.

106 However, see Kassianidou (2005, 137–139), for the suggestion that the copper debris was brought from elsewhere. I thank J. Webb for this reference.

107 See Mountjoy 2018b, 190–192 Tables 3–6.

108 I would like to thank L. Van Brempt for allowing me to cite her work in progress.

109 Mountjoy 2018b, 193–194.

110 Keswani 1993, 78.

111 See map in Karageorghis and Demas 1988, 2 Fig. 1.

112 I thank G. Votruba for this information.

113 Howitt-Marshall 2012, 113.

these were not always straight forward. In any discussion of sailing routes in the eastern Mediterranean, the Mediterranean Sea as a whole has to be considered, in order to understand how routes in a particular area, such as Cyprus, were influenced by winds and currents. The map (Fig. 8) is a very simplified version of the prevailing winds and currents which affected 12th century BC shipping routes. Any primary route can have many sub-routes, depending on a plethora of factors.[114] Thus, the map and discussion here offer only a basic framework.

The winds and currents in the Mediterranean Sea (Fig. 8)

Winds and currents play a leading role in the choice of sailing routes. The Mediterranean Sea is landlocked apart from the entrances from the Atlantic Ocean and the Black Sea. The sea has high salinity resulting in water flowing in at the surface from the Straits of Gibraltar and from the Dardanelles, while a saline undercurrent flows out. The inflow from the Atlantic creates an *anti-clockwise* current round the Mediterranean, consisting of a strong eastward current running across the entire south Mediterranean until it reaches the Levantine coast; it is forced northwards up that coast and then finally returns westwards along the south Anatolian coast. Arriving at the Aegean Sea at the end of the south Anatolian coast, it collides with the northern limit of the main east current and is pushed northwards up the East Aegean–West Anatolian interface to meet the current flowing out of the Dardanelles. The combined currents then flow south-west across the Aegean, giving rise to an anti-clockwise current in this sea. This current exits the Aegean between West Crete and Cape Malea on the south Peloponnesian coast, but meets the east current once more and is sent up the Ionion Sea along the west coast of Greece and on into the Adriatic Sea, where it also runs anti-clockwise.[115] The prevailing winds, especially in the summer, blow between north-west and north-east (on the map (Fig. 8) they are shown at the north-west); at the beginning of summer, the south wind, the Sirocco, can blow northwards from the Sahara.[116] Coastal/inshore sailing could profit from local sea and land breezes, caused by the land heating up more quickly than the sea during the day and cooling more quickly at night, giving rise to on-shore and off-shore breezes.[117]

The text below refers to boats with the single-mast loose-footed brailed square sail, which seems to have become popular at the beginning of the 12th century BC and allowed the boat to tack. The lower edge of the sail was no longer connected to the boom, thus, allowing more flexibility in the use of the sail, while the system of brails drawing the sail up enabled quick furling. It replaced the square-sailed rig with a yard and a boom onto which the sail was furled down.[118]

The Routes

The route from the Aegean to Africa, the Levant and Cyprus

Shipping routes in the LBA east Mediterranean were dictated generally by the anti-clockwise direction of the currents and especially by the prevailing winds. Thus, shipping eastward-bound from the Aegean or Crete to the Levant could not sail eastwards easily along the south Anatolian coast, as, although the east current now returning westwards was weaker, the north-westerlies, which blow from spring to autumn, could still drive it off course.[119] The journey could be done using local land and sea breezes, but was more dangerous than the return route from east to west (see below). The other option was to sail with the north-westerlies down to Africa. Sailing from the Cretan south coastal emporium of Kommos, ships could aim for the stopover trading station of Marsa Matruh,[120] or, sailing from Rhodes, they could sail to the Nile Delta. Indeed, Alan Wace, on Rhodes in the first decade of the 20th century, met caique owners who transported fresh vegetables from Rhodes directly by sail to Alexandria, leaving Rhodes at night and arriving at Alexandria 36 hours later.[121] Presumably they returned under engine power.

Arriving at the Nile Delta, although it was possible, ships could not sail easily directly across the open sea from the Nile Delta to harbours in the central Levant, because of the unfavourable north-

114 Tartaron 2013, 116.
115 Morton 2001, 37–39.
116 Horden and Purcell 2000, 137.
117 Morton 2001, 37–39, 48–53 with Figs. 21–22.
118 Whitewright 2018, 29–30.
119 Bar-Yosef Mayer *et al.* 2015, 418.
120 Knapp 2018, 124, 174.
121 Per litteras E. French 2018.

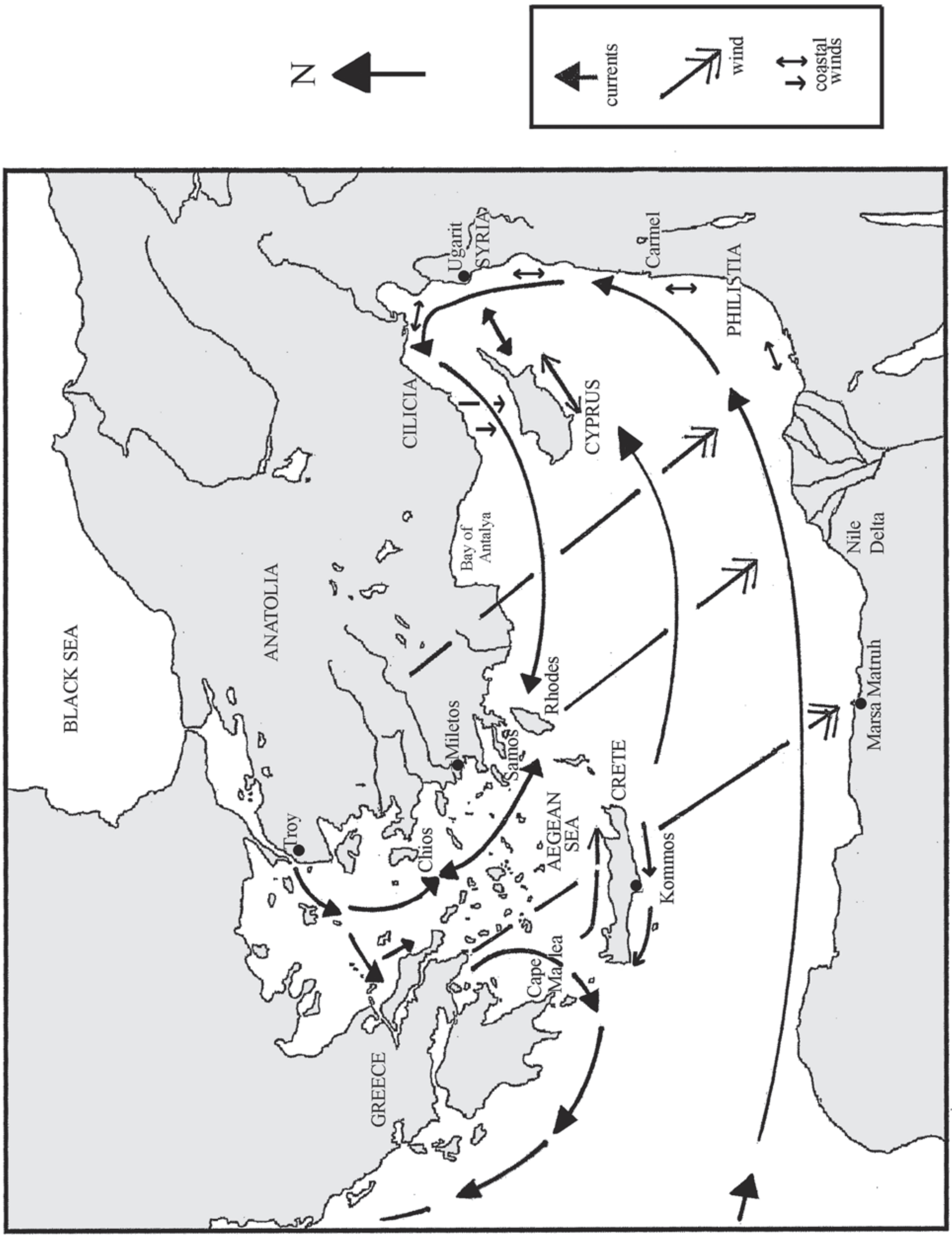

Fig. 8 Currents and winds in the eastern Mediterranean.

westerlies. But they could sail to ports in the south Levant, such as Dor, and up the Levantine coast; some difficulty might be caused by the north-westerlies when sailing up the coast, but shipping could profit from sea-surface circulation determined by local currents and land and sea breezes (the on/off-shore daily winds). The sea-surface circulation also enabled vessels to sail southwards down the Levantine coast, since the northward stream generated eddies (a reverse flow of water), thus, allowing the surface circulation to run in both directions.

Gilboa suggests that, by leaving Egypt with the early morning local southerly breeze and continuing on the open sea with the west wind, Dor could be reached easily.[122] Sailing directly north-east to Dor would have been difficult with the prevailing north-west wind. The Dor harbours just north of the Carmel Ridge provided important sheltered anchorages, although access was difficult in bad weather.[123] Shipping then continued up the Levantine coast through various ports to Ugarit and then round to Cilicia and the south Anatolian coast. The route westwards to the Aegean along the south coast of Anatolia, with the east current now returning west was favourable, although dangerous round the Bay of Antalya if storms came down from the Taurus mountains.[124] Ships used the on/off-shore land and sea breezes to tack along the coast and kept within the lee of the coast to shelter from the north-westerlies, but not too close, since shallow-lying reefs and submerged rocks could be hit when changing tacks.

Routes to and from Cyprus

A direct route from **Crete to Cyprus** has been suggested by A. Theodorou.[125] It is pointed out that when the east current, entering the Mediterranean from the Gibraltar Straits, reaches the strait between Africa and Crete, it turns north-east towards east Crete and then south-east towards the Nile delta, north of which it splits into the branch continuing round to the Levantine coast and a branch going anti-clockwise in the Rhodes cyclonic system.[126] A route from Crete to Cyprus using the north-westerly and westerly winds, which coincide with the southern branch of the Rhodes cyclonic system flowing eastwards, is suggested. The return trip to Crete would follow the usual way westwards along the south Anatolian coast, but might first cross from Cyprus to the Levant to go round to the Anatolian coast, not directly from north Cyprus to that coast (see below), as suggested on their map.[127] A direct route from Crete is important, as there is a long history of contact between the two islands, especially in LH IIIA2 to mid-LH IIIB, when transport stirrup jars, many with octopus decoration, were sent particularly from Kommos to Cyprus,[128] and in later LM IIIB, that is, late LC IIC, when the Minoan syntax of banding on pots was adapted at Kition/Hala Sultan Tekke onto vessels known as Simple Style vessels, which were in demand by the Egyptians for their contents.[129]

The prevailing winds and currents round Cyprus favoured an anti-clockwise direction, but shipping along the south coast was bidirectional due to local winds and weaker currents.

Sailing from the **South Anatolian coast to Cyprus,** viable from April until October, and generally for most of the year, has been described by Bar-Yosef Mayer et al.[130] Although the focus of Bar-Yosef Mayer et al. is on Neolithic shipping, the winds are still applicable to later shipping. The land and sea breezes in the early morning were helpful, with favourable open-sea wind patterns. However, the return route from Cyprus was still via the Levant, crossing from east or south-east Cyprus to the east or south-east Levant and then returning north back up round the coast. The crossing between **Ugarit and east Cyprus** was also viable, but seasonal winds were difficult.

Going south from **Cyprus to Egypt** (the Nile Delta) could be done by going directly with the north-east or north wind or by going with the north-westerlies down to Philistia and then back westwards round the coast to the Delta, using the off-shore breezes. The return journey was up the Levantine coast, since there was no direct reliable route north from **Egypt to Cyprus**, as it meant crossing open sea, out of sight of land, against unfavourable north-westerlies and across the west-east current. This would have been a very difficult

122 Gilboa 2015, 259–60.
123 Gilboa 2015, 248, 259–60.
124 Pryor 1988, 93.
125 Theodorou in Mantzourani and Theodorou 1991, 47–50.
126 Mantzourani and Theodorou 1991, 48 Fig. 8.
127 Mantzourani and Theodorou 1991, 50 Fig. 9.
128 Haskell 2005, 210–211, 213–214, 217, with references.
129 Mountjoy and Mommsen 2015, 471–474, 489 with fn. 177, 178; Mountjoy 2018a, Section II 63–70; 2018b, 194.
130 Bar-Yosef Mayer et al. 2015, 427–428.

journey for 12th century BC ships even with the ability to tack due to the new brailed rig. The same applied to any journey from **Egypt to Rhodes or Crete**. Inter-visibility between sites was important and, where possible, ships kept in sight of land. Egypt was isolated from the Aegean, Crete and Cyprus in this respect.[131]

The survey of Mediterranean winds and currents above has shown that sailing west from Maa to Crete or the Aegean would be very difficult. Once a 12th century BC ship left the shelter of the Akamas promontory, it was going counter the prevailing north-westerly winds, which blow most of the year, and contra the coastal current. Even continuing east round the north coast of the island would have been difficult for the same reason. Crossing the open sea west to Crete and north-west to Rhodes would have been very dangerous, even though the brailed sail now allowed ships to tack. The only favourable overseas route from Maa was to run south-east with the north-westerlies down to the south Levant, or south to Egypt, if the north wind blew, and this could equally well be done from Kouklia. On the other hand, 12th century BC vessels coming from Crete could have made their first landing at Maa and continued anti-clockwise along the south coast of the island, round to Enkomi and then followed the route to the Levant (see above). However, as in the case of Cyprus, Crete was caught up in the late 13th–early 12th century troubles. Many sites on that island were affected by recession, which led to the collapse of regional networks.[132] A major victim was the prominent harbour at Kommos, which exported transport stirrup jars from central Cretan workshops to Cyprus, and which seems to have been abandoned in the later 13th century BC.[133] It is, thus, unclear if the earlier volume of trade to Cyprus continued and took advantage of the harbour at the newly founded settlement of Maa. However, Kanta has pointed out that Cretan transport stirrup jars were still exported to Cyprus in early IIIC; they have been found at Hala Sultan Tekke, Pyla: Kokkinokremos and Maa, the latter two sites being founded very early in IIIC in terms of Crete and the Greek mainland.[134] It is indeed possible that incoming ships from Crete might have made some use of the Maa harbour in this respect.

In sum, the survey has shown that although ships theoretically could have stopped at Maa and loaded up to go westwards or southwards, yet, going westwards was not viable and cargo going south or south-east could as easily have gone from Kouklia as from Maa. The discussion of the movement of goods and the examination of winds and currents above suggests it is unlikely that Maa was a maritime trading centre. So why was Maa founded?

Enigmatic Maa

Several suggestions have been made concerning the reason for the founding of Maa. It was seen by the excavators as a defensive settlement, established late in LC IIC by locals and people from the Aegean, since LC IIC local pottery was in use together with Aegean-style pottery and other foreign elements.[135] Other views include the ideas that Maa could have been founded by locals as an independent centre for commercial reasons;[136] as a satellite site of Kouklia;[137] as a local Cypriot stronghold in similar manner to LM IIIC defensive settlements;[138] or as a pirate refuge.[139]

Maa may well have been founded by Kouklia: Palaepaphos, as has already been suggested.[140] Owing to its favourable anchorage and its position close to a river valley coming down from the Troodos, it may have been founded by Kouklia as part of the support system for the metallurgical sites of the west Troodos, providing agricultural surplus to the copper villages, while itself being provided with fine ware pottery from Kouklia, along with imported Canaanite jars, the contents of which might have been for Maa itself or for the provisioning of the copper villages. Resin, olive oil and honey were some of the products which could be transported in these jars.[141] The goods would have been stored in the storage depot in Area III and perhaps in other unexcavated

131 See inter-visibility map, Manning and Hulin 2005, 277 Fig. 11.1.

132 See Driessen and Frankel 2012, 68–69, 76–77 for an overview.

133 Haskell 2005, 217.

134 Kanta 2005, 227–230.

135 Karageorghis and Demas 1988, 211.

136 Sherratt 1998, 300–301 no. 15.

137 Keswani 2004, 155.

138 Steel 2004, 190.

139 Hitchcock and Maeir 2014, 629–630.

140 Keswani 2004, 155; Knapp 2008, 137.

141 Pulak 1988, 10–12; Killebrew 2007, 182.

depots.[142] Apart from ships possibly coming in from Crete, the harbour would have been used for bringing in the impressed pithoi and the Canaanite jars, and goods from elsewhere on the island, either directly or via Kouklia. Kouklia would have sent its own fine ware Aegean-style pottery, but that from other sites may have arrived via Kouklia or as cabotage. The use of the seal impressed pithoi and Near Eastern weights, also in use at Alassa and Kalavasos respectively, could support the idea that Maa was part of a similar network.

The foundation date (Table 1)

The most interesting aspect of the founding of Maa is that the date of its foundation may be later than was thought. As noted above, the excavators thought Maa was a defensive settlement, founded with Floor II late in LC IIC by locals and people from the Aegean, since Aegean-style pottery and LC IIC local pottery were both in use.[143] However, Aegean-style pottery only began to circulate on the island in LCIIIA in CypIIIC Early 1 and was not common in that phase.[144] It became predominant on the island in CypIIIC Early 2.[145] Thus, the Aegean-style pottery at Maa belongs to the CypIIIC Early 2 phase and it would seem that it has nothing to do with the foundation of the site.

However, it is possible that the settlement was founded in LCIIIA (possibly on the cusp of CypIIIC Early 1 and CypIIIC Early 2, Table 1). This would fit with an observation by Jung. He follows the excavators in dating the foundation to late LC IIC, but observes that the LC IIC local pottery types found in many Floor II levels suggest that Maa was more conservative than Enkomi, and retained local Cypriot characteristics longer.[146] He also notes that Aegean-style platform hearths for the Aegean flat-based cooking pot, FS 65 and 66, and the cooking pots themselves, were found together with the LC IIC shapes, from the beginning of the use of Floor II.[147] I would suggest that these two factors combined with the presence of the Aegean-style pottery in the same context strongly support an early LC IIIA foundation date for the site (Table 1).[148]

It is possible that immigrants from the Argolid trickled into Cyprus from Mid-LH IIIB onwards, as Cyprus and the north-east Peloponnese had had close trade relations for several decades. The immigrants may have come as a result of a series of earthquakes, the first in Mid-LH IIIB, a second at the end of LH IIIB, and a third at the end of LH IIIC Early 1, the latter probably accounting for an upsurge in arrivals, which continued into the very early stages of CypIIIC Early 2. French has pointed out that the full range of the typical features of Aegean-style pottery does not appear until LH IIIC Early 2 at Mycenae and Tiryns, after the LH IIIC Early 1 earthquake destruction.[149] The Aegean-style pottery on Cyprus comprises a combination of influences. These include elements of Minoan IIIB, White Slip and Rude/Pastoral Style pottery, dating from late LC IIC and LC IIC Final/CypIIIC Early 1 (Table 1), blended with the incoming Mycenaean shapes and motifs.[150] The ubiquitous deep bowl was one of the first Aegean-style shapes to appear. There are examples dating to CypIIIC Early 1 (i.e. LC IIC Final and early LC IIIA).[151] Thus, the appearance of all the Aegean-style traits on Cyprus was drawn out from late LC IIC onwards, with final additions after the third earthquake at Mycenae.

The consequences of the foundation date

The probable CypIIIC Early 2 foundation date suggests that the settlement at Maa was founded at a time when Aegean-style traits had already spread over the island. If this was the case, then no foreigners need to have been involved in its foundation at all. The occasional earlier Mycenaean imports at Maa, such as a LH IIIA2 flask[152] and a LH IIIB2 FS 296 bowl with added white paint,[153] need not to have been brought by immigrant Aegeans, but were more likely to have been removed from earlier chamber tombs when they were cleared out, for example, at Kouklia, for new

142 Only the fortifications and three main areas of the site were excavated, Karageorghis and Demas 1988, 31.

143 Karageorghis and Demas 1988, 211–266.

144 See Mountjoy 2018a, 26.2.

145 See Mountjoy 2018a, 27–28 with Table 4.

146 Jung 2011, 66.

147 Jung 2011, 67; 2017, 139–140.

148 This date supersedes Mountjoy (2018a, 25 Table 2), where I followed the LC IIC date of the excavators.

149 French 2013, 345–347.

150 Mountjoy 2018a, 27–28 with Table 4.

151 See Mountjoy 2018a, 1069, 1071, Fig. 578.

152 Mountjoy 2018a, 864 Fig. 430.66.

153 Mountjoy 2018a, 864 Fig. 430.72.

burials, or, in the case of the bowl, it could still have been in use by the family of its indigenous first owners.

A LC IIIA foundation date means that Maa was founded when all the smaller copper production networks were being slowly abandoned as a result of the instability of the late 13th–early 12th century, which affected the demand for copper in the eastern Mediterranean.[154] Since copper exploitation on the island was carried out by separate polities, each with its own copper support network, rather than control being in the hands of a large central authority, the smaller networks were more vulnerable to the problems of supply and demand than the larger sites of Enkomi, Hala Sultan Tekke, Kition and Kouklia. The smaller copper network sites mentioned above, and others as well, ended, mostly with abandonment, in CypIIIC Early 1 or just into CypIIIC Early 2.[155] Kition and Kouklia: Palaepaphos, on the other hand, profited from the disruption, both industrially and economically,[156] and continued to produce copper. It is, therefore, possible that, as other sites faded, if Kouklia founded Maa, it was aiming at taking advantage of the industrial vacuum and expanding its copper production in the west Troodos as part of its economic growth. Indeed, if the settlement of the site was carried out from Kouklia, it may well have included some of the people who had had to abandon the copper support sites further east.

The demise of Maa

The Maa fortification wall was obviously needed but did not prevent the destruction of the settlement in CypIIIC Early 2. The wall may have been a defence against "pirate" raids and it may be that the site was destroyed by "pirates", rather than being a "pirate" refuge, as Hitchcock and Maeir suggest.[157] Knapp points out that LB documents show that raiders surprised coastal towns and ports and sacked them and that the towns were not in a position to fight them off. He suggests the attackers should be called coastal raiders rather than pirates, as there is no word for pirates in any of the LBA texts.[158] After the destruction, Maa was immediately rebuilt with Floor I, but the buildings were smaller and less well-constructed than those of Floor II. The site was abandoned late in the same phase.

154 Knapp 1997, 68–69; Webb 1999, 286.
155 Mountjoy 2018a, 25 Table 2.
156 Webb 1999, 288–292.
157 Hitchcock and Maeir 2014, 629–630.
158 Knapp 2018, 173.

Bibliography

Bar-Yosef Mayer, D., Kahanov, Y., Rostin, R., and Gildor, H.

2015 Neolithic Voyages to Cyprus: Wind Patterns, Routes, and Mechanisms, *Journal of Island and Coastal Archaeology* 10, 412–435.

Beier, T., and Mommsen, H.

1994a Modified Mahalanobis Filters for Grouping Pottery by Chemical Composition, *Archaeometry* 36, 287–306.

1994b A Method for Classifying Multidimensional Data with Respect to Uncertainties of Measurement and Its Application to Archaeometry, *Naturwissenschaften* 91, 546–548.

Bryan, N.D., French, E.B., Hoffman, S.M.A., and Robinson, D.J.

1997 Pottery Sources in Bronze Age Cyprus: A Provenance Study by Neutron Activation, *RDAC* 31–64.

Courtois, J.-C.

1984 Appendix II Les poids de Pyla-Kokkinokremos. Étude métrologique, 80–85, in: V. Karageorghis and M. Demas (eds.), *Pyla-Kokkinokremos: A Late 13th Century B.C. Fortified Settlement in Cyprus*, Nicosia.

1988 Appendix VI Les poids de Maa-Palaeokastro, Étude métrologique, 404–414, in: V. Karageorghis and M. Demas (eds.), *Excavations at Maa-Palaeokastro 1979-1986*, Nicosia.

Day, L.P., and Snyder, L.

2004 The ‘Big House’ at Vronda and the ‘Great House’ at Karphi: Evidence for Social Structure in LMIIIC Crete, 63–80, in L.P. Day, M.S. Mook and J.D. Muhly (eds.), *Crete Beyond the Palaces. Proceedings of the Crete 2000 Symposium*, INSTAP Prehistory Monographs 10, Philadelphia.

Driessen, J. and Frankel, D.

2012 Minds and Mines: Settlement Networks and the Diachronic Use of Space on Cyprus and Crete, 61–84, in G. Cadogan, M. Iakovou, K. Kopaka and J. Whitley (eds.), *Parallel Lives. Ancient Island Societies in Crete and Cyprus. Papers arising from a Conference in Nicosia Organised by the British School at Athens, the University of Crete and the University of Cyprus*, BSA Studies 20, Exeter.

Fischer, P.M., and Bürge, T.

2018 *Two Late Cypriot City Quarters at Hala Sultan Tekke. The Söderberg Expedition 2010–2017*, Uppsala.

French, E. B.

2007 The Impact on Correlations to the Levant of the Recent Stratigraphic Evidence from the Argolid, 525–536, in: M. Bietak and E. Czerny (eds.), *The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millenium BC III: Proceedings of the SCIEM 2000-2nd EuroConference, Vienna, 28 of May–1 June 2003*, Vienna.

2013 The Origin and Date of Aegean-type Pottery in the Levant, 345–347, in: A. Killebrew and G. Lehmann (eds.), *The Philistines and Other “Sea Peoples” in Text and Archaeology*, Atlanta.

French, E.B., and Stockhammer, P.W.

2009 Mycenae and Tiryns: The Pottery of the Second Half of the Thirteenth Century BC – Contexts and Definitions, *BSA* 104, 175–232.

Furumark, A., and Adelman, C.M.

2003 *Swedish Excavations at Sinda, Cyprus. Excavations Conducted by Arne Furumark 1947–1948,* Stockholm.

Gifford, J.A.

1985 Appendix IV Post-Bronze Age Coastal Change in the Vicinity of Kition, 375–387, in: V. Karageorghis and M. Demas (eds.), *Excavations at Kition V. The Pre-Phoenician Levels*, Nicosia.

Gilboa, A.

2015 Dor and Egypt in the Early Iron Age: An Archaeological Perspective of (Part of) the Wenamun Report. *Egypt and the Levant* XXV, 247–274.

Gilboa, A., Shalev, Y., Lehmann, G., Mommsen, H., Erickson, B., Nodarou, E., and Ben-Shlomo, D.

2017 Cretan Pottery in the Levant in the Fifth and Fourth Centuries B.C.E., *AJA* 121, 559–593, open access on AJA Online

Hadjikosti, M.

1988 Appendix IV.1 ‘Canaanite’ Jars from Maa-Palaeokastro, 340–385, in: V. Karageorghis and M. Demas (eds), *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

Hadjisavvas, S.

1989 A Late Cypriot Community at Alassa, 32–42, in: E. Peltenburg (ed.), *Early Society in Cyprus*, Edinburgh.

1996 Alassa – a Regional Centre of Alasia, 23–38, in: P. Åström and E. Herscher (eds.), *Late Bronze Age Settlement in Cyprus: Function and Relationship*, SIMA Pb 126, Jonsered.

2017 *Alassa. Excavations at the Late Bronze Age Sites of Pano Mantilaris and Paliotaverna 1984–2000*, Nicosia.

Haskell, H.W.

2005 Region to Region Export of Transport Stirrup Jars from LM IIIA2/B Crete, 205–221, in: A.L. D’Agata and J. Moody (eds.), *Ariadne’s Threads. Connections between Crete and the Greek Mainland in Late Minoan III (LM IIIA2 to LM IIIC). Proceedings of the International Workshop held at Athens Scuola Archeologica Italiana 5–6 April 2003,* Athens.

Hatzaki, E.M.

2005 *Knossos: The Little Palace,* BSA Suppl.38, Oxford.

Hitchcock, L.A., and Maier, A.M.

2014 Yo-ho, Yo-ho, a Serens life for me! *World Archaeology* 46, 624–640.

Horden, P. and Purcell, N.

2000 *The Corrupting Sea: A Study of Mediterranean History*, Oxford.

Howitt-Marshall, D.S.

2012 The Anchorage Site at Kouklia-Achni, South-west Cyprus: Problems and Perspectives, 104–121, in: A. Georgiou (ed.), *Cyprus, an Island Culture. Society and Social Relations from the Bronze Age to the Venetian Period*, Oxford.

Iacovou, M.

2008 The 'Palaepaphos Urban Landscape Project': Theoretical Background and Preliminary Report 2006-2007, *RDAC*, 263–289.

2012 From Regional Gateway to Cypriot Kingdom. Copper Deposits and Copper Routes in the Chora of Paphos, 58–69, in: V. Kassianidou and G. Pappasavvas (eds.), *Eastern Mediterranean Metallurgy and Metalwork in the Second Millenium BC, A Conference in Honour of James D. Muhly, Nicosia, 10–11 October 2009*, Oxford.

2013 Paphos before Palaepaphos, 275–291, in: D. Michaelides (ed.), *Epigraphy, Numismatics, Prosopography and History of Ancient Cyprus. Papers in Honour of Ino Nicolaou*, Studies in Mediterranean Archaeology and Literature 179, Uppsala.

Jones, R.E., and Vaughan, S.J.

1988 Appendix IV.2 A Study of Some 'Canaanite' Jar Fragments from Maa-Palaeokastro by petrographic and chemical analysis, 386–398, in: V. Karageorghis and M. Demas (eds.), *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

Jung, R,

2011 Innovative Cooks and New Dishes: Cypriote Pottery in the 13th and 12th Centuries and Its Historical Interpretations, 57–85, in: V. Karageorghis and O. Kouka (eds.), *On Cooking Pots, Drinking Cups, Loom Weights and Ethnicity in Bronze Age Cyprus and Neighbouring Regions. An International Archaeological Symposium held in Nicosia November 6–7 2010*, Nicosia.

Jung, R., with a contribution by Mommsen, H.

2017 Cooking Vessels from Late Bronze Age Cyprus: Local Traditions, Western and Eastern Innovations, 127–145, in: J. Hruby and D. Trusty (eds.*), From Cooking Vessels to Cultural Practice in the Late Bronze Age Aegean*, Oxford.

Kanta, A.

2005 Response to Halford W.Haskell, Region to Region Export of Transport Stirrup Jars from LM IIIA2/B Crete, 223–234, in: A.L. D'Agata and J. Moody (eds.), *Ariadne's Threads. Connections between Crete and the Greek Mainland in Late Minoan III (LM IIIA2 to LM IIIC). Proceedings of the International Workshop held at Athens Scuola Archeologica Italiana 5–6 April 2003*, Athens.

Karageorghis, V.

1976 *Kition. Mycenaean and Phoenician Discoveries in Cyprus*, London.

Karageorghis, V., and Demas, M.

1988 *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

Karageorghis, V., and Kanta, A.

2014 *Pyla-Kokkinokremos. A Late 13th Century BC Fortified Settlement in Cyprus. Excavations 2010–2011*, SIMA 141, Uppsala.

Kassianidou, V.

2005 Was Copper Production under Divine Protection in Late Bronze Age Cyprus? Some Thoughts on an Old Question, 127–141, in: V. Karageorghis, H. Matthäus and S. Rogge (eds.), *Cyprus: Religion and Society from the Late Bronze Age to the End of the Archaic Period*, Bralystock.

Keswani, P.

1993 Models of local exchange in Late Bronze Age Cyprus, *BASOR* 292, 73–83.

2004 *Mortuary Ritual and Society in Bronze Age Cyprus*, Monographs in Mediterranean Archaeology 9, London.

Killebrew, A.E.

2007 The Canaanite Storage Jar Revisited, 166–188, in: S. White-Crawford, A. Ben-Tor, J.P. Dessel, W.G. Dever, A. Mazar, and J. Aviram (eds.), *'Up to the Gates of Ekron' Essays on the Archaeology and History of the Eastern Mediterranean in Honor of Seymour Gitin*, Jerusalem.

Kleiman, A., Fantalkin, A., Mommsen, H., and Finkelstein, I.

2019 The Date and Origin of the Black-on-Red Ware: The View from Megiddo, *AJA* 123, 531–555.

Knapp, A.B.

1997 *The Archaeology of Late Bronze Age Cypriot Society*, University of Glasgow, Department of Archaeology, Occasional Paper 4, Glasgow.

2008 *Prehistoric and Protohistoric Cyprus. Identity, Insularity and Connectivity*, Oxford.

2018 *Seafaring and Seafarers in the Bronze Age Eastern Aegean*, Leiden.

Manning, S., and Hulin, L.

2005 Maritime Commerce and Geographies of Mobility in the Late Bronze Age of the Eastern Mediterranean: Problematizations, 275–307, in: E. Blake and, C. Knapett (eds.), *The Archaeology of Mediterranean Prehistory*, Oxford.

Mantzourani, E.K., and Theodorou, A.J.

1991 An Attempt to Delineate the Sea Routes between Crete and Cyprus during the Bronze Age, 38–56, in: V. Karageorghis (ed.), *The Civilisations of the Aegean and Their Diffusion in Cyprus and the Eastern Mediterranean, 2000–600 BC*, Larnaka.

Morton, J.

2001 *The Role of the Physical Environment in Ancient Greek Seafaring*, Leiden.

Mommsen, H., and Sjöberg, B.L.

2007 The Importance of the 'Best Relative Fit Factor' When Evaluating Elemental Concentration Data of Pottery Demonstrated with Mycenaean Sherds from Sinda, Cyprus, *Archaeometry* 49, 359–371.

Mommsen, H., Mountjoy, P.A., and Özyar, A.

2011 Provenance Determination of Mycenaean IIIC Vessels from the 1934–1939 Excavations at Tarsus-Gözlüküle by Neutron Activation Analysis, *Archaeometry* 53.5, 900–915.

Mook, M.S., and Coulson, W.D.

1997 Late Minoan IIIC Pottery from the Kastro at Kavousi, 337–370. in: E. Hallager and B.P. Hallager (eds.), *Late Minoan III Pottery. Chronology and Terminology. Acts of a Meeting hHeld at the Danish Institute at Athens August 12–14,1994*, Aarhus.

Mountjoy, P.A.

l986 *Mycenaean Decorated Pottery: A Guide to Identification*, Studies in Mediterranean Archaeology 73, Gothenberg.

1999a *Regional Mycenaean Decorated Pottery,* German Archaeological Institute Berlin, Rahden.

1999b Late Minoan IIIC/Late Helladic IIIC: Chronology and Terminology, 511–516, in: P. Betancourt, V. Karageorghis, R. Laffineur and W-D. Niemeier (eds.), *Meletemata. Studies in Aegean Archaeology Presented to Malcolm H. Wiener as He Enters his 65th Year.* Aegaeum 20, Liège.

2004 Miletos: A Note, *BSA* 99, 189–200.

2010 A Note on the Mixed Origins of Some Philistine pottery, *BASOR* 359, 1–12.

2018a *Decorated Pottery in Cyprus and Philistia in the 12th Century BC: Cypriot IIIC and Philistine IIIC*. (*Contributions to the Chronology of the Eastern Mediterranean* 36), Vienna.

2018b Economy, Taphonomy and Trade in LC IIC–LC IIIA Cyprus: Using Data from Neutron Excavation Analysis of Pottery, 179, in: L. Hulin, L. Crewe and J.M. Webb (eds.), *Structures of Inequality on Bronze Age Cyprus: Studies in Honour of Alison K. South,* SIMA PB 187, Nicosia.

Mountjoy, P.A., and Mommsen, H.

2015 Neutron Activation Analysis of Aegean-style IIIC pottery from 11 Cypriot and various Near Eastern sites, *Egypt and Levant* 25, 421–508.

Mountjoy, P.A., Mommsen, H., and Özyar, A.

2018 Neutron Activation Analysis of Aegean-style IIIC Pottery from the Goldman eExcavations at Tarsus-Gözlükule, *Anatolian Studies* 58, 1–24.

Muhly, J.D., and Maddin, R.

1988 Appendix XII Report on Analysis of Fragment of Copper Oxhide Ingot (No. 189) from Maa-Paleaokastro, 471–473, in: V. Karageorghis and M. Demas (eds.), *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

Peltenburg, E.J.

1988 Appendix II The Maa Faience and Glazed Pottery Vessel Fragments, 314–316, in: V. Karageorghis and M. Demas (eds.), *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

Perlman, I., and Asaro, F.

1969 Pottery Analysis by Neutron Activation, *Archaeometry* 11, 21– 52.

Porada, E.

1988 Appendix 1 Relief Friezes and Seals from Maa-Palaeokastro, 301–313, in: V. Karageorghis and M. Demas (eds.), *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

Popham, M.R.

1970 Late Minoan IIIB Pottery from Knossos, *BSA* 65, 195–202.

Popham, M.R., and Milburn, E.

1971 The Late Helladic IIIC Pottery of Xeropolis (Lefkandi), a Summary, *BSA* 66, 333–52.

Pryor, J.H.

1988 *Geography, Technology and War: Studies in the Maritime History of the Mediterranean 649–1571*, Cambridge.

Pulak, C.

1988 The Bronze Age Shipwreck at Ulu Burun, Turkey: 1985 Campaign, A Very Large Number of the Canaanite Jars on the Ulu Burun Wreck Contained Resin, *AJA* 92, 1–37.

Sherratt, E.S.

1998 "Sea Peoples" and the Economic Structure of the Late Second Millennium in the Eastern Mediterranean, 292–313, in: S. Gitin, A. Mazar and E. Stern (eds.), *Mediterranean Peoples in Transition. Thirteenth to Early Tenth Centuries BCE. In Honor of Professor Trude Dothan,* Jerusalem.

Steel, L.

2004 *Cyprus before History: From the Earliest Settlers until the End of the Bronze Age*, London.

Sterba, J.H., Mommsen, H., Steinhauser, G., and Bichler, M.

2009 The Influence of Different Tempers on the Composition of Pottery, *Journal of Archaeological Science* 36, 1582–1589.

Tartaron, T.

2013 *Maritime Networks in the Mycenaean World,* Cambridge.

Tsipopoulou, M.

2004 Halasmenos, Destroyed but Not Invisible: New Insights on the LMIIIC Period in the Isthmus of Hierapetra. First Presentation of the Pottery from the 1992–1997 Campaign, 103–124, in: L.P. Day, M.S. Mook and J.D. Muhly (eds.), *Crete Beyond the Palaces. Proceedings of the Crete 2000 Symposium,* INSTAP Prehistory Monographs 10, Philadelphia.

Vermeule, E.T., and Karageorghis, V.

1982 *Mycenaean Pictorial Vase Painting,* Cambridge.

Voigtländer, W.

2003 *Die Palastkeramik. Tiryns X,* Mainz.

Warren, P. M.

2007 Characteristics of Late Minoan IIIC from the Stratigraphical Museum Site at Knossos, 329–343, in: S. Deger-Jalkotzy and M. Zavadil (eds.), *The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millenium BC, Proceedings of the 2nd Euro Conference of SCIEM 2000 held at the Austrian Academy at Vienna, October 29–31 2004*, Vienna.

Webb, J.M.

1999 *Ritual Architecture, Iconography and Practice in the Late Cypriot Bronze Age,* SIMA, PB 75, Jonsered.

Whitewright, J.

2018 Sailing and Sailing Rigs in the Ancient Mediterranean: Implications of Continuity, Variation and Change in Propulsion Technology, *International Journal of Nautical Archaeology* 47, 28–44.

Zuckerman, S., Bechar, S., Ben Shlomo, D., Mommsen, H., and Mountjoy, P.A.

In preparation Neutron Activation Analysis of Mycenaean Pottery from North Israel: Reconstruction of Aegean-Levantine Trade Patterns.

Zwicker, U.

1988 Appendix VIII Investigations of Material from Maa-Palaeokastro and Copper Ores from the Surrounding Area, 427–431, in: V. Karageorghis and M. Demas (eds), *Excavations at Maa-Palaeokastro 1979–1986*, Nicosia.

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