Characterisation Studies of Mill Green ware from Axe Street, Barking (AXB06)

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Excavations at Axe Street, Barking, carried out by the Museum of London Archaeological Service, revealed that a substantial component of the later 13th and 14th-century pottery used on the site was of Mill Green ware (MG) and a sand-tempered coarseware (MGCOAR), assumed to also be a product of the Mill Green ware industry.

Several production sites making Mill Green ware are now known, including two in the Mill Green, Ingatestone, area and one at Noak Hill, located about 6 miles to the southeast of Ingatestone.

Samples of the Noak Hill pottery, and tile produced at the same site, have been analysed by Mike Hughes and samples of production waste from the 1967 excavations carried out at Mill Green by Elizabeth Sellers (Sellers 1968; Sellers 1970) and material from Harding's Farm, Ingatestone, were collected by Jacqui Pearce for comparison with samples from Axe Street (Table 1).

Table 1

TSNO	Site Code	Context	Sample No.	CNAME	FORM	ACTION
V4512	AXB06	4/025	SAMPLE 1	MG	JUG	ICPS
V4513	AXB06	1/016	SAMPLE 2	MG	JUG	ICPS
V4514	AXB06	1/018	SAMPLE 3	MGCOAR	CP	ICPS
V4515	AXB06	4/019	SAMPLE 4	MGCOAR	CP	ICPS
V4516	AXB06	4/019	SAMPLE 5	MGCOAR	JAR	ICPS
V4517	AXB06	4/019	SAMPLE 6	MG	JUG	ICPS
V4518	AXB06	1/018	SAMPLE 7	MGCOAR	CP	TS;ICPS
V4519	AXB06	1/018	SAMPLE 8	MG	JUG	ICPS
V4520	AXB06	4/026	SAMPLE 9	MG	JUG	ICPS
V4521	AXB06	4/026	SAMPLE 10	MG	CP	TS;ICPS
V4558	MGC1967			MGCOAR	JAR	ICPS
V4559	MGC1967			MGCOAR	JAR	ICPS
V4560	MGC1967			MGCOAR	JAR	ICPS
V4561	MGC1967			MGCOAR	JAR	ICPS
V4562	MGC1967			MGCOAR	JAR	TS;ICPS
V4563	MGC1967			MGCOAR	JAR	ICPS
V4564	MGC1967			MG	JUG	TS;ICPS
V4565	MGC1967			MG	JUG	ICPS

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V4566	MGC1967	MG	JUG	ICPS
V4567	MGC1967	MG	JUG	ICPS
V4568	MGC1967	MG	JUG	ICPS
V4569	MGC1967	MG	JUG	ICPS
V4576	Ingatestone Harding's farm	MG		ICPS
V4577	Ingatestone Harding's farm	MG		ICPS
V4578	Ingatestone Harding's farm	MG		ICPS
V4579	Ingatestone Harding's farm	MG		ICPS
V4580	Ingatestone Harding's farm	MG		ICPS
V4581	Ingatestone Harding's farm	MG		ICPS

Thin Section Analysis

Thin sections were prepared by Steve Caldwell, University of Manchester, of samples from Axe Street (MG and MGCOAR) and the 1967 Mill Green production site (MG and MGCOAR). The MGCOAR sample from Axe Street, however, turns out to have an identical composition to the MG sample, indicating that some jars were produced without added tempering.

Axe Street MG

The two samples of MG from Axe Street have a very similar appearance in thin section. The following inclusion types were noted:

- Subangular quartz. Moderate grains up to 0.3mm across.
- Rounded quartz. Sparse grains, some with brown-stained veins.
- Altered Glauconite/phosphate. Sparse brown optically isotropic grains up to 0.4mm across.
- Clay Pellets. Rounded dark brown pellets with a similar texture to the groundmass.
- Flint. Sparse subangular brown-stained grains up to 0.3mm across.

The groundmass consists of optically anisotropic baked clay minerals, moderate angular quartz up to 0.1mm across, moderate rounded opaque and dark brown grains up to 0.05mm across and moderate muscovite laths up to 0.1mm long.

Mill Green 1967 MG

The following inclusion types were noted in thin section:

- Clay Pellets. Moderate rounded pellets with a finer texture than the groundmass.
- Rounded Quartz. Rare grains up to 0.4mm across.
- Altered Glauconite or Phosphate. Sparse subangular grains up to 0.3mm across.

The groundmass consists of optically anisotropic baked clay minerals and abundant well-sorted angular and subangular quartz grains c.0.1mm across, rounded dark brown and opaque grains up to 0.1mm across and sparse muscovite laths up to 0.1mm long.

Mill Green 1967 MGCOAR

The thin section of MGCOAR has similar characteristics to those in the MG section except that moderate rounded quartz grains up to 1.5mm across, sparse rounded flint up to 1.5mm across and sparse rounded chert/silicious sandstone up to 0.5mm across are present.

Discussion

The thin sections suggest that the Axe Street samples differ in texture and the frequency of rounded clay pellets from the 1967 Mill Green samples and that the MGCOAR sample differs from the MG sample from the same site only in the presence of rounded quartzose sand, which must have been deliberately added as temper.

Chemical Analysis

Samples were taken for analysis using Inductively-Coupled Plasma Spectroscopy, which was carried out at Royal Holloway College, London, under the supervision of Dr J N Walsh. A range of major elements was measured as percent oxides (App 1-5) and a range of minor and trace elements was measured as parts per million (App 6-10). Silica was not measured but was estimated by subtracting the total measured oxides from 100%. The data were normalised to aluminium before multivariate statistical analysis using the WinStat add-in to Excel (Fitch 2001).

Variability within the Axe Street Samples

The Axe Street samples include vessels identified as MGCOAR and vessels identified as MG. However, the thin section evidence indicates that not all the MGCOAR vessels need have added quartz sand. Visually, there is no reason to suppose that the vessels come from more than one source and the chemical data were therefore analysed to search for internal patterning and a distinction between MG and MGCOAR samples.

Factor analysis of the Axe Street data, omitting elements which might be present in the calcium phosphate infilling of pores post-burial, was carried out and four factors were found. An examination of the factor scores found no evidence for internal grouping and there is little evidence that the three MGCOAR samples have any distinguishing characteristics.

Furthermore, there is no difference in the estimated silica content of the MG and MGCOAR samples (69.46 +/- 2.09 % and 69.95 +/- 2.08 % respectively).

The chemical analysis therefore is consistent with the samples all coming from a single source and for no difference in composition between MG and MGCOAR samples.

Comparison with Mill Green and Noak Hill

The Axe Street data were then compared with the two groups of Mill Green samples and the Noak Hill samples. As a control, the data from the analysis of a series of Mid Saxon and medieval wares from Abbey Retail Park, Barking, were included (Alan Vince 1998). Factor analysis, using the same restricted element set as before, found four factors. Plots of F1 against F2 and F2 against F3 (Figs 1 and 2) indicate that the Mill Green wares have difference compositions to the other medieval wares, being distinguished mainly by their F1 scores. Within the Mill Green ware samples there is considerable overlap between the two Mill Green groups although the 1967 samples all have higher F3 scores than the Harding's Farm samples. As with the Axe Street samples, there is no indication of a difference in composition between the MG and MGCOAR samples from either site. The Axe Street samples are closer in composition to the Noak Hill samples than to the Mill Green samples.

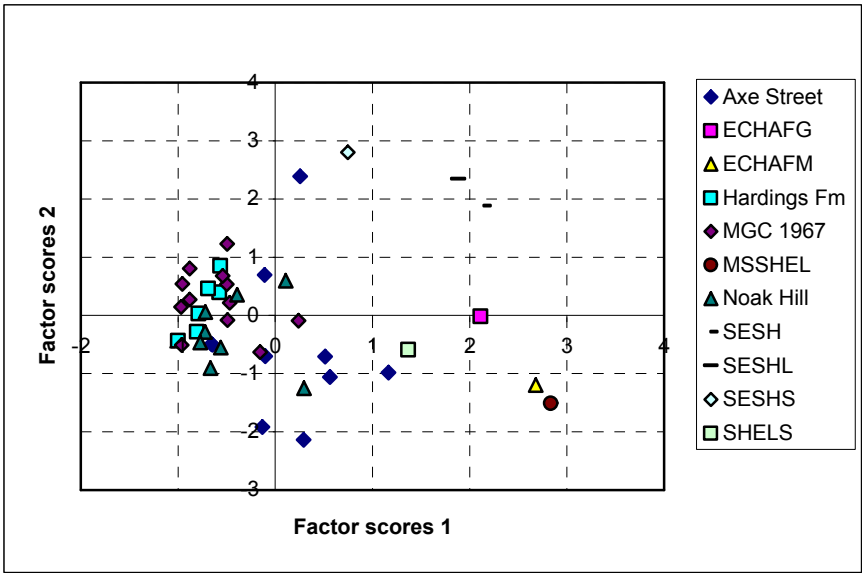

Figure 1

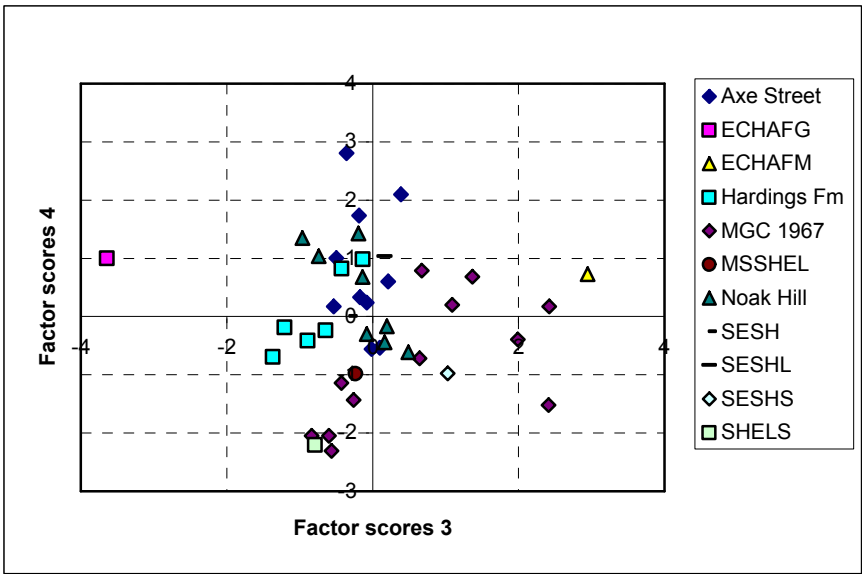

Figure 2

Discussion and Conclusions

The thin section and chemical analyses indicate that the Axe Street Mill Green ware probably comes from a single source, with the same clay being used for the sand-tempered jars as for the glazed wares. It also suggests that Mill Green itself is not the source of the Axe Street pottery, which is more likely to come from Noak Hill.

This result is consistent with the distance of Barking from Noak Hill and Mill Green. All three sites lie close to the London-Colchester road, which was undoubtedly used for transport of the pottery. Mill Green lies about 10 miles from Barking whilst Noak Hill is closer, being about 6 miles as the crow flies.

However, Mill Green vessels almost certainly occur in the city of London (Pearce et al. 1982) but appear to have ignored Barking in favour of the larger and richer market in the city.

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Appendix 1. ICPS Data for Major elements. Axe Street MG

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4520	13.13	5.97	1.69	0.42	0.37	2.53	0.82	0.10	0.026
V4513	15.46	7.99	1.60	1.54	0.40	2.69	0.71	2.56	0.032
V4517	16.62	8.12	1.49	0.52	0.44	2.81	1.03	0.47	0.020
V4518	14.48	7.33	1.15	1.38	0.40	2.33	0.66	2.37	0.017
V4512	16.43	8.32	1.59	0.72	0.56	3.28	1.03	0.20	0.028
V4519	14.55	6.88	1.26	1.14	0.51	2.80	0.90	0.80	0.021
V4521	12.71	6.65	1.12	0.80	0.36	2.22	0.72	0.64	0.025
Mean	14.77	7.32	1.41	0.93	0.43	2.67	0.84	1.02	0.024
SD	1.51	0.87	0.23	0.43	0.07	0.35	0.15	1.02	0.005

Appendix 2 ICPS Data for Major elements. Axe Street MGCOAR

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4514	13.43	6.78	1.03	1.53	0.42	2.25	0.62	2.71	0.017
V4515	14.75	7.23	1.23	1.14	0.48	2.48	0.82	1.19	0.069
V4516	13.37	6.71	1.22	0.72	0.41	2.29	0.75	0.31	0.022
Mean	13.85	6.91	1.16	1.13	0.44	2.34	0.73	1.40	0.036
SD	0.78	0.28	0.11	0.41	0.04	0.12	0.10	1.21	0.029

Appendix 3 ICPS Data for Major elements. Harding's Farm MG

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TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4580	15.80	7.25	1.44	0.34	0.34	2.55	0.87	0.12	0.017
V4579	17.47	8.10	1.90	0.33	0.38	2.93	0.92	0.10	0.030
V4578	16.34	7.64	1.38	0.32	0.39	2.71	0.97	0.11	0.016
V4577	17.67	8.16	1.81	0.32	0.40	3.07	1.07	0.12	0.027
V4576	15.90	7.41	1.37	0.30	0.36	2.59	0.86	0.11	0.019
V4581	16.46	7.40	1.44	0.39	0.35	2.56	0.89	0.15	0.017
Mean	16.61	7.66	1.56	0.33	0.37	2.74	0.93	0.12	0.021
SD	0.79	0.39	0.23	0.03	0.02	0.22	0.08	0.02	0.006

Appendix 4 ICPS Data for Major elements. 1967 Mill Green MG

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4566	17.03	9.33	1.64	0.24	0.46	2.75	1.09	0.13	0.020
V4569	16.18	8.41	1.63	0.25	0.42	2.77	1.00	0.40	0.053
V4565	16.70	8.56	1.68	0.18	0.36	2.97	1.17	0.12	0.027
V4567	17.07	8.49	1.67	0.28	0.41	2.91	0.98	0.08	0.021
V4568	15.90	9.42	1.35	0.35	0.41	2.50	0.98	0.15	0.022
V4564	15.78	9.11	1.44	0.21	0.38	2.70	1.12	0.20	0.027
Mean	16.44	8.89	1.57	0.25	0.41	2.77	1.06	0.18	0.028
SD	0.57	0.45	0.14	0.06	0.03	0.17	0.08	0.11	0.012

Appendix 5 ICPS Data for Major elements. 1967 Mill Green MGCOAR

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4563	15.99	7.84	1.59	0.27	0.51	2.79	1.00	0.16	0.025
V4559	15.93	7.96	1.50	0.31	0.35	2.62	0.88	0.16	0.022
V4562	16.72	7.93	1.83	0.38	0.29	2.95	0.96	0.19	0.029
V4561	16.19	7.74	1.78	0.28	0.35	2.73	0.90	0.11	0.025
V4560	17.71	8.59	1.76	0.28	0.36	2.67	1.03	0.08	0.022
V4558	17.60	8.64	1.72	0.40	0.40	2.85	0.99	0.08	0.026
SD	0.80	0.39	0.13	0.06	0.07	0.12	0.06	0.05	0.003

Appendix 6 ICPS Data for minor and trace elements (ppm) Axe Street MG

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4512	442	119	21	62	52	18	97	174	22	82	38	59	39	8	1	4	3	178	92	20
V4513	484	108	31	42	57	17	201	146	27	73	33	60	35	7	1	5	3	4,904	160	17
V4517	402	119	27	56	40	19	89	163	21	95	37	56	38	6	1	3	2	900	83	16
V4518	380	107	32	31	35	16	161	144	16	72	28	42	29	3	1	3	2	124	91	13
V4519	422	112	20	42	29	16	110	144	14	87	29	43	29	4	1	2	2	975	71	13
V4520	321	94	21	67	53	15	71	133	29	74	38	70	40	7	1	5	2	516	76	20
V4521	367	85	26	39	47	13	107	113	20	67	32	51	33	6	1	3	2	274	86	16
Mean	403	106	25	48	45	16	119	145	21	79	34	54	35	6	1	4	2	1,124	94	16
SD	53	13	5	13	10	2	45	20	5	10	4	10	5	2	0	1	0	1,700	30	3

Appendix 7 ICPS Data for minor and trace elements (ppm) Axe Street MGCOAR

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4514	412	97	35	29	34	15	245	125	17	71	25	42	26	4	1	3	2	220	106	12
V4515	441	108	27	43	53	16	158	131	25	87	37	64	39	8	1	4	3	87	91	18
V4516	339	85	26	43	37	15	89	118	16	70	30	49	31	4	1	3	2	189	77	15
Mean	397	96	29	38	41	15	164	125	19	76	31	52	32	5	1	3	2	165	91	15
SD	53	12	5	8	10	1	78	7	5	10	6	11	7	2	0	1	0	69	15	3

Appendix 8 ICPS Data for minor and trace elements (ppm) Harding's Farm MG

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4576	356	126	23	58	35	17	69	140	17	85	33	62	34	5	1	3	2	282	69	13
V4577	395	158	27	67	47	19	82	180	22	99	41	81	42	8	1	4	3	139	92	18
V4578	423	148	27	61	40	18	58	171	18	101	31	58	32	6	1	3	2	1,161	77	15
V4579	357	146	27	78	52	19	76	161	20	83	40	82	41	8	1	4	2	164	95	18
V4580	389	135	26	70	47	17	53	159	17	83	27	50	28	6	1	3	2	1,118	84	16
V4581	409	131	26	70	43	17	64	157	17	85	28	52	29	5	1	3	2	256	84	14
Mean	388	141	26	67	44	18	67	161	19	89	33	64	34	6	1	3	2	520	84	16
SD	27	12	2	7	6	1	11	14	2	8	6	14	6	1	0	0	0	483	10	2

Appendix 9 ICPS Data for minor and trace elements (ppm) 1967 Mill Green MG

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4558	388	105	25	74	58	18	77	178	22	57	37	78	38	8	1	3	2	44	85	18
V4559	359	93	24	58	46	17	65	132	20	52	35	74	36	7	1	3	2	48	85	16

V4560	332	110	27	73	44	19	70	164	20	66	37	73	37	7	1	3	2	93	90	15
V4561	352	98	27	76	48	18	72	163	22	61	38	84	39	9	1	3	3	45	85	18
V4562	364	100	23	55	45	18	74	175	22	71	37	80	38	8	1	3	3	66	89	17
V4563	354	125	28	64	37	19	72	155	19	71	35	73	35	7	1	2	2	180	80	15
Mean	358	105	26	67	46	18	72	161	21	63	37	77	37	8	1	3	2	79	86	17
SD	18	11	2	9	7	1	4	17	1	8	1	4	1	1	0	0	0	53	4	1

Appendix 10 ICPS Data for minor and trace elements (ppm) 1967 Mill Green MGCOAR

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4564	382	147	27	47	48	18	70	167	28	73	43	101	44	10	2	4	3	126	99	21
V4565	410	165	29	69	43	19	86	185	26	76	52	113	52	10	1	4	3	93	83	18
V4566	369	146	30	61	39	21	74	168	21	70	38	80	38	8	1	3	2	99	85	15
V4567	367	126	26	73	40	20	76	176	24	65	40	82	40	8	1	3	3	51	80	16
V4568	423	116	34	65	74	18	52	185	22	63	29	71	30	7	1	3	3	238	88	20
V4569	410	135	30	64	43	19	74	165	22	74	42	93	43	8	1	4	2	141	84	17
Mean	394	139	29	63	48	19	72	174	24	70	41	90	41	8	1	3	3	125	87	18
SD	24	17	3	9	13	1	11	9	3	5	7	15	7	1	0	1	0	64	7	2