

## Chemical Characterisation of Anglo-Scandinavian Lincoln Kiln-type Ware (LKT)

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As part of a survey of the Anglo-Saxon pottery of northern England, funded by English Heritage, a series of chemical analyses were carried out of samples of pottery from the East Midlands of types which were traded to Yorkshire between the late 9<sup>th</sup> and the mid 11<sup>th</sup> centuries. These samples consist of Torksey ware, from production sites excavated by M Barley; Shelly ware from the Silver Street kiln in Lincoln; sandy and gritty wares produced in Lincoln (LG and LSLS, Young and Vince 2006) and Stamford ware from production sites or waste dumps at Pantiles and Wharf Road, Stamford. This report describes the analysis of the Silver Street kiln waste (Young 1989; Miles and Wachter 1989; Woods 1989).

Six samples were selected from the Silver Street waste and analysed using Inductively-Coupled Plasma Spectroscopy at Royal Holloway College, London under the supervision of Dr J N Walsh.

### Chemical analysis

A range of major elements was measured and expressed as percent oxides (App 1) and a range of minor or trace elements were measured as parts per million (App 2).

Mean values and standard deviations were then calculated for each element.

The data were then compared with analyses of various mid Saxon, Anglo-Scandinavian and Medieval shelly wares from the east midlands and northern England (Table 1). These samples form three groups: those wares for which there is evidence for their production in Lincoln or its suburbs (LKT, LSH and LSLOC), earlier, handmade shelly ware (ELFS) and later handmade shelly ware (LFS).

cname	Name	Comments	locality	Total
ELFS	Early Lincolnshire Fine-Shelled ware	Young and Vince 2006, 37	Flixborough	5
			York	1
LFS	Lincolnshire Fine-Shelled ware	Young and Vince 2006, 81-8	Barton-upon-Humber	5
			Beverley	6
			Doncaster	3
			Tickhill	3
			Warmsworth	1
			York	1
LKT	Lincoln Kiln-type ware	Young and Vince 2006, 47-62	Flixborough	1
			Lincoln	6
			Market Weighton	1
LSH	Lincoln Late Saxon	Young and Vince	Beverley	1

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	Shelly ware	2006, 56-62	Melton	2
LSLOC	Lincoln Local Late Saxon fabric	Young and Vince 2006, 65-69	Beverley	1

The data were normalised to aluminium and factor analysis carried out using WinStat for Excel. Elements associated with shell or post-depositional concretions were omitted (calcium, strontium, phosphorus and the rare earth elements). Zirconium was also omitted because it was not possible to complete dissolve the zircon crystals which contain the zirconium. Three factors were found and bi-plots were produced of Factor 1 versus Factor 2 (Fig 1) and Factor 1 versus Factor 3 (Fig 2). The two plots indicate that the Lincoln-made samples form a separate group, distinguished by negative F1 scores, and the two handmade shelly wares are separated through their F2 scores. The Market Weighton, Flixborough, Beverley and Melton sample all plot with the Silver Street samples.

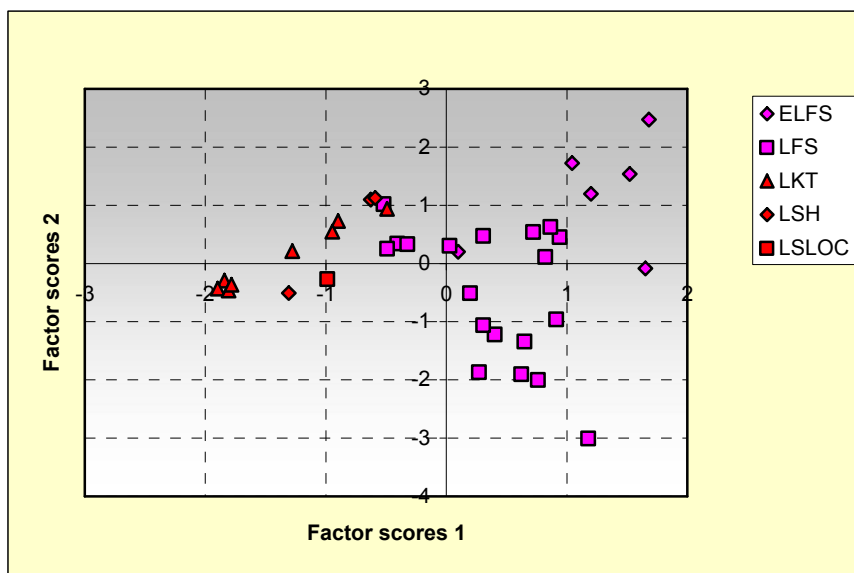


Figure 1

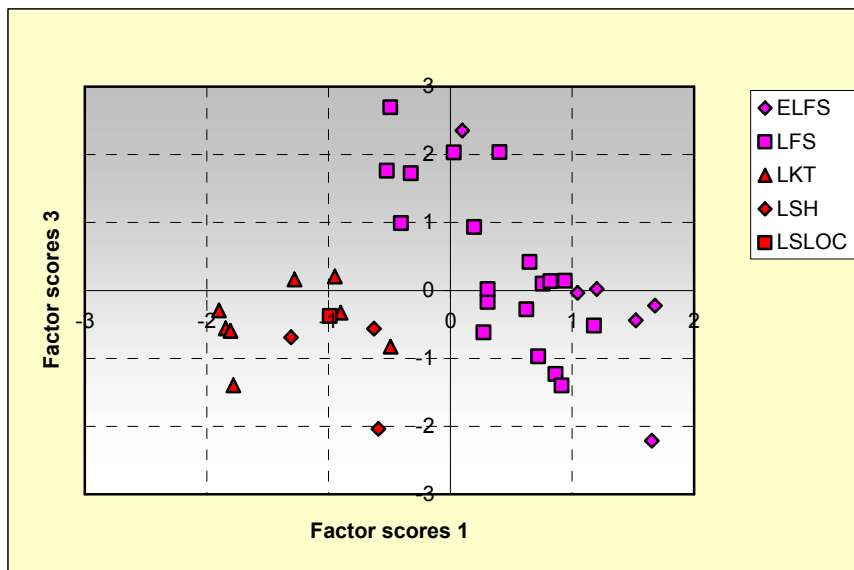


Figure 2

### Discussion

The chemical analysis clearly separates three groups: the handmade ware produced before pottery production started in Lincoln; the Lincoln-made wares and the handmade ware produced contemporary with and after the cessation of the production of shelly ware in Lincoln. Most of the sampled sherds of LFS are probably of post-conquest date.

### Conclusions

The Silver Street samples have similar chemical compositions to samples of Lincoln shelly wares from Beverley, Melton and Market Weighton, all in East Yorkshire. They confirm that Lincoln products were traded north of the Humber. The dissimilarity of the two handmade shelly wares, both of which occur in Lincoln, to the Lincoln products indicates that their sources were elsewhere. This is an important result, both for the history of the East Midlands pottery industry and because these three groups (Lincoln shelly wares; LFS and ELFS) are identical in appearance in thin section (Vince in Young and Vince 2006).

### Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4001	18.18	6.41	1.21	14.81	0.25	2.72	0.76	0.22	0.04
V4002	16.23	5.67	1.15	15.07	0.23	2.76	0.63	0.18	0.04
V4003	17.44	5.43	1.22	14.09	0.23	2.96	0.72	0.18	0.04
V4004	17.96	5.64	1.30	16.31	0.23	2.68	0.74	0.17	0.04
V4005	15.40	5.26	1.04	15.82	0.18	2.18	0.59	0.52	0.04
V4006	17.99	6.07	1.06	14.64	0.22	2.40	0.75	0.33	0.03
Mean	17.20	5.75	1.16	15.12	0.22	2.62	0.70	0.27	0.04
SD	1.13	0.42	0.10	0.81	0.02	0.28	0.07	0.14	0.00

## Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4001	310	90	31	92	46	16	342	90	16	62	42	75	42	7	1	3	2	12	102	14
V4002	271	95	27	69	47	15	268	91	21	61	37	73	38	7	1	4	2	18	93	13
V4003	302	83	29	92	49	16	270	85	23	64	41	77	42	8	1	3	3	16	97	15
V4004	313	85	28	105	49	16	309	96	20	63	39	73	40	8	1	3	2	17	92	15
V4005	307	74	27	68	64	15	281	87	33	67	39	92	42	10	2	6	3	18	117	15
V4006	330	98	26	104	35	15	267	101	16	67	41	69	41	6	1	2	2	19	78	12
Mean	306	88	28	88	48	16	290	92	22	64	40	77	41	8	1	3	2	17	97	14
SD	19	9	2	16	9	1	30	6	6	3	2	8	2	1	0	1	0	3	13	1

## Bibliography

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