Chemical analysis of floor tiles from Blanket Row, Hull

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Summary

The chemical composition of medieval floor tiles from Blanket Row, Hull were compared with examples from previous excavations in Hull, York and Launceston Castle, Cornwall. The Blanket Row tiles could be grouped into at least three groups. One of these consisted of 'Flemish' floor tiles, typologically identical to tiles found along the east and south coasts of England (Group 1). The second consisted of plain white-slipped tiles covered with a mottled green glaze (Group 2). Typologically these tiles are similar to the Flemish tiles, but much thinner. The third group consisted of a single tile with a two-colour decoration typical of the Nottingham tilery (Group 3). All three groups have distinct chemical compositions but the chemical composition alone does not indicate the source of any of the groups.

Introduction

A sample of medieval floor tiles from an excavation at Blanket Row, Hull, were selected and submitted for study by Dr J Stopford, University of York. Alongside these, comparanda from Hull and York were submitted (Table 1). The tiles were visually classifiable into three main groups:

Table 1

TSNO	Group	Sitecode	Context	Cname	Form	Action	Description
V757	1	bhw98	116	Flemish	Floor	pts;icps	plain
V758	1	bhw98	116	Flemish	Floor	pts;icps	plain
V759	1	bhw98	116	Flemish	Floor	pts;icps	plain
V760	1	bhw98	116	Flemish	Floor	pts;icps	plain
V761	1	bhw98	116	Flemish	Floor	pts;icps	plain
V762	2	bhw98	337	Flemish	Floor	pts;icps	ns pg
V763	3	bhw98	56	Nottingham	Floor	pts;icps	decorated (Whitcomb) frag
V764	2	bhw98		Flemish	Floor	pts;icps	
V765	1	bhw98	2277	Flemish	Floor	pts;icps	plain
V766	2	HB73/6		Flemish	floor	pts;icps	NS P-G;Phase 4e
V767	2	YORYM:1977.13		Flemish	Floor	pts;icps	NS P-G

Group 1: a series of thick, oxidised red earthenware tiles, some retaining a white slip and others either plain and lead-glazed or so worn than surfaces were not visible. Visually, the appearance of the tiles, the colour, and the texture of the fine, silty fabric are characteristic of Flemish floor tiles, as is the presence of nail holes on the upper surface of some of the tiles, in some of the corners. In many Flemish tiles only two opposing corners have these nail holes but in one of the submitted samples it seems that not only was there a nail hole in

each corner but also a central hole (sample V761). One of the tiles (sample V759) has a lighter coloured body which, on closer examination, is seen to be due to mottling. Sample V761 has a similar, though less pronounced mottling. This is often a feature of calcareous bodies when fired in the presence of salt (NaCl).

Group 2: a series of thin tiles with reduced cores and oxidised sides and bases. The lack of oxidation under the white slip and copper-mottled lead glaze indicates that the tiles were fired once, whereas Flemish tiles were almost certainly fired first as unglazed biscuit and then again when glazed. The texture of the fabric is similar to that of Group 1.

Group 3 is a single high-fired red earthenware tile bearing a thin white slip pattern. This pattern is similar to those found on tiles produced at Nottingham and widely traded down the Trent valley and into Yorkshire. The fabric, visually, is also similar to that of Nottingham products and it is likely that this tile was indeed produced in Nottingham.

These samples were compared with previously analysed tiles from Launceston Castle, which appear to be from a single, late medieval Flemish tile pavement (Samples V743-748) and four samples of visually-different tile types found at Holy Trinity Goodramgate, York (Vince 1998).

Methodology

Each tile was sampled using the same protocol: a vertical slice through the tile was taken for thin-section and at the same time an offcut was obtained for chemical analysis. The latter was mechanically ground so as to remove all surfaces and margins, either original or secondary breaks. In this way contamination of the sample through burial was minimised. Experience has shown, however, that with porous earthenwares it is impossible to completely remove contamination, since phosphatic, calcareous or other salts can be deposited in the pores whilst with lead glazed vessels the glaze often etches deep into the body, along cracks and pores. The cleaned chemical samples were then crushed and ground to a fine powder and submitted to the Department of Geology at Royal Holloway College, London for Inductively Coupled Plasma Spectroscopic analysis (ICP-AES).

Analysis

The following major elements were analysed: AL2O3, FE2O3, MGO, CAO, NA2O, K2O, TIO2, P2O5, MNO. The Group 3 sample was clearly distinguished from the remainder by most of its major chemical elements (high Al_2O_3, Fe_2O_3, TiO and low MgO, CaO and Na_2O). The values for Groups 1 and 2 overlapped although the median values for each element were different, usually by more than one standard deviation (Table 2)

Table 2

Oxide	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
Gp 1 mean	11.58	4.28	1.55	2.88	0.83	2.31	0.50	0.19	0.07
Gp 1 SD	1.48	0.63	0.21	0.63	0.03	0.25	0.07	0.04	0.01
Gp 2 mean	13.21	4.85	1.30	0.48	0.50	2.66	0.66	0.08	0.01
Gp 2 SD	0.64	0.17	0.09	0.09	0.05	0.14	0.03	0.03	0.01

The most striking differences are in the frequencies of CaO, MnO and P2O5, all three of which are mobile elements that might be present as a result of post-burial contamination.

The following minor and trace elements were measured as parts per million: BA, CO, CR, CU, LI, NI, SC, SR, V, Y, ZN, ZR*, LA, CE, ND, SM, EU, DY, YB. The values of most of these elements are higher in Group 1 than in Group 2, which tends to suggest a higher silt content in Group 1, all other factors being equal. Exceptions are Zr and V. Zr is present mainly in zircon, an accessory mineral common in detrital sands. This difference is greater than one standard deviation. These analyses therefore are probably partly explained by differences in texture between the two groups of tiles.

The minor and trace elements in the Group 3 sample tend to be at the extreme ends of the measured values. For Ba, Co, LI, Sc, Ce and Nd they are higher than the remaining samples. For Cu, Zr and Dy the values are intermediate between Group 1 and Group 2. However, the values are not markedly different and it is likely that if further samples were taken of Group 3 tiles they would be found to overlap with the values found for the other two groups.

Table 3

Element	BA	CO	CR	CU	LI	NI	SC	SR	V
Gp 1 mean	385.17	10.50	68.50	24.00	54.83	42.00	9.83	129.83	60.00
Gp 1 SD	27.82	1.64	10.07	3.35	8.95	6.10	1.33	8.61	12.96
Gp 2 mean	291.00	13.00	91.25	18.25	47.50	35.25	12.50	79.00	112.50
Gp 2 SD	8.76	1.41	7.37	2.22	4.80	5.74	1.00	7.07	5.26

Table 4

Element	ZN	ZR*	LA	CE	ND	SM	EU	DY	YB
Gp 1 mean	78.33	33.33	32.33	59.17	28.29	5.45	1.14	3.62	1.65
Gp 1 SD	8.59	3.78	3.44	7.31	3.19	0.27	0.21	0.48	0.22
Gp 2 mean	60.25	53.50	28.75	52.00	25.03	3.94	0.86	2.30	1.50
Gp 2 SD	7.41	5.92	2.63	6.06	2.01	0.63	0.16	0.40	0.22

Principal components analysis

The Hull (and comparanda) data were analysed statistically using Principal Components Analysis (PCA). In this method, the similarity of samples is reduced to a two-dimensional value capable of being displayed on a graph. Up to fourteen Components can be calculated, each consisting of a series of weightings assigned to each element. The value and sign of each weighting helps determine the position of any particular sample on the graph. The Hull data were included in a PCA along with the samples of Flemish tiles from Launceston and the four samples of Holy Trinity Goodramgate tiles. A plot of PC1 versus PC2 showed that Groups 1, 2 and 3 were clearly separated clusters. The Launceston Castle samples plot at one end of the Group 1 cluster and the Goodramgate samples formed outliers to these clusters, with AG493 and AG496 being similar to each other and separated from the remaining samples The other two Goodramgate samples plotted close to Groups 1 and Group 2 respectively but a second graph, plotting PC3 versus PC1 shows that these two samples are in fact separable from the Hull groups through their PC3 values (which depend mainly on high negative Cu and CaO and high positive Eu and Yb values).

The Group 1 tile with a variegated groundmass (V759) plots some way from the other Group 1 samples, with sample V761, with the similar but less obvious mottled groundmass plotting midway between this sample and the remainder of the Group 1 samples. Given the tight clustering of the Launceston castle samples, which are interpreted as being produced from the same batch of clay, it can be suggested that the four remaining Group 1 samples are also tiles from a single pavement with V761 and V759 being either samples from a single, second pavement or two pavements. The Group 2 samples also show some internal structure within their cluster. The two Blanket Row samples, and the other Hull sample (V766) plot close together and the sample from the Bedern in York (V767) is further apart. This pattern is even clearer when PC3 is considered. The York sample has a negative PC3 value and the Hull samples have positive values. Whether the tiles from the two Hull sites could have been produced as a single consignment is a question which can only be considered further through knowledge of the archaeological context.

Acknowledgements

Peter Hill prepared the samples and Dr N Walsh at the Dept of Geology, Royal Holloway College undertook the ICPS analyses.

Bibliography

Vince, Alan 1998 *Petrological analysis of medieval and later ceramic floor tiles from Holy Trinity Goodramgate, York* Unpublished report for On Site Archaeology

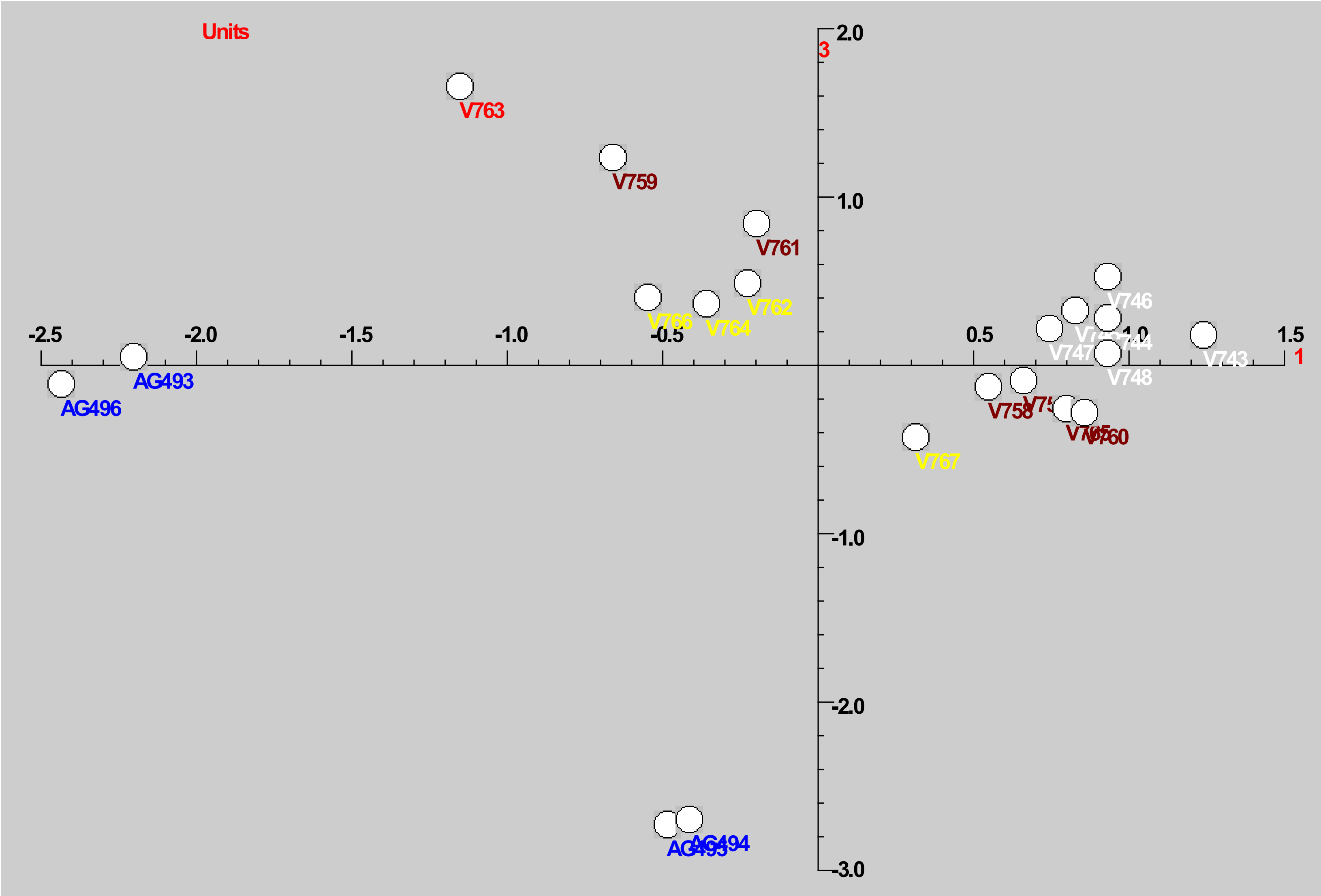

Figure 1 PCA Plot of PC1 versus PC3

Major elements (percentage oxides)

TSNO	AL2O3	FE2O3	MGO	CAO	NA2O	K2O	TIO2	P2O5	MNO
V757	10.85	4.06	1.50	2.77	0.82	2.13	0.46	0.20	0.07
V758	11.04	4.08	1.54	3.88	0.82	2.17	0.46	0.18	0.07
V759	14.11	5.31	1.93	3.22	0.80	2.72	0.61	0.19	0.07
V760	10.29	3.70	1.29	2.92	0.79	2.06	0.45	0.16	0.06
V761	12.61	4.76	1.58	2.31	0.84	2.30	0.54	0.16	0.09
V762	12.81	4.66	1.31	0.52	0.55	2.64	0.65	0.07	0.01
V763	14.82	8.14	1.05	0.23	0.18	2.50	0.72	0.07	0.04
V764	13.70	4.96	1.35	0.51	0.46	2.71	0.68	0.11	0.01
V765	10.56	3.74	1.45	2.16	0.88	2.47	0.45	0.27	0.06
V766	13.80	5.02	1.38	0.53	0.53	2.81	0.68	0.05	0.02
V767	12.52	4.74	1.17	0.34	0.44	2.47	0.61	0.07	0.01

Minor and trace elements (ppm)

TSNO	BA	CO	CR	CU	LI	NI	SC	SR	V	Y	ZN	ZR*	LA	CE	ND	SM	EU	DY	YB
V757	382.00	10.00	64.00	25.00	50.00	40.00	9.00	132.00	51.00	18.00	84.00	32.00	29.00	54.00	27.23	5.16	1.00	3.40	1.60
V758	368.00	10.00	72.00	22.00	52.00	40.00	9.00	134.00	59.00	19.00	72.00	32.00	31.00	55.00	27.12	5.35	1.10	3.40	1.60
V759	429.00	13.00	70.00	27.00	70.00	51.00	12.00	143.00	83.00	24.00	90.00	39.00	37.00	69.00	32.78	5.61	1.43	4.40	2.00
V760	350.00	9.00	61.00	19.00	50.00	37.00	9.00	120.00	48.00	18.00	66.00	30.00	29.00	53.00	26.08	5.58	1.02	3.30	1.40
V761	404.00	12.00	86.00	23.00	61.00	48.00	11.00	129.00	66.00	21.00	81.00	37.00	36.00	68.00	31.69	5.84	1.36	4.00	1.80
V762	284.00	13.00	100.00	19.00	42.00	38.00	13.00	70.00	120.00	13.00	59.00	57.00	27.00	49.00	25.48	3.70	0.87	2.50	1.70
V763	447.00	15.00	84.00	21.00	72.00	47.00	14.00	128.00	109.00	14.00	71.00	44.00	36.00	70.00	33.77	5.62	1.29	3.00	1.80

V764	303.00	14.00	82.00	15.00	52.00	36.00	13.00	87.00	112.00	12.00	60.00	54.00	31.00	56.00	24.49	4.52	1.05	2.50	1.50
V765	378.00	9.00	58.00	28.00	46.00	36.00	9.00	121.00	53.00	18.00	77.00	30.00	32.00	56.00	24.84	5.16	0.91	3.20	1.50
V766	292.00	14.00	91.00	19.00	51.00	40.00	13.00	81.00	110.00	14.00	70.00	58.00	31.00	58.00	27.47	4.39	0.85	2.50	1.60
V767	285.00	11.00	92.00	20.00	45.00	27.00	11.00	78.00	108.00	9.00	52.00	45.00	26.00	45.00	22.66	3.16	0.66	1.70	1.20

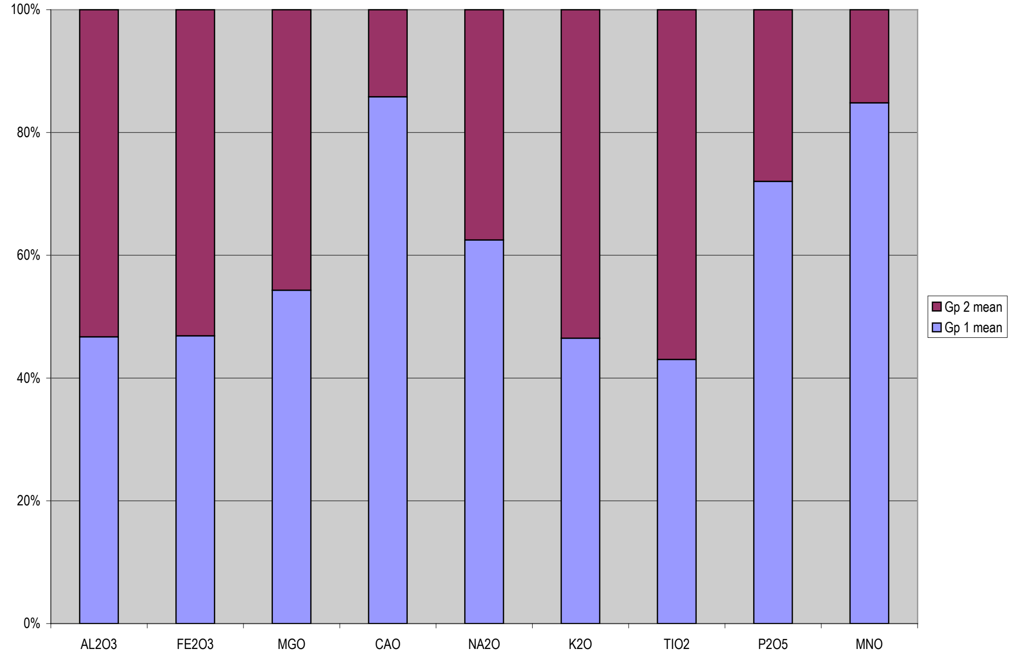

Figure 2 Comparison of mean values for major elements for Groups 1 and 2