Characterisation of Clay Tobacco Pipes produced at Ludlow, Shropshire

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As part of a study of the clay tobacco pipe industry at Pipe Aston, a series of analyses of clay tobacco pipe and other waste from production sites in the village have been analysed using Inductively-Coupled Plasma Spectroscopy (Peacey and Vince 2003). These studies indicate that the earliest production sites known, probably of early to mid 17th-century date, were using a Coal Measures seatearth similar in chemical composition and visual characteristics to that used at Broseley. However, in the second half of the 17th century a different clay was introduced and this was the only clay used in the village from that time until the end of the pipe-making industry in the early to mid 18th century.

The only documentary evidence for the use of pipeclay in the area comes from the manor of Caynham, situated to the southeast of Ludlow, where the sale of the manor specifically mentions the rights to dig pipeclay at Clee Hill, 3-4 miles to the east of Caynham. This reference dates to the first half of the 17th century and suggests that pipemakers were either based at Caynham at that time or that pipeclay was being quarried for sale elsewhere, probably in Ludlow but perhaps also in Pipe Aston.

Prospecting in the Clee Hill area by Allan Peacey and the author showed that deposits of white- and off-white firing clays outcrop over a large area of Clee Hill. Samples of pipeclay from several outcrops were collected, fired and submitted for chemical analysis.

In addition, a series of clay pipes from the Ludlow bypass and from Pipe Aston which are believed to be Ludlow products were analysed.

All the samples were analysed using the same protocol, in which an offcut was taken and all surfaces mechanically removed. The resulting block was then crushed to a fine powder and submitted to Royal Holloway College, London, where a series of major elements were measured as percent oxides (App 1) and a series of minor and trace elements were measured in parts per million (App 2). Silica was not measured but was estimated by subtraction of the total oxides from 100%. The measured element values were normalised to aluminium, and the data were analysed using the WinStat for Excel addin ().

The ICPS data were analysed using factor analysis. This is a quick technique for determining the underlying structure of a multivariate dataset and calculates a series of factors which approximate to the variables in the original dataset. The contribution of each element to each factor is calculated and can be used as a means of finding relationships between elements, which in turn may aid their interpretation.

The Clee Hill clays

Fourteen samples of clay from the Clee Hill area were analysed. Three were from the eastern end of the hill, at Hopton Bank and Clee Hill Quarry (Groups C and D respectively, and the remainder from the western end of the hill, closest to Caynham, at Knowlbury. Several of the Knowlbury clay samples were unfit for use as pipeclays either in colour or texture. The most suitable clays all had a grey colour as dug but fired to light pink, cream or white (Group A) whilst the remaining Knowlbury clays had a yellow colour as dug and fired to a mid salmon or mid pink colour and had a silty, crumbly texture.

Estimated silica contents for these four groups were variable but the mean value for Group A was the lowest, 65.8%, and for Group D was the highest, at 79.1%.

Factor analysis indicated that there were three significant factors in the dataset and a plot of the scores for the first two factors (Fig 1) indicated that the Hopton Bank, Clee Hill Quarry and two of the Gp A samples have high F1 scores whilst the remaining Gp A and all the Gp B samples have negative F1 scores. There is no obvious patterning in the F2 scores.

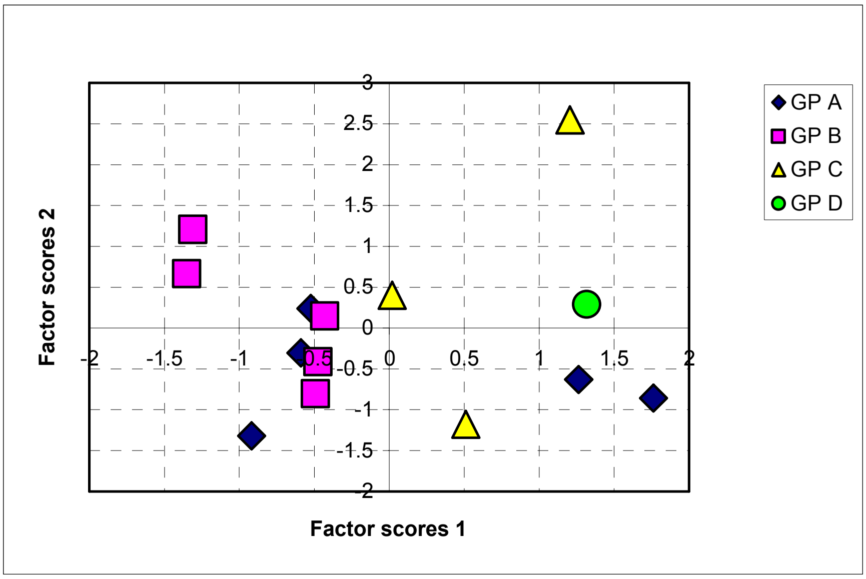

Figure 1

The two high-F1 samples were regrouped as Group A1 and the remaining Group A samples were designated Group A2. A plot of F1 against F3 scores (Fig 2) indicates that the Hopton Bank and Clee Hill Quarry samples have similar F3 scores whilst the Group A2 and Group B samples can be separated by their F3 scores. This suggests that four chemical groups exist within the Clee Hill samples: Group A1, Group A2, Group B and Group C/D.

The main distinguishing characteristics of these four groups are magnesium, scandium, potassium and barium values (all contributing to high F1 scores) and vanadium, iron and copper (all contributing to high F3 scores).

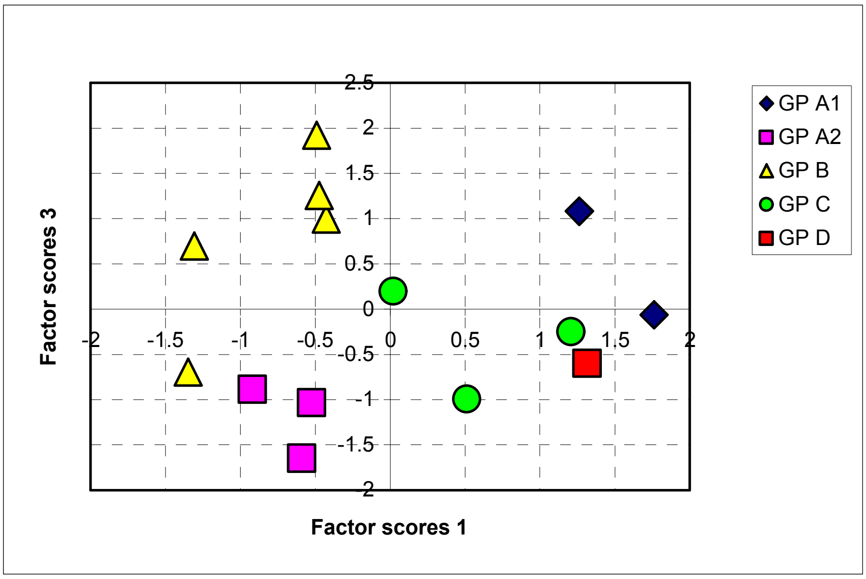

Figure 2

The Ludlow Pipes

Six samples of Ludlow pipes were analysed. Three come from the Ludlow bypass and three from Roy's Orchard, Pipe Aston. The pipes have two different maker's stamps: IA and WV and both of the IA pipes come from the bypass site, as does one of the WV pipes.

Examination at x20 magnification indicates that five have no visible inclusions at all whilst the sixth contains sparse rounded and subangular quartz grains, ranging up to 2.0mm across in an inclusionless groundmass.

Factor analysis of the ICPS data indicates that there are three significant factors. A plot of F1 against F2 scores indicates that the IA pipes have lower F2 scores than the WV pipes and that the sample with the sparse quartz inclusions (stamped WV) has a higher F2 score than the remainder.

The high F2 scores were produced mainly by high weightings for barium, potassium and copper but there are also differences between the three groups of pipes in other elements suggesting that three chemical composition groups are present. However, a much higher number of samples would be required to determine whether these three groups are valid. However, four of the elements also show a correlation with findspot (calcium, chromium, copper and strontium) and this suggests that these four elements may be affected by post-burial alteration. Re-analysis omitting these elements still produces a clear tripartite split, indicating that the difference is not due to burial conditions and may therefore reflect the use of three different batches of clay (Fig 4).

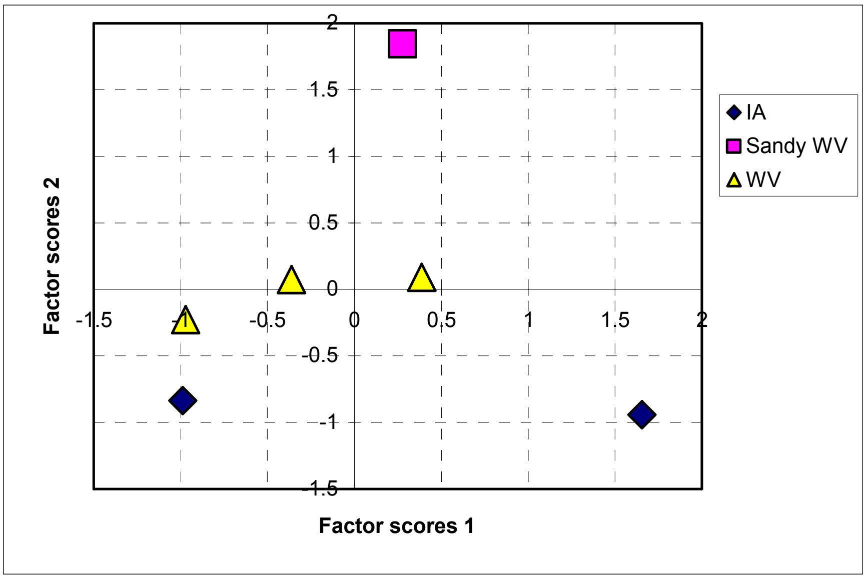

Figure 3

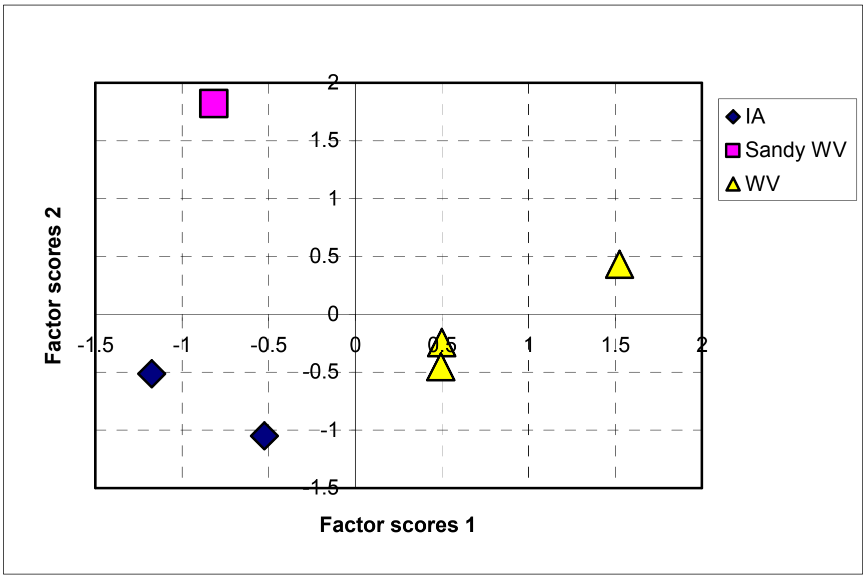

Figure 4

Comparison of Ludlow Pipes and Clee Hill Clays

The ICPS data for the Ludlow pipes and Clee Hill clays was compared using factor analysis and excluding the potentially contaminating elements identified in the analysis of the Ludlow pipes. Three factors were found of which the first and third distinguished the two groups. Fig 5 shows a plot of F1 against F3 scores and indicates that the F1 scores distinguish the eastern Clee Hills samples (and the A1 group from the western side of the hill) from the remainder. The F3 scores distinguish the Group B Clee Hill samples from the Ludlow samples. The analysis shows, however, that the differences between the three groups of Ludlow pipes are much smaller than those between the different groups of Clee Hills clays.

Examination of the data indicates that the F1 scores depend mainly on potassium, magnesium, barium and scandium values. For all of these elements, the Clee Hills samples have higher values than the Ludlow samples. Since all of these values, as used in the analysis, were normalised to aluminium, the aluminium and silica values were compared and the Group A1 and A2 clays were found to have similar aluminium and silica contents to the Ludlow pipes, as might be expected from their visual similarity to pipeclays. If the Clee Hills were the source of the pipeclay used at Ludlow, then a clay source which has so far eluded discovery was being used. It is perhaps more likely that by the time these pipes were being made (the later 17th century) the use of the Clee Hills pipeclay had ceased.

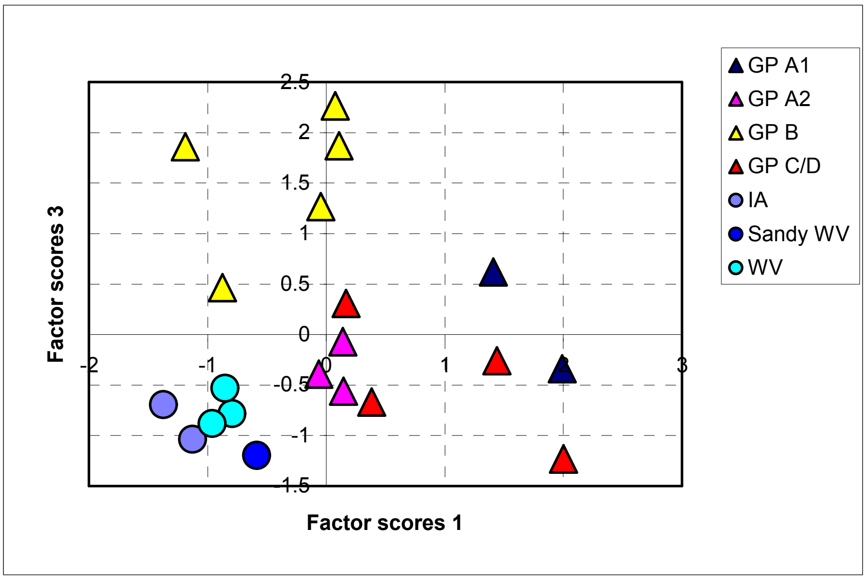

Figure 5

Comparison with Much Wenlock and Broseley Pipes

The ICPS data for the Ludlow pipes and the Clee Hill clays (omitting Group B) was then compared with the data from a series of pipes produced at Broseley and Much Wenlock.

Three factors were found and a plot of the first two factors distinguishes the Ludlow pipes from all of these comparanda. The F1 scores distinguish Ludlow pipes from the remainder and the F2 scores distinguish the Much Wenlock and Broseley pipes from the Clee Hills and Ludlow pipes.

Examination of the data indicates that the Ludlow pipes are distinguished mainly because of their low values for potassium, vanadium, magnesium, barium and scandium.

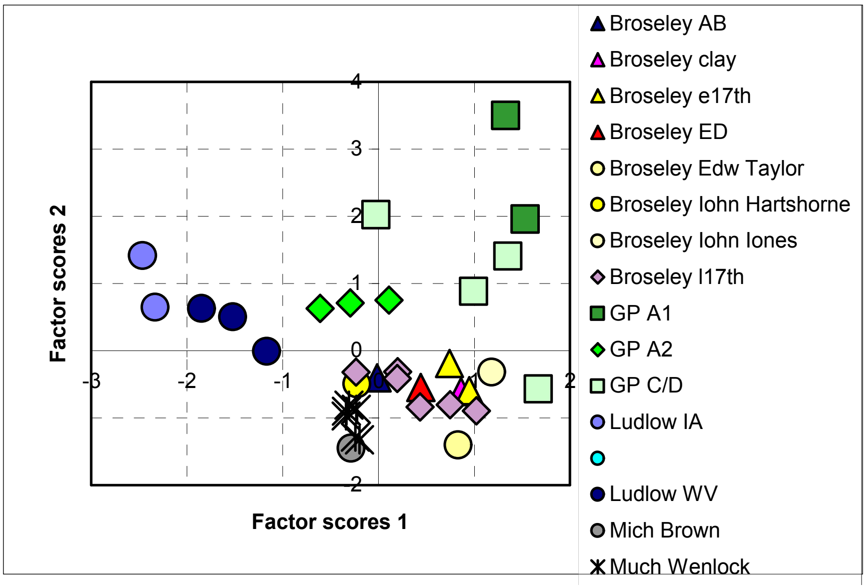

Figure 6

Comparison with Pipe Aston Pipes

Finally, the ICPS data for the Ludlow pipes was compared with that from pipes and other pipeclay artefacts produced at Pipe Aston. These samples come from three production sites: Upper Aston Field – an early 17th-century site; Pipe Aston Farm – a mid-late 17th-century site; and Roy's Orchard – a late 17th and early 18th-century site.

Factor analysis of this dataset indicates that the Upper Aston Field samples have a different composition to both the Ludlow and remaining Pipe Aston samples, so that any patterning in those samples is difficult to see. The analysis was therefore repeated omitting the Upper Aston Field samples.

In this analysis, three factors were found and although there is patterning within the factors scores no separation of Pipe Aston and Ludlow pipes was found. This suggests that the same clay source was being used by both groups of pipemakers.

High Factor 1 scores separate one of the two groups of unmarked wig curlers, a wheel-stamped, early 18th century pipe, two pipes stamped John Barnes and a pipe stamped George Brown from the remainder, although one of three Rose and Crown stamped pipes from Pipe Aston farm also has a high F1 score. Negative F1 scores separate three unmarked Pipe Aston Farm pipes and the other group of wig curlers. The Ludlow pipes have moderate F1 scores, between -1 and 1 and F2 scores between -1.7 and 0.5. Pipe Aston pipes with similar scores include examples marked: CLEMEN MELLARD, JOHN HAMMANS, STEVEN WATKINS, THOMAS EVANS, an unmarked pipe datable to the early 18th century from its mould and two of three unclassified wig curlers.

The unmatched Pipe Aston pipes include examples marked GB, GEORGE BROWN, JOHN BARNS, STEVEN WATKINS, THOMAS EVANS, a wheel-stamped pipe dated by its mould to the early 18th century, the two wig curler groups and the samples from Pipe Aston Farm. These pipes include both mid/late 17th century examples and early 18th century examples and make it clear that the difference between the two groups is not merely chronological. However, the non-matching samples consist of those with extreme scores, both positive and negative, and do not represent a single group. In all likelihood there is a high degree of patterning within this data but in general the compositions of all the Pipe Aston and Ludlow pipes are more similar to each other than they are to Much Wenlock, Broseley or Clee Hills samples and this suggests that they are all produced using pipe clay from the same, unknown, source.

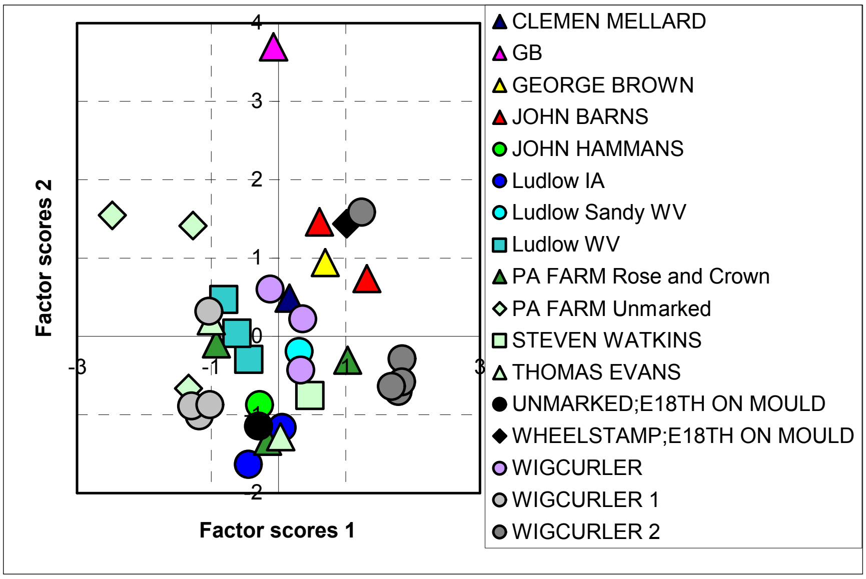

Figure 7

Conclusion

Six samples of pipes made in Ludlow were analysed. They do not appear to have been made from Coal Measures clay from the nearby source of pipeclay at Clee Hill, nor are they made from the same clays as those used at Much Wenlock and Broseley. Instead they match closely the pipes produced in the later 17th and early 18th centuries at Pipe Aston. However, the source of pipeclay used at Pipe Aston remains unknown.

Bibliography

Fitch, Robert K (2001) Winstat for Microsoft (r) Excel.

Peacey, A. and Vince, A. (2003) " Chemical characterization of clay pipes and wig curlers from Roy's Orchard, Pipe Aston, Herefordshire." Post-Medieval Archaeology, 37(2), 207-216

Appendix 1

TSNO	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO
V4213	28.38	1.69	0.38	0.43	0.12	0.96	1.25	0.18	0.015
V4214	29.77	1.55	0.43	0.40	0.16	0.82	1.20	0.11	0.008
V4215	30.47	1.54	0.42	0.38	0.16	0.85	1.30	0.10	0.011
V4216	26.72	1.52	0.29	0.18	0.10	0.57	1.37	0.03	0.013
V4217	29.00	1.79	0.41	0.28	0.12	0.81	1.22	0.03	0.011
V4218	27.47	1.41	0.36	0.27	0.16	0.80	1.26	0.19	0.010

Appendix 2

TSNO	Ba	Cr	Cu	Li	Ni	Sc	Sr	V	Y	Zr*	La	Ce	Nd	Sm	Eu	Dy	Yb	Pb	Zn	Co
V4213	390	89	44	114	86	24	74	105	53	117	63	136	66	16	4	8	4	8	54	23
V4214	286	91	33	120	59	25	59	129	34	112	36	55	38	5	1	5	4	48	47	24
V4215	268	87	39	130	63	24	65	110	38	117	36	60	38	6	1	5	4	46	39	24
V4216	210	93	23	106	43	17	34	57	42	139	47	85	49	10	2	6	4	34	32	18
V4217	230	97	28	120	79	22	48	88	36	114	47	79	48	7	1	4	3	16	37	27
V4218	292	93	23	124	36	22	51	119	42	116	48	86	50	9	2	6	4	28	36	16

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