

## **Characterisation of Pipeclay from Pipe Aston, Herefordshire, and other sites in the west of England**

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In a previous study chemical analysis using Inductively Coupled Plasma Spectroscopy was used to demonstrate that unstamped wig curlers of two forms were a minor product of the clay tobacco pipe production complex at Roy's Orchard, Pipe Aston, Herefordshire. However, a second strand of research, to establish the source of the pipeclay used at this site, was unsuccessful although it did demonstrate that the clay was not likely to have been obtained from clay sources in the parish itself, nor from Peter's Marland (Devon ball clay), Ironbridge Gorge or Hopton Bank. The latter sites are both in Shropshire and probably the closest sources of Coal Measure white-firing clay (Fig. 1).

To investigate the source of the Pipe Aston clay further a second study, using the same methodology, was undertaken. The samples were chosen to answer two main questions:

- Was a single source of pipeclay used throughout the life of the Pipe Aston industry?
- Did the Pipe Aston industry utilise the same sources of supply as contemporary industries in the Severn Valley?

Supplementary questions were also investigated in two instances.

### **The samples**

#### **Pipe Aston Site PA00/1**

The earliest archaeological evidence for pipe production at Pipe Aston found so far was discovered in 2000 on the southern boundary of the parish (Fig. 2). The typology of the waste pipes suggests a date in the 1630-40 bracket (Fig. 3). At present, the site is extremely marginal, situated in a wooded area at some distance from any habitation or routeway. In the mid-17<sup>th</sup> century, however, the site lay just to the south of the main route east towards the Severn valley.

None of the pipes found was marked, nor were there any significant typological variations within the products. On the basis of the small sample it is likely that pipe production was short-lived and probably associated with a single workshop. By contrast, the Roy's Orchard site seems to have been used by several pipemakers, some of whom probably produced their pipes on site whilst others may have made their pipes elsewhere in the parish but brought them to Roy's Orchard for firing.

This earlier site therefore provides an opportunity to answer several questions.

- a) Is the source of clay used the same as at Roy's Orchard?
- b) Can the products of the two sites be distinguished chemically?

- c) Is the variation in composition consistent with the model of a shorter-lived, smaller-scaled enterprise at PA00/1?

### **Pipe Aston Site PA02/1**

The second site at Pipe Aston is in the centre of the parish, on the opposite side of the road to Roy's Orchard. A trial excavation produced waste pipes of two types, one plain and the other with Rose and Crown stamps (Fig 4). The typology of the bowls suggests that this production slightly pre-dates the Roy's Orchard site (or at least, that part which has been investigated so far). The waste came from two layers which merged into one another and the lower layer contained mostly plain bowls and the upper one mostly stamped ones. In addition, study of the pipeclay at x20 magnification shows that the stamped bowls were produced in a clay with appreciably more silt/fine sand than the plain ones.

It seems, therefore, that two separate groups of waste are present on the site although typological evidence shows that they are close in date. The frequency of quartz silt would be affected by levigation or may vary within the pipeclay from a single source. The samples, therefore were chosen so as to include three of each group. If the two groups of waste were produced from chemically distinct clays even such a small sample as this ought to demonstrate this fact whereas if the differences are small or non-existent then this too ought to be clear from this sample. We cannot, however, expect to characterise two distinct but similar clays from such a small sample and therefore the present study can only be considered a preliminary investigation of the material.

### **Broseley**

Six samples were obtained of waste pipes found during excavation of a late 17<sup>th</sup>-century pipe factory at Broseley in 2000 (Sitecode BR00). There was no significant typological or fabric variation in the products from this site. The aim of the sampling, therefore, was simply to characterise the products, compare them with the one sample of Ironbridge Gorge pipeclay analysed in the first study and with the various Pipe Aston groups.

### **Gloucester, Quay Street**

Excavations at Quay Street, Gloucester, in 1979 revealed an isolated pipe kiln for which stratigraphic and typological evidence indicated a mid-17<sup>th</sup> century date, between c.1640 and c.1660 (Site code: 28/79). The pipes are likely to come from a single episode of production but include both spurred and heeled types. Samples of two spurred and four heeled bowls were taken. If the two forms were produced from radically different batches of clay then this might be revealed through this analysis but minor differences in the fabric of the two types cannot be expected to be revealed through this study.

## **Results**

The 24 samples in this study were analysed alongside 29 samples from the first study. The local Pipe Aston clay samples, which turned out to be unsuitable for pipe-making and were very different

chemically from the wig curlers, pipes and pipeclays were omitted from this study since they tended to mask differences within those samples. Principal Components Analysis (PCA) was used to study the full dataset (Fig 6).

PC1, the component which accounted for the majority of the variation within the data, separated the Gloucester samples from the rest, with the two Peter's Marland samples being located in between the Gloucester samples and the remainder. The elements which contribute most strongly to PC1 are K<sub>2</sub>O, Sr, Ba and Na<sub>2</sub>O, which all tend to be higher in the Gloucester samples than in any others. The proximity to the Peter's Marland samples may well be illusory. The Peter's Marland samples, for example, contain a higher Eu count than those from Gloucester so that the ratios of K<sub>2</sub>O/Sr/Ba/Na<sub>2</sub>O to Eu are quite different.

PC2 separates the Hopton Bank and Peter's Marland samples from the remainder. This is due mainly to low values for Sc, Al<sub>2</sub>O<sub>3</sub>, Cr and V. Since these elements are likely to occur in the clay mineral fraction this suggests that the Hopton Bank and Peter's Marland samples contain a higher silica content than the remainder. This is confirmed by estimating the silica content by subtracting the counts for the sum of the measured major elements from 100% (Fig 7). Peter's Marland clays have a silica content of 79-81% and the Hopton Bank samples have between 74 and 76% silica. The Broseley and PA00/1 samples have the lowest silica content, ranging from 58 to 63% for PA00/1 and 62-66% for Broseley.

PC3 separates the non-Gloucester samples into two groups, one of which contains the samples from Broseley, Ironbridge Gorge, Hopton Bank and four of the PA00/1 samples from the remainder. The main contributing elements here appear to be Fe<sub>2</sub>O<sub>3</sub>, MgO and MnO. Since this group contains the four definite Coal Measure clay samples together with the Broseley samples it is likely that the PA00/1 samples too are Coal Measure pipeclays

Finally, PC4 separates the Broseley samples (and the one Ironbridge Gorge clay sample) from the remainder. This component seems to depend mainly on low CaO values together with high Al<sub>2</sub>O<sub>3</sub>, Li and TiO values.

From this initial study we can conclude that the Broseley pipes were made using Coal Measure clay from the Ironbridge Gorge or nearby outcrops. Furthermore, the Gloucester pipes appear to have been made from a completely different source of clay which may or may not include Devon ball clay (but is certainly not identical to the samples from Peter's Marland). It is likely that PA00/1 pipes were made using Coal Measure pipeclay and they are more similar to that from Broseley/Ironbridge Gorge than from Hopton Bank. The source of the remaining Pipe Aston clays remains undetermined

To study the inter-relationships between the different Pipe Aston clays the Gloucester and Broseley pipe samples were excluded, as were the clay samples. The remaining data were analysed twice, once using the full, unaltered dataset ('reduced dataset' for short) and again by trying to take account of the varying silica content by calculating frequency as a percentage of measured elements not the total sample (the 'transformed, reduced dataset').

Analysis of the reduced dataset shows a major separation of the PA00/1 from the remaining samples (Fig 8). This seems to be due to high values for most elements, except for Zr. This is consistent with the PA00/1 samples containing less silica than the remainder. The PA02/1 samples also form a discrete group, but very close to the Roy's Orchard samples (and including one Roy's Orchard sample, V733). The stamped and unstamped pipes from PA02/1 cannot be separated in this analysis using any combination of the first four principal components.

Using the transformed, reduced dataset there is no single principal component which separates the products of the different kilnsites. However, several combinations of components do separate them (Fig 7). A plot of PC1 against PC2 shows that the PA00/1 samples have higher values for PC1 or lower values for PC2 than the remainder. The samples from PA02/1 and Roy's Orchard, however, overlap. This overlap is due entirely to stray samples from Roy's Orchard, all of them pipes rather than wig curlers. This may be due to the presence of pipes from several production sites being present, probably because they were brought to the site to fire. These 'stray' pipes are V725 and V731-3.

The stamped and unstamped pipes from PA02/1 form a single cluster suggesting that despite the visual difference in texture the basic characteristics of the clays are the same, and that a single source of clay was used for both types. This in turn suggests that the two types were produced by the same pipemaker, or that one pipemaker took over the running workshop of another, including the supply of clay.

The pipes from PA00/1 seem to have quite a variable composition although there are pairs of samples which are close, such as V1271 and V1273 and V1272 and V1275. It is possible that the clay used for these pipes is less homogenous than that used at the other two sites. This might be due to a less pure clay being obtained from the clay source or to less effective mixing of the clays at the production site (for example, through hand-working of the clay rather than using a mill or levigation). Or, it might be that more batches of clay were used at the site, but this contradicts the archaeological evidence which suggests that this was quite a small, isolated industry.

The analysis of the reduced, transformed dataset shows that although one of the main differences between the PA00/1 samples and the rest is their relative lack of silica this is not the only difference, so that the clays themselves are chemically distinct.

To conclude, this study has shown that Broseley pipes from the 2000 excavation were produced from local pipeclay and has shown that pipes made in Gloucester in the mid 17<sup>th</sup> century were utilising a quite different source of pipeclay. For Pipe Aston itself, it is likely that the earliest pipes studied, from PA00/1, were produced from a Coal Measure clay which was either less homogenous than that used at the other two sites studied, both of which were later, or was less completely mixed by the pipemakers.

The remaining Pipe Aston samples, from Roy's Orchard and PA02/1, have similar chemical compositions but despite this it is possible to distinguish the samples from the two sites, leaving a few 'stray' samples from Roy's Orchard. It is possible that these strays were pipes made elsewhere in the parish and that they will eventually be shown to match material from other production sites.

## **Bibliography**

Peacey & Vince - [Pipe Aston 1]

Peacey [Quay Street]

Higgins [Broseley]

## **Acknowledgements**

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## Figure Captions

Fig 1. Map showing location of sampled sites

Fig 2. Pipe production sites in Pipe Aston

Fig 3. Pipes from Pipe Aston, PA00/1

Fig 4. Pipes from Pipe Aston, PA02/1

Fig 5. Table showing estimated silica content for sampled pipe groups

Fig 6. PCA plot for PC1 vs. PC2 (full dataset)

Fig 7. PCA plot for PC1 vs. PC2 (reduced dataset)

Fig 8. PCA plot for PC1 vs. PC2 (transformed, reduced dataset)

**Figure 1**

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**Figure 2**

A Peacey to do



**Figure 3**

A Peacey to do

**Figure 4**

A Peacey to do

**Figure 5**

SiO%	A	B	C	D	E	F	G	H
56-58				1				
58-60				1				
60-62			1	3				
62-64			1	1	1			
64-66	2	4			2			
66-68	1				2	4		
68-70	1				2	8		
70-72	1					8		
72-74	1						1	1
74-76							2	2
78-80								1
80-82								1
<b>Grand Total</b>	<b>6</b>	<b>6</b>	<b>1</b>	<b>6</b>	<b>6</b>	<b>23</b>	<b>2</b>	<b>3</b>

Key:

(a) Gloucester Quay Street

(b) Broseley

(c) Ironbridge Gorge

(d) PA00/1

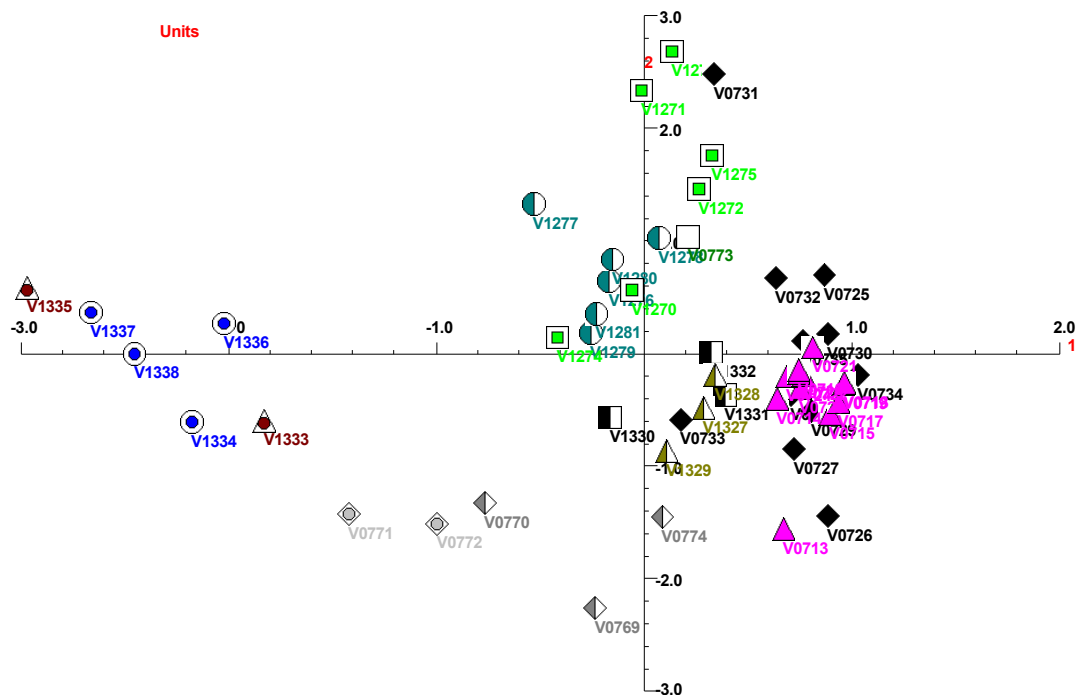
(e) PA02/1

(f) PA95/2

(g) Peter's Marland

(h) Hopton Bank

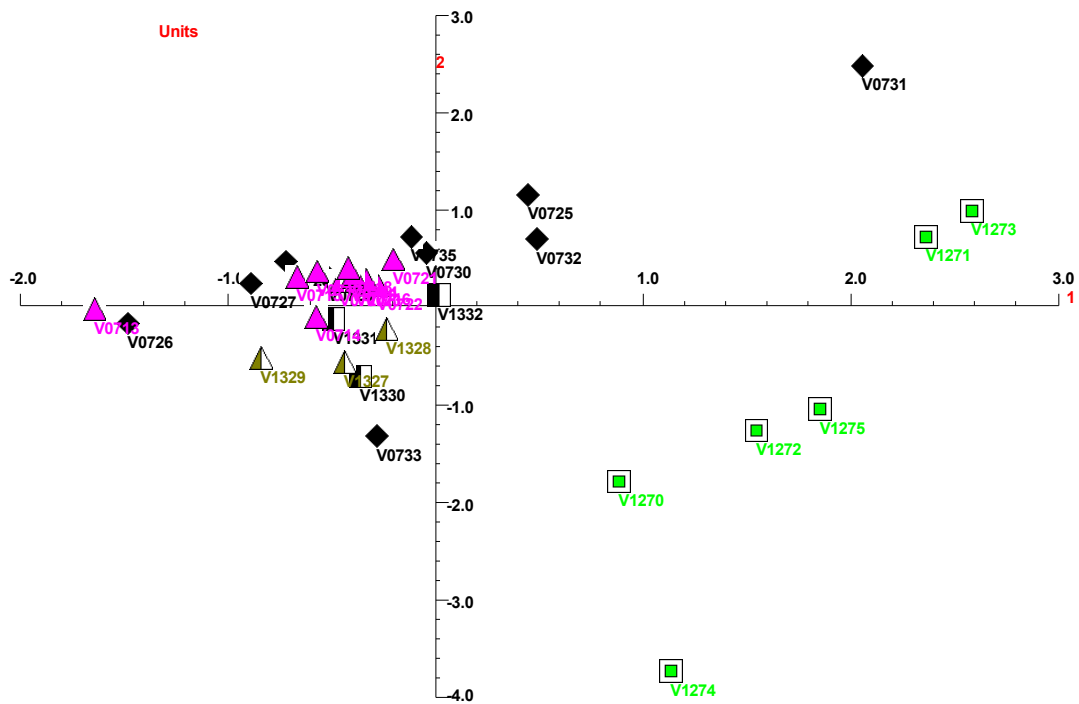
Figure 6



Key:

- Dot in circle: Gloucester Quay Street, heeled bowls
- Dot in triangle: Gloucester Quay Street, spurred bowls
- Dot in diamond: Peter's Marland ball clay
- Half-filled diamond: Hopton Bank
- Half-filled circle: Broseley
- Square in square: Pipe Aston PA00/1
- Unfilled square: Ironbridge Gorge
- Half-filled square: Pipe Aston PA02/1 Unmarked pipes
- Half-filled triangle: Pipe Aston PA02/1. Rose and Crown stamped pipes
- Filled diamond: Pipe Aston, Roy's Orchard pipes
- Filled triangle: Pipe Aston, Roy's Orchard wig curlers

Figure 7



Key:

Square in square: Pipe Aston PA00/1

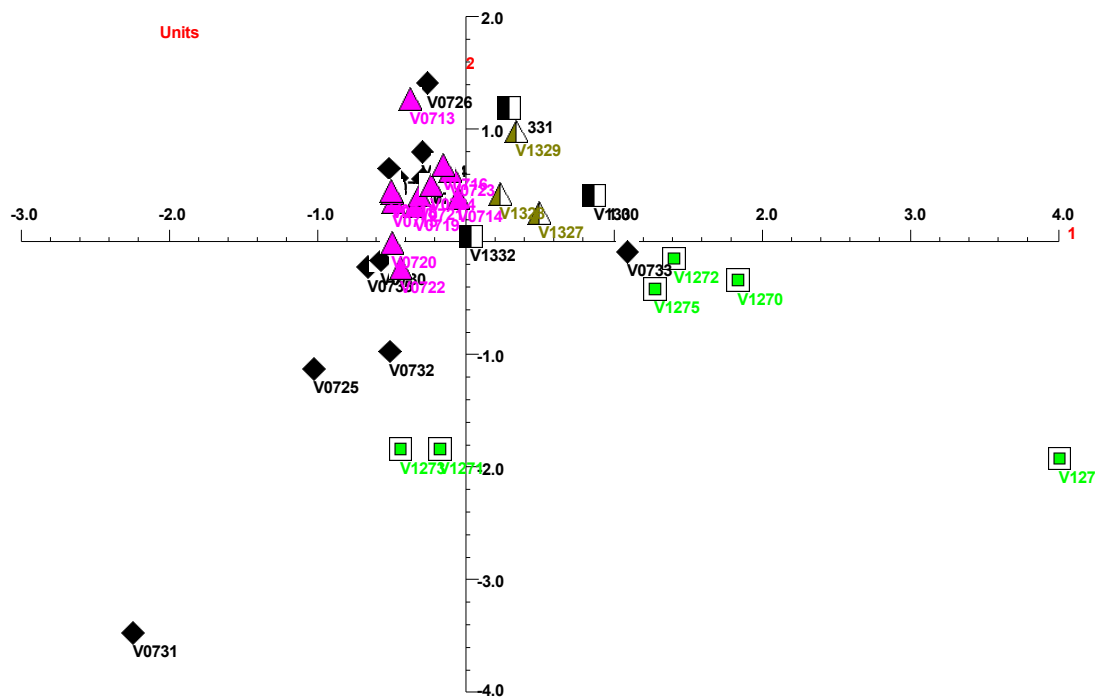
Half-filled square: Pipe Aston PA02/1 Unmarked pipes

Half-filled triangle: Pipe Aston PA02/1. Rose and Crown stamped pipes

Filled diamond: Pipe Aston, Roy's Orchard pipes

Filled triangle: Pipe Aston, Roy's Orchard wig curlers

Figure 8



Key:

Square in square: Pipe Aston PA00/1

Half-filled square: Pipe Aston PA02/1 Unmarked pipes

Half-filled triangle: Pipe Aston PA02/1. Rose and Crown stamped pipes

Filled diamond: Pipe Aston, Roy's Orchard pipes

Filled triangle: Pipe Aston, Roy's Orchard wig curlers