

Pipe Aston BAR Appendix: Chemical Analyses of Pipe Clays

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Background

One of the fundamental questions concerning the Pipe Aston clay tobacco pipe industry concerns why the pipe-makers chose Pipe Aston as their base. More generally, it seems clear that the demand for clay tobacco pipes in the early 17th century is due to the holding of the Council of Wales and the Marches at Ludlow Castle. The council began in the late 15th century (the earliest known president held office from 1473) and ran until 1689. Its abolition led to the abandonment of Ludlow Castle and the decline of Ludlow as a social and administrative centre ([references needed]).

Pipe Aston is located four miles to the south-west of Ludlow and on the opposite bank of the Teme. Possible factors affecting the location of the industry are:

- The availability of white-firing pipeclay.
- Fuel.
- Skilled labour.
- Transport and access to Ludlow.

The main sources of pipeclay utilised in the early 17th century in England were the Tertiary Ball Clays which outcrop in isolated patches in North and South Devon (Peter's Marland and Bovey Tracey); Dorset and the Isle of Wight and Surrey; Jurassic whiteware clays such as those which crop out in the Northampton area (Northampton Field, 1686); Coal Measures whiteware clay or other white-firing clays.

Of these, only the possibility of using a local clay would favour Pipe Aston and consequently a search was made, both in literature and in the field, to find local clays which might have been used for pipe manufacture (See below, Use of Local Clays). Some off-white firing clays were found, but are much inferior to pipeclays and clearly were never used at Pipe Aston.

Fuel, in the form of wood charcoal was abundantly available in Mortimer Forest and the earliest production site investigated, at Upper Aston Field, certainly used wood. However, by the late 17th century at Roy's Orchard, Carboniferous Coal was being used as a fuel. If fuel was indeed a reason for locating the pipe industry at Pipe Aston, it would have been equally available at sites even closer to Ludlow (for example, Ludford, immediately opposite Ludlow on the west bank of the Teme, which does have some archaeological and documentary evidence for pipe production in the later 17th and early 18th centuries).

Clearly, there was no prior availability of pipe-making skills in the Pipe Aston area in the early 17th century but there was a pre-existing pottery industry located immediately to the west of Pipe Aston and iron working took place at Burrington, to the north and west of Pipe Aston. However, since muffle fragments were present at Upper Aston Field, and the use of this feature appears to be limited in other industries it is unlikely that these industries could have supplied a pool of trained labour for the nascent pipe industry.

Finally, Pipe Aston lies on the road from Wigmore to Ludlow (Whitcliffe Road) which presumably was a major trade route before the foundation of the pipe industry. However, equally good locations with access to Ludlow were available elsewhere and we conclude that at present the reason or reasons for locating the pipe-making industry at Pipe Aston remain unknown.

However, having determined that local clays could not have been used at Pipe Aston, this raised the related question of where the pipeclay came from, and did the source change with time?

Methodology

Samples of a random range of clay pipe bowls from Roy's Orchard were analysed using Inductively-Coupled Plasma Spectroscopy, carried out by Dr J N Walsh at Royal Holloway College, London. These were sampled to establish a base for comparison with the unmarked wig curlers, which were suspected to have been produced at the site.

Subsequently, clays were sampled from sites around Caynham Camp, known from documentary sources to be a source of pipeclay, and clay and clay pipes from Broseley and Ironbridge Gorge were also sampled for comparison.

To establish the characteristics of North Devon ball clay, samples of pipes produced at Bristol and Gloucester, and ball clays from the Peters Marland clay pits were taken. For other potential sources we relied on samples collected for other purposes (such as Developed Stamford Ware, produced using a similar Jurassic whiteware clay to that used at Northampton).

Each sample was prepared by mechanically grinding the outer surface away. This surface was thought to have been potentially contaminated by groundwater after burial. The resulting pellet of clay was ground to a fine powder and a range of elements was measured. Major elements were measured as percent oxides (App 1) and minor and trace elements were measured in parts per million (App 2). Silica was not measured but was estimated by subtraction of the total measured oxides from 100%. Before comparison of samples, the data were normalised to aluminium, a major constituent of the clay fraction and only a minor part of the coarse fraction (silt and sand), mainly in the form of feldspar grains. Multivariate statistical techniques were employed to analyse the data, mainly using the Factor Analysis program from WinSTAT, an add-in for Microsoft Excel (2002).

Use of Local Clays

Pipe Aston is located in an area of Silurian rocks, mostly mudstones with some limestone. The mudstone weathers to a light brown clay which fires to a red colour and is usually noticeably micaceous. Clearly, this could not have been used as a pipeclay but was used to bond the stone walls of the various excavated kilns. Within the Silurian strata occur several beds of bentonite, formed from weathered volcanic ash falls. These do produce a workable white-firing clay. Samples were collected from The Quarry in Mortimer Forest, a trackway through Mortimer Forest and from immediately below the castle at Wigmore. The latter clay was levigated and subsamples taken from the finer and coarser fractions. In addition, a sample of clay from Pipe Aston Stream was taken. This from its appearance is likely to have been a weathered mudstone and its high lime content caused the sample to disintegrate after firing. Finally, a sample of brick kiln waste from Brick Kiln Piece, in Aston, was analysed. This was definitely made from a weathered mudstone.

Factor analysis of the data from these local clays was compared with that for a sample of pipes from Upper Aston Field (Fig 1) and the randomly selected pipes from Roy's Orchard (Fig 2). In both cases, four factors were found and a plot of the scores for the first two, F1 and F2 indicates that the weathered mudstones have high F2 scores whilst the bentonites have low F1 scores. The two subsamples of the Wigford clay are almost identical in their F1 and F2 scores.

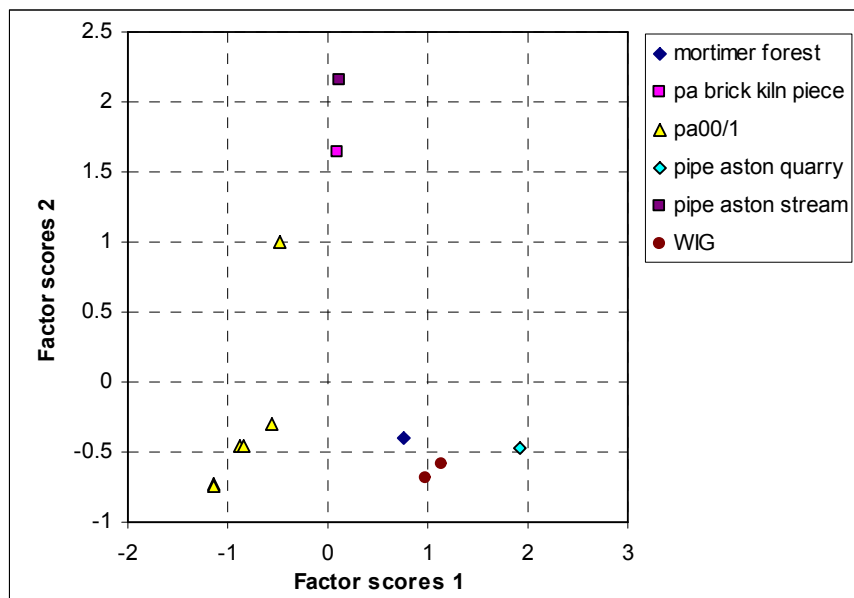


Figure 1

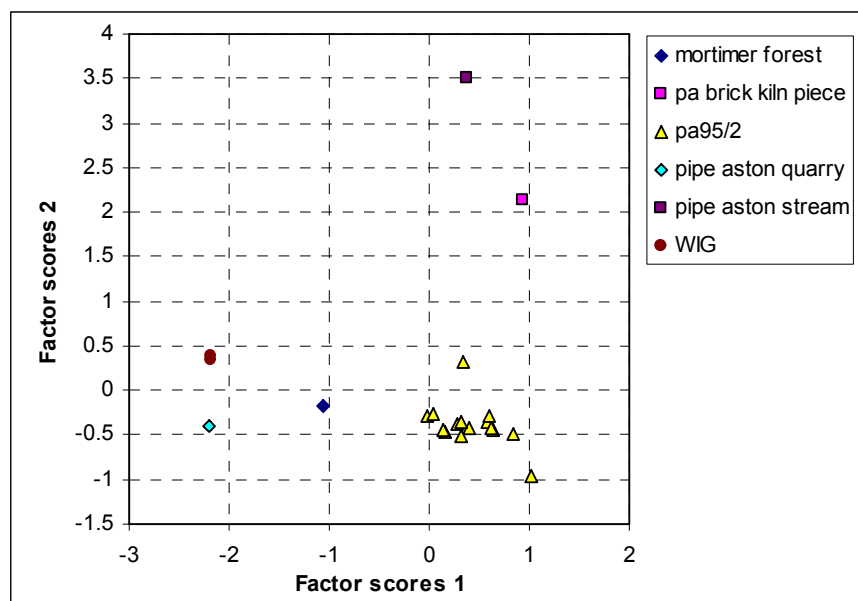


Figure 2

High F1 scores are due to Chromium, Titanium, Scandium, Vanadium, Cobalt and Nickel and low F1 scores are due to high Zirconium and Potassium values. High F2 scores are due to high values for Manganese, Sodium, Iron, Zinc, Strontium, Barium and Copper.

These results suggest that the pipe clays can be distinguished from both local weathered mudstones and bentonites, both of which can also be distinguished from each other.

Broseley/Ironbridge Gorge

Broseley and Much Wenlock in the late 17th and 18th centuries was one of the major pipe production centres in England. However, there is no evidence, so far, that pipe production was carried out in this area prior to the start of the Pipe Aston industry. Samples of two early 17th-century pipes were supplied by David Higgins (Broseley 7583) and samples from a late 17th-century waste dump were also included (BR00).

A group of samples from a late 17th-century production site at High Street, Much Wenlock (AA06/86) and samples from two stamped pipes by Much Wenlock makers, Mich Brown (Easthorpe Wood) and Edw Taylor (Chalford), were analysed.

In addition, a sample from Ironbridge Gorge, collected by Allan Peacey, was also analysed.

Factor analysis of the data from these samples, together with that from six samples from Upper Aston Field (PA00/1) found five factors. A plot of the first two factors (Fig 2) indicates that the Much Wenlock and Broseley samples form separate clusters, with the Ironbridge Gorge sample forming part of the Broseley group. The Upper Aston Field samples include three which can be clearly distinguished from the Broseley samples, one by its high F2 score and two by their high F1 scores, and three which are similar to, but discrete from, the

Broseley samples. None of the Pipe Aston samples are similar to the Much Wenlock samples.

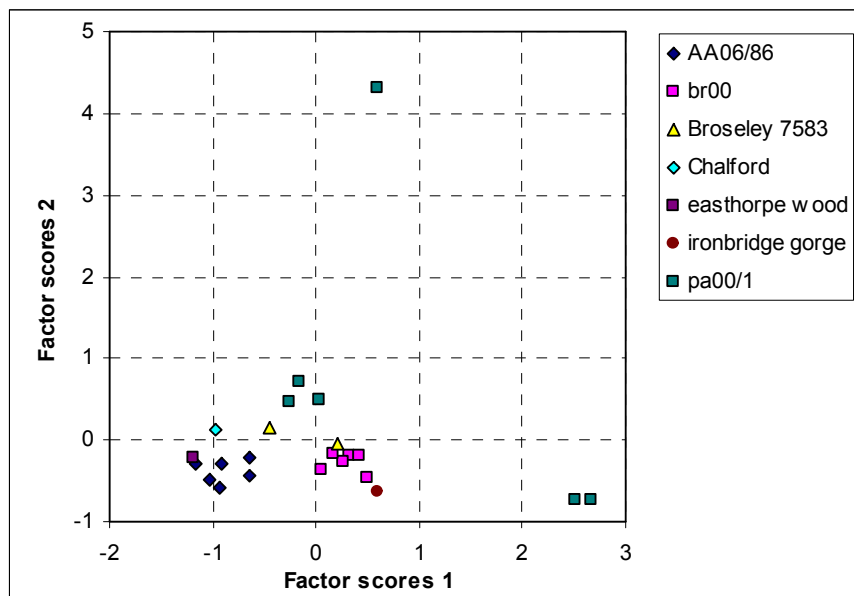


Figure 3

Clee Hill

The area around Clee Hill is known to have been a source of pipeclay, since the right to dig pipeclay was excluded from the sale of the manor at Caynham in 1680 (Peacey and Vince 2006, 18). Caynham itself lies on Devonian marl, which weathers to a red-firing micaceous clay, but Coal Measures clays outcrop around the summit of Clee Hill immediately to the east and presumably extraction rights were for common land there.

Samples of various clays were taken from Knowbury and from Hopton Bank, 3 miles to the east. The Knowbury clays included some which on firing produced fabrics which were visually similar to pipeclay but most were clearly different and have been excluded from comparison.

Factor analysis of this Clee Hill data with the Upper Aston Field and Roy's Orchard produced six factors and a plot of the first two (Fig 4) shows no clear differentiation of the two Pipe Aston groups and the Clee Hill samples, whilst a plot of the F3 against F4 scores (Fig 5) separates most of the Pipe Aston samples from the Clee Hill ones. All of the samples can be differentiated using a combination of the first four factors, but the comparison is definitely better than with the Broseley/Much Wenlock/Ironbridge Gorge material. This suggests that the Coal Measures whiteware clays outcropping around Clee Hill may have been used at Pipe Aston but that so far we have failed to find the actual outcrops utilised.

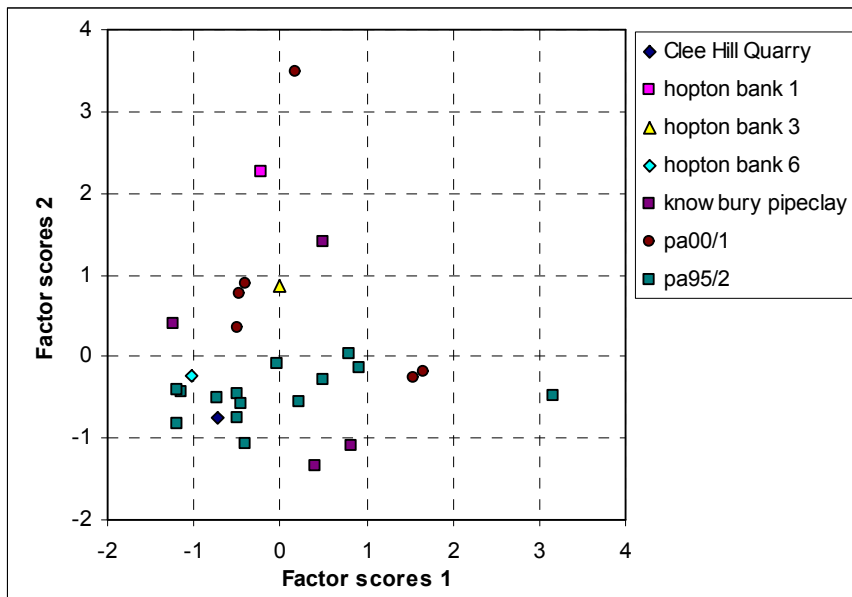


Figure 4

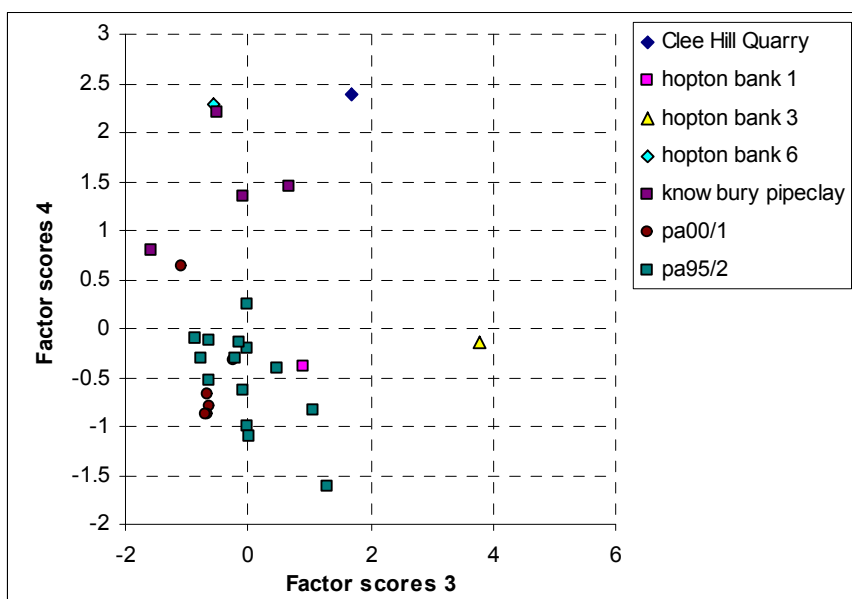


Figure 5

Ludlow

A small number of pipes from Roy's Orchard have stamps which suggest that they were made by late 17th-century Ludlow makers. These presumably were made elsewhere and came to the site as a result of visitors and casual contact. Three of these pipes, marked "WV" were sampled together with three samples from Ludlow, one marked "WV" and the other two marked "IA". The ICPS data for these Ludlow pipes was compared with the Pipe Aston products and with the Clee Hills pipeclay using Factor Analysis.

Four factors were found. A plot of the first two factor scores (Fig 6) shows that the Upper Aston Field samples are similar to the clay samples from the Clee Hills but that the Ludlow and remaining Pipe Aston pipes are similar to each other and different from the Clee Hills and Upper Aston Field samples. The analysis was repeated, omitting the Clee Hills and Upper Aston Field samples and again no difference could be found between the Ludlow and Pipe Aston samples.

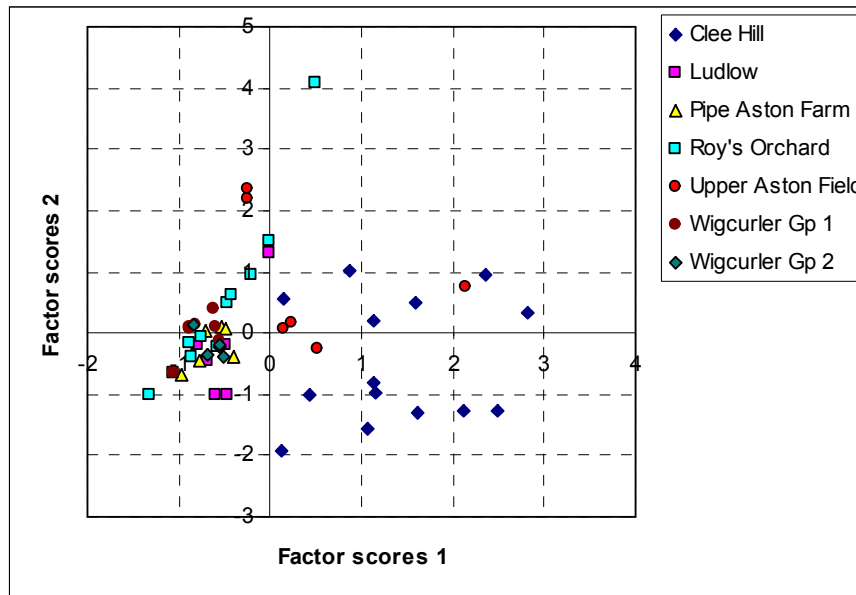


Figure 6

This analysis suggests that by the late 17th century, Ludlow pipemakers were using identical clays to those used at Pipe Aston. These can be distinguished from the clay samples collected around Clee Hill and from the samples of Upper Aston Field pipes which match those samples. However, the documentary reference to pipeclay at Caynham dates to the late 17th century and this suggests that the Clee Hills clay was still regarded as a valuable asset in 1680. If so, then, it is likely that these Ludlow and Pipe Aston pipes were using a Clee Hills clay. However, the difference in composition suggests that perhaps by the late 17th century the use of Clee Hills pipeclay had ceased and that its mention in the 1680 indenture was anachronistic. Against this is the fact that pipemaking was certainly still being carried out at Caynham itself in the early 18th century.

North Devon Ball Clay

The use of North Devon ball clay in the Severn Valley is demonstrated by port book records which document the shipment of pipeclay to Bristol and Gloucester (Grant 1983, 40). It would have been feasible to obtain this clay at Pipe Aston by shipping the clay to Worcester and then transferring the cargo to a barge for transport up the Teme to Ludlow. To test this possibility samples of clay from Peters Marland and of pipes made at Bristol and Gloucester were analysed and compared with the Pipe Aston products.

Factor analysis of the data from these North Devon ball clay samples and the Pipe Aston samples found four factors. A plot of F1 against F2 (Fig 6) shows that the Bristol and Gloucester pipes form a distinct group, separated by negative F1 scores and positive F2 scores. The two Peters Marland samples do not plot with these samples, however, having positive F1 and F2 scores. Four of the Roy's Orchard pipes have similar characteristics. These include all of the latest analysed pipes, dated to the early 18th century. The remaining Pipe Aston samples are distinct from both the Bristol/Gloucester group and the Peters Marland samples.

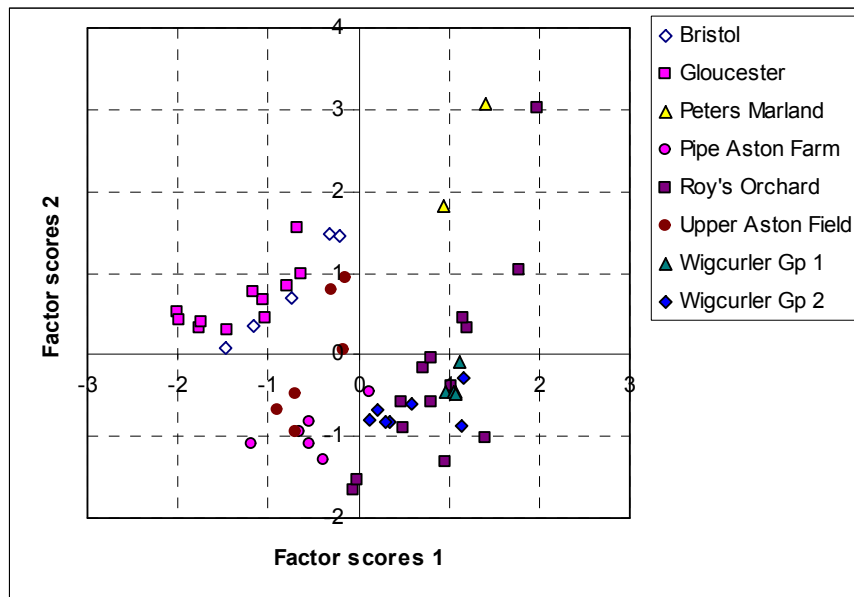


Figure 7

The third and fourth factors distinguish the Upper Aston Field samples from the remainder (Fig 7).

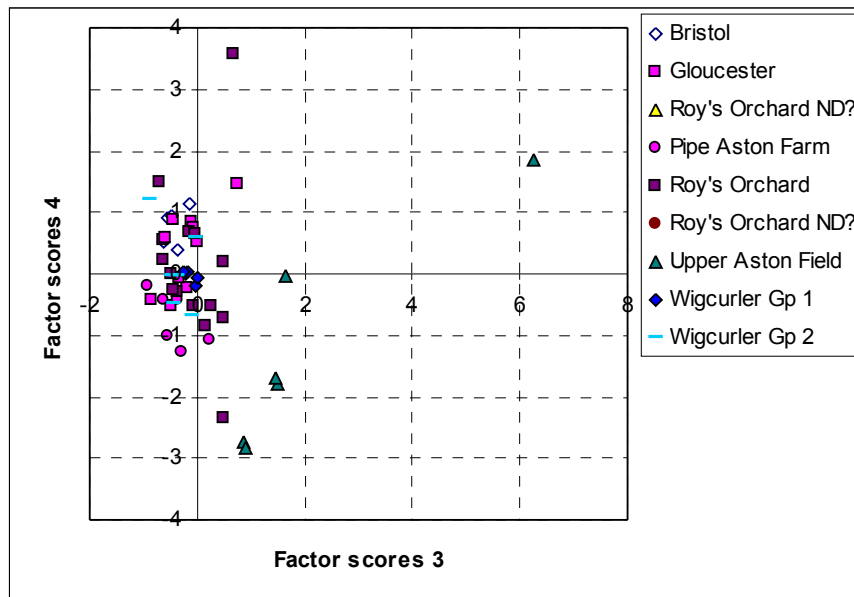


Figure 8

This analysis therefore is consistent with the conclusion that the Upper Aston Field pipes were made from a completely different clay, probably obtained from Caynham, and suggests that perhaps by the early 18th century the pipemakers at Roys Orchard might have been using North Devon ball clay. However, the dissimilarity of all the Pipe Aston samples from the Bristol and Gloucester pipes does not support this.

Dorset Ball Clay

Dorset and Isle of Wight ball clay was used by the London pipemakers from the early 17th century, despite the proximity of similar white-firing clays in the Thames basin, for example those used by the Surrey whiteware potters (Cowell 1988). The early 17th century London pipemakers had a monopoly on the use of Dorset Ball Clay (Atkinson and Oswald 1969, 171-227) which must, therefore, have either been available more cheaply or was better suited for the manufacture of clay tobacco pipes. A case could therefore be made for any early 17th century pipemakers trained in London and moving to Pipe Aston wanting to use Dorset ball clay. To test this possibility, samples of pipeclay from Poole were obtained and sampled.

Factor analysis of these samples, the Pipe Aston samples and those from Bristol, Gloucester and Peters Marland was carried out and four factors were found. A plot of the first two factors (Fig 9) shows that the Poole samples have positive F1 and F2 scores, like the Peters Marland and some of the Roys Orchard pipes. This result confirms the possibility that some of the Roys Orchard pipes were made from Tertiary ball clay but that the majority were not.

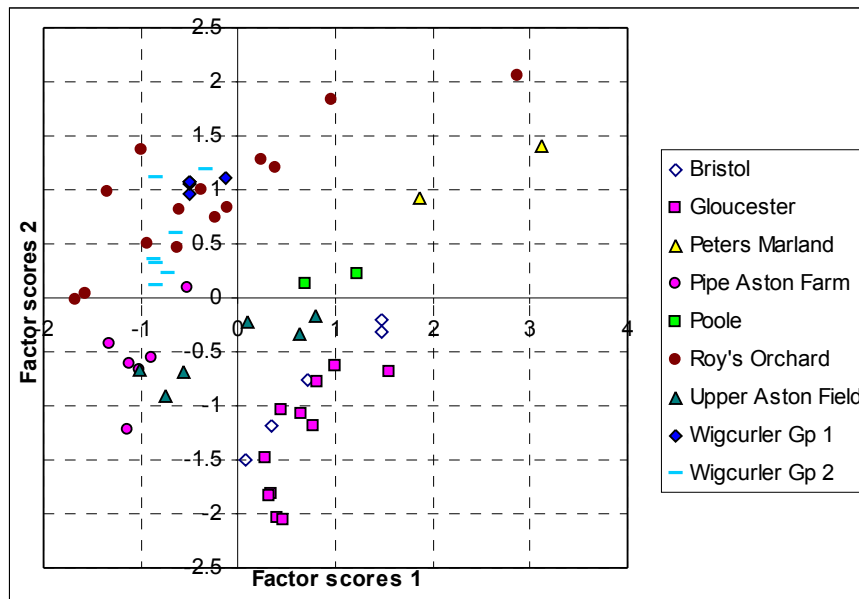


Figure 9

Jurassic Whiteware

In the early 18th century, the pipeclay available at Northampton Field, Northampton, was described as being “amongst the best in the land” (1712). This clay would have been a Middle Jurassic Estuarine Beds clay. Similar clays were used for the production of whiteware pottery at Stamford and around the North Yorkshire moors. Samples of such wares were available for comparison.

Factor analysis shows that both samples of North Yorkshire whiteware and Stamford wares can be distinguished from all the Pipe Aston samples, and from each other. The Upper Aston Field samples have the greatest similarity with these comparanda, especially with the North Yorkshire samples.

This analysis suggests that a Jurassic origin for the Pipe Aston pipe clay can be discounted.

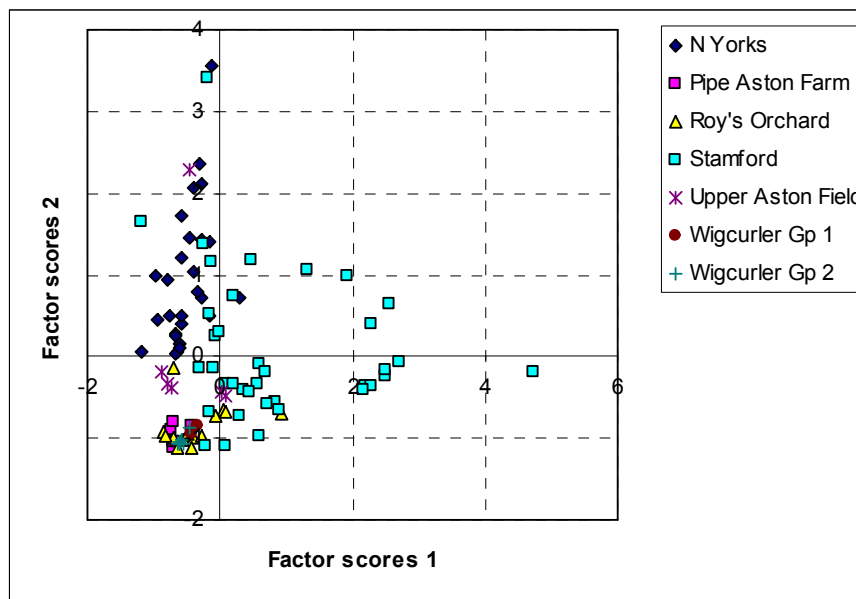


Figure 10

Conclusions

This study shows quite clearly that the pipes produced at Pipe Aston were not made from locally-available clays and that therefore access to pipeclay was not a factor in the foundation of the Pipe Aston industry.

The earliest pipeclay sampled from Pipe Aston comes from Upper Aston Field. These samples are close in composition to those from Broseley and the Clee Hills and it is likely that a source in the Clee Hills was supplying Pipe Aston at that time. Certainly, these pipes were made from a Coal Measure clay and this is supported by x20 magnification study of the pipe fabric, which demonstrates the presence of abundant rounded clay pellets in the Upper Aston Field pipes, a feature of many pipes and other ceramics made from Coal Measures whiteware clays and not seen in any of the other Pipe Aston pipe and wig curler samples.

All the other sampled pipes and wig curlers from Pipe Aston can be distinguished chemically from the Upper Aston Field samples and form distinct but overlapping composition groups.

These include:

- 1) Pipe Aston Farm
- 2) Roy's Orchard late 17th century pipes
- 3) Roy's Orchard concave-ended wig curlers
- 4) Roy's Orchard round-ended wig curlers
- 5) Roy's Orchard early 18th century pipes

The six sampled late 17th-century Ludlow pipes have similar compositions.

The comparison of the Ludlow and Pipe Aston pipes with the Clee Hills clays shows that there is not a precise match but that this might be because the pipeclay samples are not from the actual beds used in the 17th and 18th centuries, or it may be that from the late 17th century onwards the use of local, Clee Hills, Coal Measures pipeclay ceased and better quality imported pipeclay was used instead. It is certainly the case that none of these later 17th century and later pipes contain rounded clay pellets, which are, by contrast, visible in late 17th century Broseley and Much Wenlock pipe fabrics.

The Pipe Aston pipe samples were compared with Tertiary ball clays from North Devon and Dorset/Isle of Wight and slight evidence was found that perhaps some of the early 18th century pipes at Roy's Orchard were made from ball clays. However, if this was the case it is remarkable that the Bristol and Gloucester pipes are so distinct from those made at Pipe Aston. A further remarkable feature is that the Peters Marland clay samples do not match the Bristol and Gloucester pipes better, and that despite being made from a number of different makers at two different centres the Bristol and Gloucester pipes have such similar compositions. Presumably, the North Devon pipeclays used in the 17th century have now been exhausted and the two clay samples come from deeper quarries where the clays would not have been exposed to the same weathering processes and the exhausted clays used for the Bristol and Gloucester pipes.

The possibility that a Jurassic pipeclay was being used at Pipe Aston was explored and dismissed.

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