Attribution Enhanced – Another Bovey Tracey find?

A paper read by Joanna Dunster and Nick Panes at Kensington Central Library on 10th January 2015

Introduction

The story of porcelain making at the Indeo Pottery in Bovey Tracey, Nicholas Crisp's ill-fated venture after the closure of the Vauxhall factory, was known and documented before any firm attribution of extant pieces to the factory had been made. The history of the factory and related correspondence between William Cookworthy and Thomas Pitt was set out in two ECC papers by Roger Massey in 2002.[1]

That is not to say that tentative attributions had not been put forward. Phillips auction catalogue for a sale on 16th September, 1998 included two similar sauceboats which were tentatively attributed to Bovey Tracey. (**1**) This attribution was based on two principal arguments. The first was that the paste of the sauceboats was slightly odd looking and creamy in colour, linking to the correspondence which referred to serious firing problems in which many pieces were described as 'smoaked'.

Writing on 20th December 1767 Cookworthy expressed the opinion to Thomas Pitt that 'By some Experiments lately made I have fixt to certainty that the tint of yellow or cream colour in the Bovey pieces is absolutely owing to the kiln and not to want of fire'.[2] The second argument was that the sauceboats were similar in design to those produced at Vauxhall, from which it was known that both workmen and moulds had been transferred to Bovey Tracey.

Whilst tentative attributions were based on connoisseurship, scientific analysis provided some further information about Bovey Tracey porcelain. A paper in *Geoarchaeology*[3] in 2000 by Victor Owen, Brian Adams, and Roy Stephenson examined the chemical composition of a small number of sherds found on the Indeo Pottery site, finding that phosphatic, true porcelain, and soapstone based porcelains were experimented with, the latter with an unusual component, barite, not normally found in contemporary porcelains.

1. Sauceboats sold in 1998 tentatively attributed to Bovey Tracey by Bonhams. Bonhams

It is not known with any certainty why barite was included in the paste but it may have been an attempt to whiten the discoloured wares. It seems likely that the chronology was that the soapstone and phosphatic pastes were tried by Crisp in the early period, and that he subsequently tried a hard paste composition when Cookworthy became involved.

2. A Bovey Tracey fuddling cup. Private collection

3. Another Bovey Tracey fuddling cup. Victoria and Albert Museum

As part of an increasing trend towards science and connoisseurship supporting one another, Mary White's ECC paper in 2007[4] concerned a highly unusual fuddling cup (**2**), almost unique in 18th-century porcelain. The paste of this fuddling cup was creamy in colour and in composition similar to the soapstone sherds analysed by Owen.[5] Both the paste and glaze of this piece contained barite. As barite is often found associated with lead bearing earth its presence in a lead glaze is not unknown, but barite in the paste composition is still regarded as a signature of Bovey Tracey origin.

Mary White identified the probable source of the barite from mining activity, some eight miles north of Bovey Tracey. However, whilst this may have been the source, commercial activity of any sizeable scale did not commence there until the 1840s, and then the search for lead, discontinued in 1853, caused the barite to be largely ignored. After some 32 years in abeyance, the mine at Bridford was reopened to mine the barite in 1875. One further site in Devon existed where barite can be found. Although this site, at South Hams is nearly 30 miles from Bovey Tracey, it is only a mile or two from Kingsbridge, the birth place of William Cookworthy, so might well have been known to him, and thus, in turn, to Nicholas Crisp.

This fuddling cup became the first firm attribution to Bovey Tracey and its acceptance resulted in a similar fuddling cup, the only other known, being attributed to Bovey Tracey. This second fuddling cup, in the Victoria & Albert Museum (**3**) was not analysed but attributed based on connoisseurship. It was noted that although by a different hand, the painted pattern on the V&A fuddling cup bore similarities to the pattern on the previously mentioned sauceboats. (**4**)

The painting style on both fuddling cups has great similarities being 'delft' in style, a style also known at Vauxhall some from painters who may have worked previously in delft production. The blue in the White fuddling cup is stronger and the form of the flower is perhaps fairly similar to that on the sauceboats and

4. Stylistic similarity between the painting on the fuddling cup (left) described by Mary White and the sauceboat. Private collection

the two handled cup. The V&A flowers are less well formed although the pattern still appears to be a two-flower variant of that on the other pieces.

In 2010 Nicholas Panes, together with Victor Owen, provided chemical analysis of one of the previously analysed sauceboats.[6] The sauceboat and one of the fuddling cups shared not only the painting style but it was found that the glaze composition was similar. Whilst the paste appeared to be a slight variant from the sherds the signature component, barite, was present. The finding therefore increased the certainty that both sauceboats, as well as both fuddling cups were of Bovey Tracey origin.

Until recently these four pieces comprised the only extant pieces attributed to Bovey Tracey. Some years after it was sold by Bonhams in the Billie Pain Collection, a small double handled cup previously regarded as an experimental Vauxhall piece was identified. (**5**) The cup shares the creamy colour of the other pieces and the flower spray is similar to that on the sauceboat and the fuddling cup. Strangely it has been squashed out of its previously round shape, whether deliberately or during firing is unknown.

Although it was known to be across the Atlantic the exact location of this piece was unknown so no further attempts to examine it were possible. However, the 2014 ECC trip to USA and Canada by ECC members held a surprise when the cup was located in Toronto in the porcelain collection of Rosalie Wise Sharp. It was displayed on a shelf next to the second Bovey Tracey sauceboat! (**6**)

Beyond examining it nothing further would have been possible as destructive testing of the piece was clearly inappropriate. However, new work by Joanna Dunster, has resulted in a promising technique non-destructively testing the glaze and the cobalt in underglaze blue-painted English porcelains.

5. Double handled cup, 6 cm high. Private collection

6. The double handled cup displayed below a Bovey Tracey sauceboat

Methods

X-ray Fluorescence Spectroscopy (XRF) is a non-destructive analytical technique which is used to obtain major and minor elemental compositional data from solid objects, thin films and powders. The technique has been in use for material analysis and characterisation studies for decades, and the development of portable and hand-held instruments during the 1980s has led to a vast increase in their use in field-work and specialist applications, including environmental and geological samples,[7] museum conservation and cultural heritage studies,[8] field archaeology,[9,10] and forensic archaeology,[11] often in tandem with other complementary analytical techniques.[12]

The accuracy of hand-held XRF depends on a sample of sufficient size (>10 mm in width, >2 mm thickness) and a relatively smooth, flat surface for analysis, in order that the detected energy does not include refracted energy from the incident X-ray. In addition, the spot-size is relatively large (in this case 8 mm in diameter), meaning that fine detail and small particles are difficult to target, and contamination may occur from surrounding areas.

The range of detectable elements is optimal for analysis of most inorganic materials (potassium [K] – uranium [U]), and can be extended to include some lighter elements with the use of a vacuum pump or helium (He) gas flush. However, the omission of lighter elements including some normally present in ceramics means that the raw data are rarely representative of the objects' composition.

For instance, in the case of vitreous materials such as glass, enamel and glaze, a significant proportion of the composition is silica (SiO_2), and even though it is a major component, the silica peak is very small, and the oxygen peak non-existent, due to the attenuation of emitted energy from these lighter elements by the air between the sample surface and the detector.

Furthermore, certain elements, such as lead (Pb), arsenic (As) and gold (Au), create peaks in the same area, leading to peak overlaps where all three elements are present in the same sample. With all of these considerations, the analyst must not trust in the numbers generated by the software, but the measurement conditions, sample geometry and known constituent elements must be taken into consideration when interpreting each set of results.

XRF spectra are most commonly used to detect the presence or absence of elements (qualitative data), which can identify unknown samples non-destructively, and with speed, ease and accuracy. Since the peak area of each element in the spectrum is proportionate to the amount of that element present in the sample, overlaying several spectra is an effective means of quickly establishing the compositional similarity between two samples.

With a spread-sheet of peak area data, peak ratios can be used to generate semi-quantitative data, and this is effective for enamels and pigments, as many of the colourant elements (chromium [Cr], manganese [Mn], iron [Fe], cobalt [Co] and copper [Cu]) are of a similar mass, meaning that their rates of detection are broadly similar. This research is part of a doctoral research project, which seeks to develop a methodology for analysing British porcelain enamels and underglaze pigments, to characterise manufactories and periods, in order to allow unknown samples to be provenanced by comparison with a data bank of well-provenanced objects.

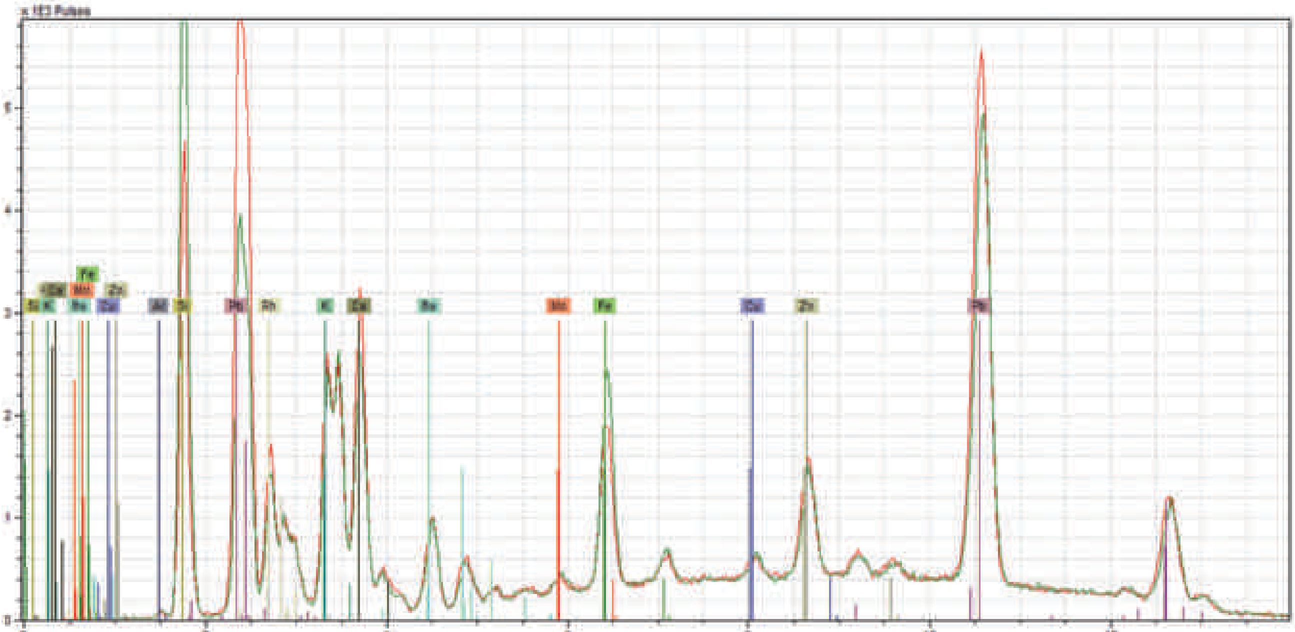
Having identified the cup in Rosalie Sharp's collection, it was compared using XRF with the Bovey Tracey sauceboat in a private collection. An Oxford Instruments X-MET 5100 hand-held X-ray Fluorescence analyser with a rhodium-anode, and a Silicon Drift Detector (SDD) was used for all analyses, following the analytical methodology developed by Domoney (2012),[13] The conditions under which it has been used to analyse porcelain glaze and enamels are summarised in Appendix 1.

Before, at increments during, and after each session of analysis, a soil standard (3a2) was read, and the results checked against a record of the expected values in order to check for machine drift. Additionally, a silica blank was analysed under the same conditions to be used for the porcelain enamels in order to detect machine artefacts so that these could be subtracted from the resulting data during the processing stage. A typical cycle of analysis is shown in Appendix 2. Bruker Artax software was used to remove the background signal from the peaks, and to convert the spectra to peak area data. The peak area data are provided in Appendix 3.

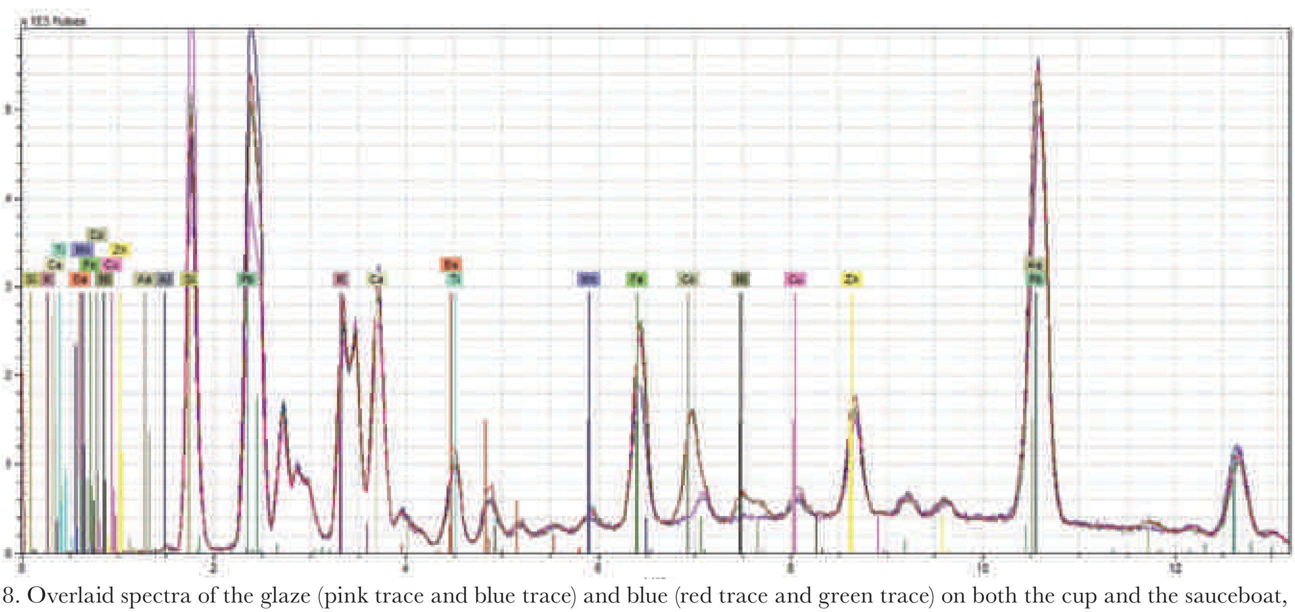
Results

The spectra generated from analysis of the glaze and blue areas of the object overlay almost exactly, meaning that the major and minor elemental composition of the glaze and blue pigment are almost identical. (**7**) The glaze has a Pb flux, and contains significant Sn, which may have been added deliberately as an opacifier. The factory is characterised by the presence in the glaze of barium (Ba), which is yet to be found in significant quantities in any other British porcelain glazes. There is also a significantly greater quantity of zinc (Zn), relative to other glazes tested by the same method. (**8**)

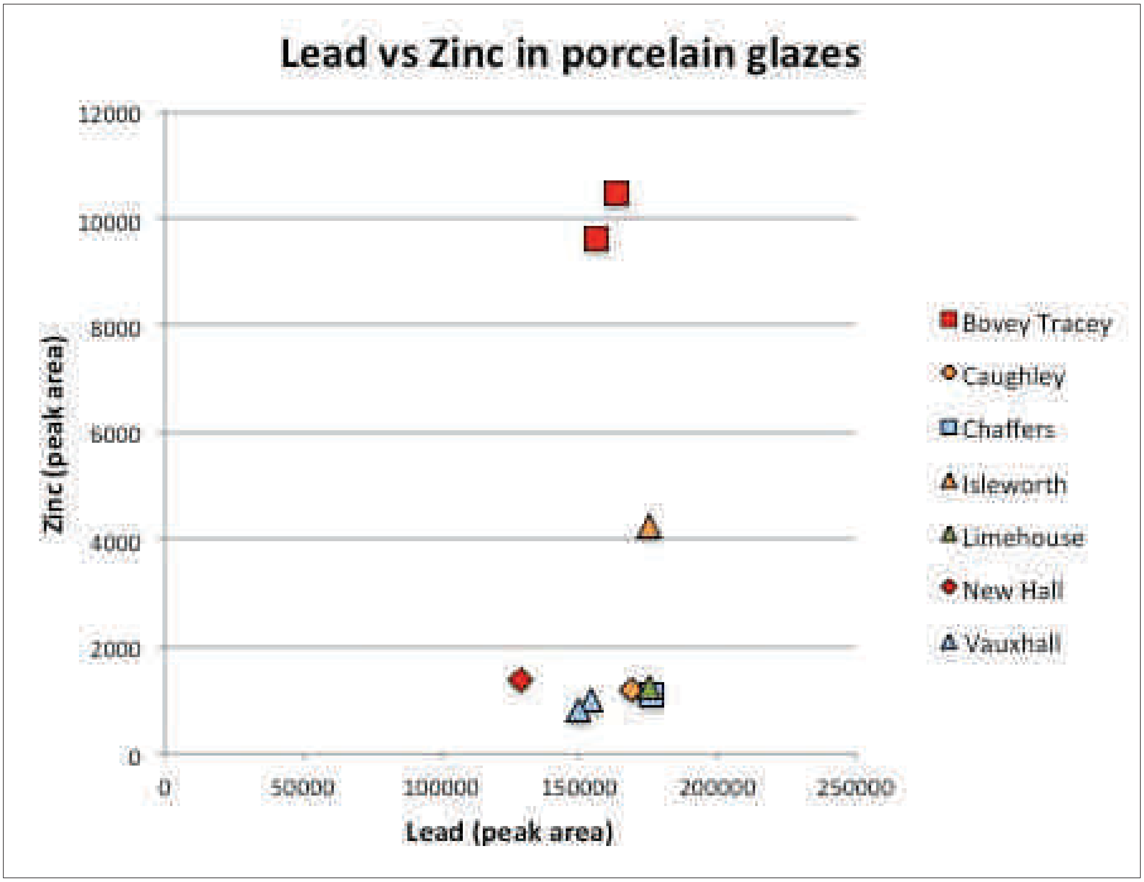
The underglaze blue pigment is based on Co, which provides the dark blue colour. As the colour sits underneath a layer of glaze, the elemental compositional data for the pigment include elements present in the glaze. For this reason, during the data-processing stage, the peak area data from analyses of



7. Overlaid spectra of the glaze in this image the red line shows the data from the cup and the green line is from the sauceboat



8. Overlaid spectra of the glaze (pink trace and blue trace) and blue (red trace and green trace) on both the cup and the sauceboat, showing that the pigments contribute manganese, iron, cobalt and nickel



9. Peak area of lead vs zinc in Bovey Tracey and contemporary soft paste porcelain leaded glazes

the glaze were subtracted from the data from areas of blue colour. The result is peak area data for the composition of the blue pigment, typically cobalt (Co), manganese (Mn), iron (Fe), and nickel (Ni).

Furthermore, the composition and thickness of glaze over the blue pigments is likely to vary between objects and manufactories, and so the composition of the underglaze blue is not directly comparable. This discussion therefore relies on the presence or absence of elements, and on ratios of peak areas.

Comparing the two objects with contemporary British soft-paste porcelain demonstrates that the peak area ratio of zinc to lead in the glaze is significantly higher (**9**) which supports the observation that they are both significantly different from the products of other factories, and consistent with one another.

Conclusion

Based on this small sample of qualitative data, both objects appear to be consistent with one another, and also with the glaze formula employed by Bovey Tracey. It would appear that the probable attribution of the cup can be confirmed as Bovey Tracey, making it the fifth object attributed to the factory. Based upon qualitative XRF examination in air, the glazes of the double-handled cup from the collection of Rosalie Sharp and the Bovey Tracey sauceboat appear closely similar in composition, and show the barium concentrations apparently characteristic of Bovey Tracey and no other 18th-century porcelain manufactory. Furthermore, the glazes of the two objects show high zinc, distinguishing them from all other English porcelain so far analysed. The compositionally distinctive attributes of these objects provides support for the assertion made by Freestone (4) that portable XRF is a useful technique for the identification of these wares.

Future research will build on these conclusions by employing more data from each of the different manufactories, in order to test the strength of conclusions where a pigment appears to be distinctive, and also to offer greater resolution in the case of overlap between manufactories.

The development of analytical standards based on the composition of porcelain glazes and enamels will allow data to be quantified, and the significance of these apparent differences and similarities can be discussed in greater detail.

ACKNOWLEDGEMENTS

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APPENDIX 1 - CONDITIONS USED IN HAND-HELD XRF ANALYSIS

	current	**voltage**	**filters**
condition 1	45 μA	15kV	500μm Al
condition 2	15 μA	45kV	25μm Fe

APPENDIX 2 - A TYPICAL CYCLE OF ANALYSIS

Area of analysis	**Measuring time (seconds)**	**Condition**	**Additional action**
Soil Standard (3a2)	60	1, 2	check results against expected values
Si blank	30	1, 2	check results against previous values
Glaze	30	1, 2	check results to ensure no contamination by adjacent enamel/gilding
Blue area	30	1, 2	check results to ensure no contamination by adjacent gilding (where present)

APPENDIX 3 – PEAK AREA DATA, PROCESSED TO REMOVE MACHINE ARTEFACTS AND BACKGROUND (The letter in parentheses indicates the spectral line from which the peak area data were calculated)

	condition 1										condition 2		
Glaze	**Al (K)**	**Si (K)**	**K (K)**	**Ca (K)**	**Mn (K)**	**Fe (K)**	**Co (K)**	**Ni (K)**	**Cu (K)**	**Zn (K)**	**Sn (K)**	**Ba (K)**	**Pb (L)**
cup	204	19647	6708	4097	1264	10798	nd	nd	2047	10565	8268	3803	163137
sauceboat	221	30422	5162	3195	1622	12220	nd	nd	2226	9562	7805	2573	156055

	condition 1										condition 2		
Blue	**Al (K)**	**Si (K)**	**K (K)**	**Ca (K)**	**Mn (K)**	**Fe (K)**	**Co (K)**	**Ni (K)**	**Cu (K)**	**Zn (K)**	**Sn (K)**	**Ba (K)**	**Pb (L)**
cup	187	21264	7550	5252	1743	14498	8225	2150	2654	12065	7353	3805	156063
sauceboat	137	21438	6295	1479	2078	13325	7664	1816	1659	11030	6943	2593	152408

NOTES

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